

# SASKATOON

## Package Boilers

### SERVICE MANUAL

Starting-operating  
and equipment maintenance information for your SASKATOON boiler.

**Model:**

*MORGAN 10-34 BATTERY*

Northern Blizzard Resources  
Lloydminster, AB

OTS-G150W, S/N 7119

MADE IN CANADA BY:

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*AFE # 10F5019L*

*INSTALLED MARCH 2011*



# PREVENTATIVE MAINTENANCE

RECOMMENDED FOR

## SASKATOON BOILERS – ALL TYPES – ALL SIZES – ALL FUELS

DISPLAY ONE OF THESE CARDS IN A VISIBLE LOCATION AS NEAR AS POSSIBLE TO THE BURNER. AN ADDITIONAL CARD SHOULD BE DISPLAYED IN THE BOILER ROOM WHERE IT WILL BE EASILY ACCESSIBLE IN AN EMERGENCY.

**MAINTENANCE INSTRUCTIONS:** A regular maintenance program is critical to ensure that your boiler will operate reliably and efficiently. Your maintenance program will consist of daily, weekly, monthly, semi-annual, and annual tests that will confirm that all parts of the boiler are operating as intended. The frequencies and tests recommended by **Saskatoon Boiler** are listed below. An experienced operator may have to increase the frequency or add additional checks depending on the actual operating conditions or jurisdictional requirements. The owner's safety program, maintenance lockout procedures and hazard assessment requirements must be followed.

### DAILY

1. Blowdown the boiler through each blowdown connection for a minimum of five seconds.
2. While the boiler is operating, blowdown the water column(s) to the low water cut off point. If the unit does not shut down, correct the fault.
3. Check the stack temperature.
4. Verify that combustion gasses are not leaking from the boiler into the boiler room.
5. Verify that the boiler pressure or water temperature is not excessive.
6. Verify the fuel and water levels. The boiler must not run out of either during operation.
7. Add lubricating oil to the air compressor oil reservoir if low.

### WEEKLY

1. Observe the operation of the electronic combustion control to ensure that it functions as described in the manufacturer's documentation.
2. Clean the boiler exterior so that oil and dust do not accumulate. Pay extra attention to the operating components.
3. Inspect the feedwater or circulation system and maintain it per the manufacturer's recommendations.
4. Steam Boilers - Test the feedwater and compare it against the water standards supplied by the water treatment company.
5. Turn the oil strainer(s).

### MONTHLY

1. Perform a Try Lever Test; refer to the "**SAFETY AND OPERATION CHECK PROCEDURES**" section of the manual for the try lever test procedure.
2. Test the high limit control to be sure that it operates satisfactorily.
3. Inspect the burner air damper linkages and damper connections. Tighten if required.
4. Lubricate the blowdown valve(s).
5. Clean the air compressor intake filter.
6. Clear the electrode porcelains of any carbon deposits.

### SEMI-ANNUALLY

1. Thoroughly clean the furnace and tubes.
2. Check for any tube or boiler leaks.
3. Replace the gasket around the rear turn chamber with a new one.
4. Clean the sight glass in the rear door. Replace if necessary.
5. If the unit is equipped with a non-freeze siphon drain for the pressure controls, it must be disassembled and cleaned.
6. Inspect the fuel tank, water tank, lines and connections for leaks. Repair or tighten as necessary.
7. Flush the air compressor.
8. Drain and flush the oil strainer(s).

### ANNUALLY

1. Remove all handhole and manway covers and inspect the waterside of the boiler for corrosion or scale build-up.
2. Flush the inside of the boiler with a hose, making sure to remove all sludge and deposits.
3. Return the handhole and manway covers with new gaskets.
4. Disconnect the piping on the discharge side of the feedwater pipe and inspect for scale buildup.
5. Inspect the check valve(s) in the feedwater system to determine that they are seating properly.
6. Lubricate the electric motors if they are equipped with grease fittings.
7. Replace the fusible plug if so equipped.
8. Inspect the fuel filter and replace if necessary.
9. Check the fuel pump pressure to ensure that the pressure conforms to the manufacture's requirements, adjust or replace the fuel pump as required.
10. If the unit is equipped with probe type level controls, they should be removed and cleaned.
11. Verify that the safety valve(s) are in proper working condition.
12. Remove, inspect and clean all components of the burner oil nozzle assembly. See the "**BURNER AND BURNER OIL ASSEMBLY SERVICING AND MAINTENANCE**" section of the manual.
13. Lubricate the manual shut-off valve(s).

### VERY IMPORTANT WARNINGS

1. **NEVER** perform any maintenance work on the boiler without first turning the main fused disconnect switch to the "OFF" position.
2. **NEVER** tamper with or by-pass any of the controls.
3. **NEVER** set the burner to high fire until it has sufficiently warmed up.
4. **NEVER** interrupt the supply of feedwater until the burner is turned off and the pressure is below 10 psig [70kPa] within the boiler.
5. **NEVER** drain the boiler until the burner is off and the boiler's fluid has cooled.
6. **NEVER** supply feedwater to the boiler through any connection other than the factory feedwater connection.
7. **NEVER** introduce chemicals to the boiler through the feedwater pump or upstream of it.
8. **NEVER** start the burner with the oil return line valve closed. Damage to the oil pump will occur.
9. **NEVER** allow the boiler to run out of fuel or water.
10. **NEVER** allow the boiler fluid to freeze within the boiler or it's associated components.
11. **NEVER** operate a boiler while it is being transported.
12. **NEVER** transport a boiler with fluid in it.
13. **NEVER** lift the boiler while there is fluid in it or any of the storage tanks.
14. **ALWAYS** ensure that there is lubricating oil in the air compressor oil reservoir.
15. **ALWAYS** ensure that all motors and bearings are properly lubricated.
16. **ALWAYS** close the manual shut-off valves in the fuel lines before opening the unions or connection points.
17. **ALWAYS** use the manual as a guide for the proper care of the boiler. Do not simply discard any of the recommended procedures as bothersome or unnecessary.

### PROCEDURES IN CASE OF AN EMERGENCY

1. Shut off all power to the boiler.
2. Shut off the manual fuel valve(s).

### NORMAL OPERATION

After the "Original Start-up" or "Restart-up" (as instructed in the manual) has been completed your boiler is ready for its normal automatic operation. It requires, in addition to normal maintenance, only supervision to safeguard against the unexpected malfunction of a component.

Open the fuel valve(s), and turn the main fused disconnect (breaker), boiler and the feedwater or circulating pump switches to the "on" position. Once the boiler and fluid has warmed, the boiler can be switched to automatic firing. The boiler will operate on high fire until the demand is met, after which it will operate automatically to maintain the demand required. If the demand even on low fire is too great, the burner will automatically shut off and start again when necessary.

### TROUBLE-SHOOTING

1. Check all fuses.
2. Check fluid level in the boiler.
3. Check the limit controls to ensure that they are working.
4. Check all manual resets.
5. If the fault can not be located, review the "**SERVICE INSTRUCTION & TROUBLE-SHOOTING SECTION**" of the manual.

INSTALLED FOR: \_\_\_\_\_ AT: \_\_\_\_\_ ON: \_\_\_\_\_  
INSTALLED BY: \_\_\_\_\_ OF: \_\_\_\_\_

## SASKATOON BOILER MFG. CO. LTD

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# **INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS**

**FOR  
SASKATOON BOILER MFG. CO. LTD.  
OTS, F, J & V SERIES (10-1250 HP)  
STATIONARY GAS FIRED BOILERS  
INSTALLED IN PERMANENT BUILDINGS**

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## **FOREWORD**

**“READ AND SAVE THESE INSTRUCTIONS FOR REFERENCE”**

**“USE ONLY QUALIFIED PERSONAL FOR THE INSTALLATION, OPERATION AND MAINTENANCE OF YOUR SASKATOON BOILER”**

**“THE OWNER’S SAFETY PROGRAM MUST BE FOLLOWED”**

This manual has been written to provide information regarding the installation, operation and maintenance procedures required to ensure that you will receive satisfactory service from your **SASKATOON BOILER**. This manual covers a precision piece of equipment that has been designed and manufactured with considerable care and attention to detail. Applicable local Jurisdictional Acts and Regulations have been met as well as the applicable *AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) CODES* and *CANADIAN STANDARDS ASSOCIATION (CSA) requirements*. The boiler unit has been approved by *UNDERWRITERS’ LABORATORIES OF CANADA (ULC)*. The boiler has been manufactured using rigid specifications and precise fabrication methods. All components have been carefully selected and installed with the utmost care and attention. Every part of your **SASKATOON BOILER** has been inspected and tested prior to final delivery.

Similar care should be taken during the installation, operation, and maintenance of your **SASKATOON BOILER**. The purpose of this manual is to provide detailed information for the diligent installation, operation and maintenance of the boiler package. **FAILURE TO FOLLOW THE REQUIREMENTS AND RECOMMENDATIONS PROVIDED WITHIN THIS MANUAL COULD RESULT IN VOIDING YOUR WARRANTY EITHER IN PART OR WHOLE.**

It is not presumed that every possible situation and condition has been covered in this manual. If a situation arises that is not covered within this manual, feel free to contact **Saskatoon Boiler** as advice is readily available. A copy of this manual must be kept near your boiler. If your manual is lost or destroyed, a replacement copy can be obtained from **Saskatoon Boiler**.

In addition to this manual, **Saskatoon Boiler** has included a bulletin titled **“PREVENTATIVE MAINTENANCE”** which is a quick reference detailing the recommended frequency of all essential operational checks that should be completed. It should be noted that the recommendations given on the **“PREVENTATIVE MAINTENANCE”** bulletin are based on normal operating conditions and may not suit every boiler installation.

Properly installed, operated and maintained, your **SASKATOON BOILER** will give you many years of efficient, satisfactory service.

## **WARRANTY**

**SASKATOON BOILER MFG. CO. LTD.**, agrees to repair or replace f.o.b. Saskatoon, Saskatchewan any workmanship or materials, which, within one (1) year from date of startup or eighteen (18) months from date of shipment, whichever occurs first, shall prove to have been defective in material or workmanship, provided it is given prompt notification of the discovery of any such defects. **SASKATOON BOILER MFG. CO. LTD.** will not be responsible for repairs made without its consent, or the consequence thereof, nor shall it be held liable for damage or delays arising out of the repair or replacement of any such defective materials. This express warranty is in lieu of any implied warranties.

**THESE INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS HAVE BEEN REVIEWED BY UNDERWRITERS’ LABORATORIES OF CANADA.**



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# **INSTALLATION INSTRUCTIONS**

**THE INSTALLATION OF THE BOILER ASSEMBLY AND RELATED EQUIPMENT SHALL BE IN ACCORDANCE WITH THE ACTS AND REGULATIONS OF THE LOCAL JURISDICTIONAL AUTHORITIES AND THE APPLICABLE CANADIAN STANDARDS ASSOCIATION (CSA STANDARDS) REQUIREMENTS.**

## **RECEIPT OF THE BOILER**

Prior to accepting the shipment of the boiler package, **Saskatoon Boiler** recommends that a thorough inspection is completed to verify that your boiler has not been damaged during shipping. Any damage should be noted with trucking company and pictures taken for reference.

## **LIFTING THE BOILER**

Your boiler has been supplied with lift lug(s). **Saskatoon Boiler** requires that the boiler package is lifted using the lift lug(s). A qualified and experienced crane operator must perform all lifting operations.

**Never lift your boiler using a basket/sling method,  
or by any part of the boiler package other than the lift lug(s).**

**Never lift the boiler while there is fluid in it.**

All required information (boiler weight, minimum sling angle, etc.) for safely performing the lift can be found on the “**CUSTOMER DRAWING**” that is included in the drawings section of this document package.

## **RESPONSIBILITIES OF THE INSTALLER**

It is the responsibility of the boiler's installer to ensure that all applicable jurisdictional requirements and CSA standards are met during the boiler installation and that the boiler and related equipment are operating in a safe manor prior to handing over the unit to the owner. In addition, the boiler's owner and/or operator(s) must be fully aware of all procedures and practices that will enable him/her to safely operate the boiler.

## **INSTALLATION CLEARANCES**

Your boiler requires clearance for operational safety, inspection, and maintenance. Please review local jurisdictional requirements along with the sections “**CLEARANCE TO COMBUSTIBLE CONSTRUCTION**” and “**CLEARANCE FOR INSPECTION AND MAINTENANCE**” in this manual prior to locating the boiler's final position. The boiler must be installed on a level non-combustible surface.



### **CLEARANCE TO COMBUSTIBLE CONSTRUCTION**

<b><u>OPERATING CONDITIONS</u></b>	<b><u>MINIMUM CLEARANCE (INCHES)</u></b>				
	<b><u>ABOVE</u></b>	<b><u>FRONT</u></b>	<b><u>STACK</u></b>	<b><u>BACK</u></b>	<b><u>SIDES</u></b>
Water up to 250°F (Oil Fired)	6	48	18	6	6
Water over 250°F (Oil Fired)	18	48	18	18	18
Steam up to 15 psig (Oil Fired)	6	48	18	6	6
Steam 16 to 50 psig (Oil Fired)	18	48	18	18	18
Steam greater than 50 psig (Oil Fired)	48	96	36	36	36
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**Note: The boiler front side is the end where the burner is attached.**

If the minimum clearance to combustible construction is less than that shown, please contact Saskatoon Boiler for a permissible solution. The minimum dimensions shown in the above table do not supercede any jurisdictional clearance requirements. In cases where conflicts exist, the larger dimension shall be used.

### **CLEARANCE FOR INSPECTION AND MAINTENANCE**

Every boiler requires space for performing inspection and maintenance tasks, please review the **“CUSTOMER DRAWING”** that is included in the drawings sections of this document package for the required inspection and maintenance clearances for your boiler package. The required clearances shown on the customer drawing do not supercede any jurisdictional clearance requirements. In cases where conflicts exist, the larger dimension shall be used.

### **FINAL LOCATION BOILER SUPPORT**

All Saskatoon Boilers are constructed as package units, and as such are completely self-supporting.

The boiler must be installed on a level non-combustible floor or pad that can safely support the operating weight of the boiler. If shims are required to ensure that the boiler will be level during operation, they must be installed at intervals not exceeding two feet. When shims are required it is recommended that the shims be grouted in position.

Each boiler package includes tie down locations where anchor bolts are to be installed. The size and location of the tie downs have been designed to meet specific site location requirements as specified in the Canadian Building Code. If the boiler is moved and installed at a different location Saskatoon Boiler should be contacted to verify tie down acceptability.

### **COMBUSTION AIR**

An adequate supply of fresh air is critical for the operation of your boiler.

If the boiler room is located adjacent to an outside wall and fresh air is provided by natural infiltration from the outdoors, a permanent combustion air supply inlet is required having a total free flow area of 1 in<sup>2</sup> for every (30000) Btu/Hr or 70mm<sup>2</sup> for every 1 kW of fuel required. Information regarding the burner's maximum allowable heat input is located on the **“CUSTOMER DRAWING”** that is included in the drawings section of this document package.



Boiler rooms that are not adjacent to an outside wall, combustion air must be supplied in a manner acceptable to the authority administering CSA Standards.

When calculating the required vent opening, consideration must be given to the blocking effect of louvers, grills or screens within the opening. Screens shall not be smaller than 1/4 in [6mm] mesh and shall be readily accessible for cleaning. When using louvers and the designed free flow area is not known, it can be assumed that wood louvers have 20% free flow area, and metal louvers and grills have 60% free flow area. All automatic operated dampers or automatically adjusted louvers shall be interlocked so that the main burner cannot operate unless either the damper or louver is in the full open position.

All combustion air openings must be located at least 1 ft [300mm] above grade or the anticipated snow level, whichever ever is greater.

### **FUEL PIPING**

The boiler requires a fuel supply that can maintain the required volume and pressure of natural gas/propane that is detailed on the “**CUSTOMER DRAWING**” that is included in the drawing section of this document package. Any vented component that is a part of the fuel supply piping must be vented per applicable codes and jurisdictional requirements. It is the responsibility of the installer to ensure that all piping meets all jurisdictional requirements.

### **WIRING**

The boiler’s electrical connection entrance box is located on the front support leg (burner end). It is the responsibility of the installer to supply a fused disconnect which meets, as a minimum, the specifications listed on the voltage and amperage plate on the boiler’s front door. Ensure that the boiler on/off switch and any other associated electrical switches are in the off position prior to wiring the entrance box.

**All wiring must be completed in accordance with the current edition of the Canadian Electrical Code and/or applicable jurisdictional requirements.**

### **THE BREECHING AND/OR CHIMNEY/STACK**

The size of the boiler’s breech and/or chimney/stack must be sized no smaller than the smoke outlet connection on the boiler. See the “**CUSTOMER DRAWING**” that has been included within this document package for the size of the chimney supplied. When required, increase size so the pressure drop through the flue assembly is less than 0.2” WC. The breeching must slope upward toward the flue outlet at a minimum slope of 1/4” [6 mm] per linear foot. Provisions must be made for regular inspection and cleaning. Draft regulators are not required when the boiler is installed per **Saskatoon Boilers** recommended flue gas outlet arrangement.

### **CONNECTION OF SERVICES**

Every **Saskatoon Boiler** has been designed and manufactured to withstand all loads that are a direct result of the boiler itself. If the boiler has to support an external load, **Saskatoon Boiler** must be consulted to verify if the external loading is acceptable.

**Saskatoon Boiler** will not be responsible for any damage caused by any external loads that have been applied to the boiler or boiler support structure without the written consent of **Saskatoon Boiler**.

See the “**CUSTOMER DRAWING**” that is included in the drawings section of this document package for the data regarding the service connection sizes, ratings, and locations.

## **INITIAL CLEANING OF THE BOILER**

In most cases a new boiler will only require a quick internal inspection to verify that no foreign matter has entered into the boiler during the installation process. An optional alkaline boilout process or equivalent can remove any additional contaminants prior to initial startup. If the boiler has been stored in or transported through a corrosive or salty environment, a thorough cleaning of all boiler external surfaces should be performed to prevent corrosion.

## **WATER QUALITY (STEAM, HOT WATER AND WATER/GLYCOL BOILERS)**

One of the major causes of boiler failure is poor water quality due to an improper, inadequate or non-existent water treatment program.

Due to the complexity of water quality, it is beyond the scope of this manual to recommend a water treatment program that would suit all applications and/or boiler locations. Instead, **Saskatoon Boiler** strongly recommends that you contact a competent local water treatment company to set up a water treatment program that will be specific to your local water conditions. Their recommended water treatment program and blowdown instructions must then be followed.

The most common reasons to follow a water treatment program are:

1. The prevention of scale and sludge build-up on the boiler's water side;
2. The prevention of corrosion on the boiler's water side;
3. To control the pH value of the water;
4. Control of carry-over (contamination of the steam/circulating system after the boiler).

## **BOILER OPERATIONAL EFFICIENCY**

There are a number of environmental and installation conditions that will effect the operational efficiency of your boiler, the most common conditions are air temperature, barometric pressure, elevation and chimney/stack arrangement.

If you have not purchased the field start up option for your boiler, the operational efficiency of your boiler has been set to the conditions, and elevation of **Saskatoon Boiler's** Saskatoon factory. A qualified boiler technician may have to be contacted to adjust the burner to suit actual site conditions.

The operational efficiency of your boiler should be monitored on a regular basis. Particular attention should be paid after major changes in ambient temperature. If adjustments to the burner operation are required, a qualified boiler technician must be contacted to perform the adjustment.

## **BOILER OPERATING PROCEDURES**

Boiler operating personal must be fully acquainted with the operating procedures of the boiler and related equipment. All boiler operators must be certified to operate the supplied boiler by the jurisdictional agency in charge for the boiler location.

**“NEVER TAMPER WITH OR BY-PASS ANY OF THE CONTROLS OR SWITCHES ON THE BOILER.”**

### **START-UP PROCEDURE**

1. Ensure all necessary valves are in the correct operating position.
2. Drain winterizing fluid from feedwater pump if applicable.
3. Fill the boiler with water or water/glycol (as applicable) to the proper level. If applicable, verify that the low water cut off and high limit switches have been reset.
4. Reset all applicable gas pressure switches.
5. Ensure that any obstruction or cover has been removed from the chimney/stack and combustion air openings.
6. Warm up the boiler gradually prior to entering its normal automatic operating cycle:
  - Boilers with a High/Low or Modulating Burner – Set the burner to the low fire setting. Then turn the boiler on at the On/Off switch leaving the boiler on low fire until the boiler and boiler's fluid have sufficiently warmed up to prevent THERMAL SHOCK.
7. After the boiler and fluid have sufficiently warmed, the boiler is ready to enter its normal automatic operating cycle.

**Refer to the enclosed Electronic Combustion Control bulletin for a detailed operating sequence.**

### **NORMAL OPERATION**

After the start-up procedure, normal operation can begin. On/Off burners can be set to “On” and High/Low and Modulation burners can be set for automatic firing. Safety and operation check procedures should now be performed, refer to the **“SAFETY AND OPERATIONAL CHECK PROCEDURES”** section of this manual. After the safety and operation checks are completed, your boiler is ready for normal operation. Normal maintenance and supervision of the boiler is required to safeguard against unexpected malfunction of its components. Refer to local jurisdictional regulations for the level of supervision required. Refer to the **“MAINTENANCE INSTRUCTIONS”** section of this manual for periodic maintenance requirements.

**“DO NOT OPERATE THE BOILER IN AN UNSAFE MANNER”**

### **EMERGENCY SHUT-DOWN**

1. Shut off all power to the boiler.
2. Shut off the manual fuel valve(s).

**Note: Have installer show location and identify emergency switches and valves.**



## **BOILER SHUT-DOWN**

The following steps 2, 3 and 4 are to be carried out for safety reasons when the shut down will be for an extended period or when the shutdown is for maintenance purposes. These steps are to be supplemented by applicable instructions given in the “**MAINTENANCE INSTRUCTIONS**” section of this manual.

**Note: Any applicable owner maintenance lockout procedures and hazard assessment requirements must be followed.**

1. Turn off the power to the burner at the burner On/Off switch.
2. Turn off the manual valve in the fuel supply line to the boiler.
3. Never turn off the water supply to the boiler until the unit has cooled.
4. After the boiler has sufficiently cooled, turn off the feedwater or fluid circulation pumps as applicable.
5. For draining steam boilers refer to the section “**SHORT TERM LAYUP OF STEAM BOILERS**” form this manual.
6. For draining hot water and water/glycol boilers refer to the section “**SHORT TERM LAYUP OF HOT WATER AND WATER/GLYCOL BOILERS**” form this manual.

## **COLD WEATHER SHUT-DOWN**

In addition to the steps listed previously in the “**BOILER SHUT-DOWN**” section above, special consideration must be made if freezing of the boiler and/or it’s external piping is a possibility. For steam or hot water boilers, either keep the boiler room and boiler system sufficiently above freezing temperature or drain the boiler and system. See items 5 & 6 in the “**BOILER SHUT-DOWN**” section above. For water/glycol boilers, ensure that the water/glycol mixture has the correct concentration to prevent the possibility of freezing.

## **BOILER START-UP AFTER EXTENDED SHUT-DOWN**

When the boiler has been shut down for an extended period and it is to be restarted, test and start-up procedures must be performed to ensure the unit is ready for normal operation.

## **SAFETY AND OPERATION CHECK PROCEDURES**

**THE FOLLOWING CHECKS ARE TO BE MADE AFTER STARTUP AT THE PRESCRIBED INTERVALS INDICATED IN THE MAINTENANCE SECTION OF THIS MANUAL AND IN THE BULLETIN ENTITLED “PREVENTATIVE MAINTENANCE”.**

1. **Low Level Cut Off(s) – Steam Boilers** - While the boiler is operating, open the blowdown valve on the bottom of the water column below the low level cut off being tested and allow the water level to drop until the low level cut off shuts the burner off. Repeat this operation twice for each low level cut off. The water level should promptly return to normal operating levels after each test. If the water level does not return to the normal operating level check the feedwater piping system to ensure all components are in proper working condition and that no blockage exists. **DO NOT LET THE WATER LEVEL IN THE BOILER DROP BELOW THE LOWER NUT ON THE GAUGE GLASS.**

Note: Steam boiler probe type low level cut off(s) have a built in, factory set, 5 second delay before shutting the burner down.

2. **Low Level Cut Off – Hot Water and Water/Glycol Boilers**

- Boilers with a water column mounted float or probe low level cut off - While the boiler is operating open the 3-way valves and allow the water level to drop within the low level control until the low level cut off shuts the burner off.
- Boiler with a shell mounted probe type low level cut off - Push the test switch button at the control panel and hold (approximately 5 seconds) until the boiler safely shuts down.

3. **Safety Valve(s) (Rapid Opening)**

**Try Lever Test** – While the boiler is operating near the maximum operating pressure, lift the try lever on the safety valve for 5 to 10 seconds. Release the try lever and allow the spring to snap the disk to the closed position. If the valve simmers, operate the try lever test 2 or 3 more times to allow the disk to seat properly. If the disk continues to simmer the safety valve must be replaced or repaired by a qualified technician.

**Opening and Blowdown Test** – The safety valve should be sent to a qualified testing facility for these tests.

4. **Relief Valve(s) (Proportional Opening)**

**Try Lever Test** – While the boiler is operating at a minimum pressure of 5 psig [35 kPa], lift the try lever on the relief valve for 5 to 10 seconds. Release the try lever and allow the spring to close the disk to its closed position. If the valve simmers, operate the try lever test 2 or 3 more times to allow the disk to seat properly. If the disk continues to simmer the relief valve must be replaced or repaired by a qualified technician.

**Opening and Blowdown Test** – The relief valve should be sent to a qualified testing facility for these tests.

Safety and Relief Valve Operational Tolerances			
Code Section	Set Pressure psig	Set Pressure Tolerance	Blowdown
ASME Section I Power Boiler Valve Stamp V	16-70	$\pm 2$ psig	2 psig
	71-100	$\pm 3$ %	3%
	101-300	$\pm 3$ %	3%
ASME Section IV Heating Boiler Valve Stamp HV	15 psig Steam		
	15	$\pm 2$ psig	2-4 psig
	Hot Water		
	15-60 61-160	$\pm 3$ psig $\pm 5$ %	N/A N/A

Table referenced from ASME Section I, PG-72.2 & Section IV, HG-401.1 (k)

5. **High Limit Pressure Control – Steam Boilers** – While the boiler is operating, set the operating limit control above the setting of the high limit control. Partially close the valve in the main steam line and allow the steam pressure to increase until the setting of the high limit control is exceeded. This will trip the burner's emergency shut-down. At the time of shut-down, check the control setting with the pressure gauge. The pressure reading from the pressure gauge and the high limit should be within the values specified in the TABLE "ALLOWABLE DEVIATION BETWEEN PRESSURE CONTROL AND PRESSURE GAUGE". If the pressure difference is greater than the range specified, the pressure gauge and the high limit should be tested to verify that they are operating to the tolerances specified by the manufacturer. Return the operating control to its original setting.

ALLOWABLE DEVIATION BETWEEN PRESSURE CONTROL AND PRESSURE GAUGE	
Pressure Range	Accuracy Tolerance
Up to 15 psig Steam	$\pm 3$ psig
Greater than 15 up to 150 psig Steam	$\pm 8$ psig
Greater than 150 up to 300 psig Steam	$\pm 10$ psig

6. **High Limit Temperature Control – Hot Water and Water/Glycol Boilers** – While the boiler is operating, set the operating limit control above the setting of the high limit control and allow the temperature to increase until the setting of the high limit control is exceeded. This will trip the burner's emergency shut-down. At the time of shut-down, check the control setting with the temperature gauge. The temperature gauge and the high limit should be within  $\pm 3$  % of each other. If the temperature difference is greater than  $\pm 3$  % both the temperature gauge and the high limit should be tested to verify that they are operating to the tolerances specified by the manufacturer. Return the operating control to its original setting.
7. **Linkages** – Ensure that set screws and nuts are tight on all control linkages.
8. **Boiler Assembly and Service Lines** – With the unit operating, trace all water, steam and fuel lines and inspect for leaks. Check the handholes and manway (if applicable) for leakage as well.
9. **Boiler Doors** - While the boiler is operating, check all bolts, nuts, etc. for both the front and rear doors to ensure that they are tight and that there is no combustion gas leaking past the gaskets into the boiler room.
10. **Double Check** – That all valves, switches and controls are in the operating position and, in particular, that all controls have been returned to their correct setting. The boiler is now ready for its normal operating cycle.



## **SERVICE INSTRUCTIONS & TROUBLE-SHOOTING**

It should never be assumed that any component of the system is defective until the component has been thoroughly tested. All the controls and burners are tested under actual firing conditions at the factory. Unless components were damaged during shipping or the boiler was installed incorrectly, all equipment should operate as intended.

### **BURNER ASSEMBLY SERVICING AND MAINTENANCE**

- The burner motor is typically permanently lubricated. If grease fittings are incorporated on the motor, lubricate annually.
- Inspect and clean burner components a minimum of once a year, replace all damaged or worn components. Prior to removing the nozzle assembly, note its position in the burner blast tube, it must be reinstalled into the same location. See electrode placement drawing in the drawings section of this manual.
- Be sure that all wires are intact and that the ignition electrode porcelains are not cracked.
- Check that the ignition electrode tip location is in accordance with the dimensions given in electrode placement drawing in the drawings section of this manual.
- Verify that the flame scanner is clean and set so that nothing obstructs its view.
- Keep the burner area around the boiler free from dust, lint, and all flammable materials.

### **BURNER MOTOR WILL NOT START WITH ON/OFF SWITCH IN THE "ON" POSITION**

- Check for power at the entrance box on the boiler leg. Check the main fused disconnect and correct the fault if necessary.
- Check the fuses in the control panel and replace if required.
- Check for power through the limit circuit, if the circuit is open, check each control individually in the external operating circuit (operating control, high limit, low water cutoff(s), high water cutoff, gas pressure switches, flow switch and remote shutdown switch as applicable) until the open switch is found and the condition corrected.
- If the boiler is equipped with proof of closure switch(es) in the main gas shut off valve(s) the switch(es) and valve(s) must be in the fully closed position in order to start the boiler.
- With power through the limit circuit, the primary combustion control should allow the burner to start. If the motor fails to start, reset the motor overload switch(es) if applicable and check the motor starter for loose connections
- Refer to the electronic combustion control documentation if the burner will still not start.

### **BURNER MOTOR STARTS BUT BURNER FAILS TO FIRE**

- Ensure that the external electrical supply is sufficient to maintain the requirements of the boiler unit at start-up and during operation. Periods of insufficient electrical supply may cause burner backfiring.
- Verify that the manual valves in the fuel supply line(s) are open.
- Verify that the pilot or main fuel line automatic shut off valve opens to allow pilot flame.
- Check for sufficient fuel pressure with a pressure gauge.
- Verify the ignition transformer is producing spark by looking through the rear door sight glass.
- If the burner is equipped with a main fuel control valve modulation motor, verify that it switches to the low fire position prior to attempting to fire.
- If the boiler is equipped with proof of closure switch(es) in the main gas shut off valve(s) the switch(es) and valve(s) must be in the fully closed position in order to start the boiler.
- Check that any obstructions or covers have been removed from the chimney/stack.

- Verify that the burner motor is rotating in the correct direction for the fan to pressurize the furnace. Correct the electrical supply wiring to the entrance box if rotation is incorrect.
- Check that the fan has not come loose from the burner shaft.
- Check for power to the burner air pressure switch. If the circuit remains open while the burner motor is operating, check the switch.

#### **BURNER MOTOR RUNS WITH CORRECT FUEL PRESSURE BUT BURNER DOESN'T FIRE**

- Check for power to the main gas and pilot automatic shutoff valves at the terminal strip in the control panel.
- Check if the valves are receiving power and that there is fuel pressure downstream from the valves.
- Verify the ignition transformer is producing spark by looking through the rear door sight glass.
- Check for power to the ignition transformer at the terminal strip in the control panel and on the primary side of the ignition transformer. Make sure that there are no loose connections.
- Inspect the electrodes to ensure that the spacing and location are correct. Look for evidence of cracked porcelains or electrode shorting. If electrodes have been damaged, replace the electrodes ensuring the correct electrode spacing after installation.
- Ensure the ignition cables are in good condition and are not shorting. Replace if required.
- Verify that the electronic combustion control is in proper working condition.
- Verify that the modulating motor returned to the low fire position.
- Verify that the air pressure switch is in proper working condition.

#### **BURNER FIRES BUT LOCKS OUT ON SAFETY (LOSS OF FLAME)**

- Verify that there is a sufficient pilot and main flame to maintain flame detection.
- Verify that the flame detector sensor is not dirty and the electrical connections are in good condition.
- Verify that the burner is receiving adequate fuel pressure required for normal operation, refer to the “FIRE TEST REPORT” for required fuel pressure.
- Verify that the electronic combustion control is in proper working condition.

#### **BURNER OPERATES ON LOW FIRE BUT DOES NOT GO TO HIGH FIRE**

- Verify that the auto/low fire switch is in proper working correctly.
- Verify that the high/low control is in proper working correctly.
- Verify that the high fire valve is receiving power and that it is working correctly.
- Verify that the burner assembly is receiving sufficient fuel supply for high fire.
- Verify that the electronic combustion control is working correctly.
- Verify that the gas regulating valve(s) are opening to the correct position by checking the downstream pressure against the “FIRE TEST REPORT”.
- Verify that there is power to the high fire drive source and that the linkages are in proper working condition and are not binding.

#### **BURNER AIR DAMPER FAILS TO OPERATE**

- Verify that there is power to the air damper drive source and that the linkages are in proper working condition and are not binding.

#### **BURNER AIR DAMPER ADJUSTMENTS**

If you have not purchased the field start up option the burner's fuel/air ratio has been factory set by **Saskatoon Boiler** to achieve the boilers optimum operating efficiency for the conditions and elevation of our Saskatoon factory. A qualified boiler technician with a flue gas analyzer must be utilized if adjustment is required. The factory set position of this damper is shown on the “FIRE TEST REPORT” documentation that is included in this manual.

# **MAINTENANCE INSTRUCTIONS**

A regular maintenance program is critical to ensure that your boiler will operate reliably and efficiently. Your maintenance program will consist of daily, weekly, monthly, semi-annual, and annual tests that will confirm that all parts of the boiler are operating as intended. The frequencies and tests recommended by Saskatoon Boiler are listed below. An experienced operator may have to increase the frequency or add additional checks depending on the actual operating conditions or jurisdictional requirements:

**Refer to the “BOILER OPERATING PROCEDURES” and “SAFETY AND OPERATION CHECK PROCEDURES” sections for information to perform each check and for safety precautions.**

**Note: Any applicable owner maintenance lockout procedures and hazard assessment requirements must be followed.**

## **DAILY:**

1. **Steam Boilers** - Blowdown the boiler through each blowdown connection for a minimum of five seconds.
2. **Steam Boilers** - While the boiler is operating, blowdown the water column(s) to the low water cut off point. If the unit does not shut down, correct the fault
3. Check the stack temperature. If excessive over a short period of time, inspect the seal at the rear turn chamber baffle and refractory. If the stack temperature becomes excessive over a longer period of time, check the waterside of the boiler for scale build-up and the fireside for soot accumulation.
4. Verify that combustion gasses are not leaking from the boiler into the boiler room.
5. Verify that the boiler pressure or water temperature is not excessive.

## **WEEKLY:**

1. Observe the operation of the electronic combustion control to ensure that it functions as described in the manufacturer's documentation.
2. Clean the boiler exterior so that dust do not accumulate. Pay extra attention to the operating components.
3. Inspect the feedwater or circulation system and maintain it per the manufacturer's recommendations.
4. **Steam Boilers** - Test the feedwater and compare it against the water standards supplied by the water treatment company.

## **MONTHLY:**

1. Perform a Try Lever Test; refer to the “**SAFETY AND OPERATION CHECK PROCEDURES**” section of this manual for the try lever test procedure.
2. Test the high limit control to be sure that it operates satisfactorily.
3. Inspect the burner air damper linkages and damper connections. Tighten if required.

## **SEMI-ANNUAL:**

1. Thoroughly clean the furnace and tubes.
2. Check for any tube or boiler leaks. Have a qualified repair shop perform any required repairs.
3. Replace the gasket around the rear turn chamber with a new one.
4. Clean the sight glass in the rear door. Replace if necessary.
5. If the unit is equipped with a non-freeze siphon drain for the pressure controls, it must be disassembled and cleaned.
6. Inspect the fuel lines and connections for leaks. Repair or tighten as necessary.



## **ANNUAL:**

1. Remove all handhole and manway (if applicable) covers and inspect the waterside of the boiler for corrosion or scale build-up. If the boiler fluid has been captured for reuse, it should be tested to ensure its quality prior the boiler being filled.
2. Flush the inside of the boiler with a hose, making sure to remove all sludge and deposits.
3. Return the handhole and manway (if applicable) covers with new gaskets.
4. **Steam Boilers** - Disconnect the piping on the discharge side of the feedwater pipe and inspect for scale buildup.
5. Inspect the check valve(s) in the feedwater system to determine that they are seating properly.
6. Lubricate the electric motors if they are equipped with grease fittings.
7. Replace the fusible plug if so equipped.
8. If the unit is equipped with probe type level controls, they should be removed and cleaned.
9. Verify that the safety valve(s) are in proper working condition.
10. Inspect and clean components of the burner assembly. See the "**BURNER ASSEMBLY SERVICING AND MAINTENANCE**" section of this manual.

## **BOILER MAINTENANCE LOG**

Check with the local jurisdictional regulations regarding the requirements pertaining to maintenance logs.

Maintenance logs are a useful tool to help prevent boiler accidents and ensure a long and efficient boiler life. Logs are intended to be a continuous record of a particular boiler's operation and maintenance.

## **INTERNAL DEPOSITS - WATERSIDE**

Deposits found on the internal surfaces of a boiler may include scale, sludge, corrosion, and oil.

1. **Scale:** is caused by feedwater impurities being precipitated directly onto the heat transferring surfaces or by the suspended matter settling out on the metal and becoming hard and adherent. Scale is undesirable because it interferes with the boiler's ability transfer heat and may lead to overheating and boiler failure. Scale build up on the boiler's surfaces can be minimized through a customized water treatment program.
2. **Sludge:** is a sedimentary deposit formed either by suspended material in the water or by precipitation from the boiler water. It may be a result of the internal chemical treatment reacting with minerals or salts contained within the water. Sludge is usually soft and less adherent than scale, and in steam boilers, some can be carried off during the daily boiler blowdown.
3. **Corrosion:** may occur within a boiler system either while the boiler is in service or while it is out of service. When a boiler is laid up in either wet or dry storage, proper precautions should be taken to minimize corrosion.
4. **Oil or Grease:** in the boiler water is very undesirable as it may deposit, particularly in conjunction with sludge to impair the heat transfer to such an extent that damage to the boiler may result. Oil or grease may also cause excessive steam contamination. It is very important that the entry of oil or grease into the water be avoided.

## **INTERNAL DEPOSITS - FIRESIDE**

When carbon based fuel is burned, a number of problems can arise that will affect the fireside of the boiler system. The three most common problems that may occur are the accumulation of soot and corrosion.

1. **Soot:** is the formation of unburned carbon particles on the boiler's furnace and tubes caused by the incomplete combustion of the fuel. To minimize the formation of soot on the boiler's surfaces a qualified boiler technician can adjust the burner for optimum combustion.
2. **Corrosion:** may occur on the fireside of a boiler either while the boiler is in service or while it is out of service. Burner maintenance or fuel treatment is required if furnace or tube corrosion is evident due to boiler operation. See the section "**BOILER STORAGE – FIRESIDE**" for some recommendations to prevent corrosion while the boiler is out of service.

## **CLEANING AND CARE OF THE BOILER**

All boiler surfaces should be kept clean of scale, sludge, soot, slag, corrosion or the build-up of any other material that would effect the boiler's operation. Foreign materials that build-up on the surfaces of your boiler will affect the boiler's ability to effectively transfer heat from the fireside to waterside, thus reducing the boiler's efficiency and potentially causing the boiler to overheat and fail.

The following rules can be used as a guide to predict when the boiler requires cleaning.  
When the stack temperature reaches:

480°F for hot water heating boilers (boilers up to 121°C, 250°F liquid) or low pressure heating boilers (boilers up to 103 kPa, 15 psi steam).

580°F (3 pass) high temperature hot water power boilers (boilers above 121°C, 250°F liquid) or high pressure steam power boilers (boilers above 103 kPa, 15 psi steam).

725°F (2 pass) high temperature hot water power boilers (boilers above 121°C, 250°F liquid) or high pressure steam power boilers (boilers above 103 kPa, 15 psi steam).

<b>Efficiency Loss from Build-Up on Boiler Surfaces</b>		
<b>Build-Up Thickness</b>	<b>Water Side Scale</b>	<b>Fire Side Soot</b>
1/32"	6.1%	16.2%
1/16"	11.6%	27.9%
3/32"	16.4%	36.8%
1/8"	20.7%	43.7%
5/32"	24.6%	49.2%
3/16"	28.2%	53.6%
7/32"	31.4%	57.6%
1/4"	34.3%	60.8%

Information for the table above was from the National Board BULLETIN / Fall 1995

## **SHORT TERM LAYUP OF A STEAM BOILERS**

See **"BOILER SHUT-DOWN"** section in this manual for the proper shutdown procedure.

When the boiler is to be taken out of service, reduce it's pressure to below 10 psig [70 kPa] and allow the water to sufficiently cool prior to draining. All fluid removed from the boiler for disposal should be disposed of as required by your local jurisdictional regulations. If the fluid removed will be reused, it should be captured and tested to ensure it's quality prior to the boiler being refilled.

See **"STEAM BOILER STORAGE - WATERSIDE"** section in this manual for the proper storage procedure.

### **STEAM BOILER STORAGE - WATERSIDE**

1. **Dry Storage:** is preferable for boilers that will be out of service for an extended period and/or where freezing conditions are possible.

The boiler must be thoroughly dried and the entry of moisture must be prevented. The use of a moisture absorbing material is a good way to control the humidity within a closed boiler. The amount of moisture absorbing material required depends on the type used, always follow the manufacturer's recommended instructions. All moisture absorbing material should be placed in trays that will be large enough to contain the original material plus the additional volume expected as moisture is collected. Replace all moisture absorbing materials at the intervals recommended by the manufacturer.

If a moisture absorbing material is used, we recommend that a label be placed on the boiler in a prominent location stating that a moisture absorbing material has been inserted and that it must be removed prior to filling the boiler.

2. **Wet Storage:** this process is suitable for boilers which will only be out of service for a short period of time, or where a standby boiler will be required on short notice and there is no possibility of freezing. Note that for longer shutdowns, dry storage is the preferred method.

The boiler should be filled to the top with chemically treated water to reduce the possibility of corrosion and water pressure slightly greater than atmosphere should be maintained during the standby period.

## **SHORT TERM LAYUP OF A HOT WATER OR WATER/GLYCOL HEATING BOILER**

See **"BOILER SHUT-DOWN"** section in this manual for the proper shut down procedure.

When a heating boiler is to be removed from service the following procedure should be followed:

1. While maintaining boiler water temperature between 180° F to 200° F, [80° C to 93° C], drain off boiler water from the bottom drain valve until the water runs clear of debris. All water removed from the boiler should be disposed of as required by local jurisdictional regulations.
2. Refill the boiler or system to the appropriate level, add a sufficient amount of water treatment compound.
3. When all the dissolved gases are released from the water through a high point vent valve (approximately 1 hour), shut down the burner and allow the boiler to cool.
4. See the **"HOT WATER OR WATER/GLYCOL BOILER STORAGE – WATERSIDE"** below for the storage procedures.



A clean, properly maintained hot heating boiler should not be drained unless there is a possibility of freezing, a considerably amount of sludge/dirt has accumulated on the waterside, or unless the boiler has to be drained for inspection or repairs. Very little sludge or dirt should accumulate on the waterside of a heating boiler where little make up water is required unless the water treatment program is not adequate for the local water conditions.

### **HOT WATER OR WATER/GLYCOL BOILER STORAGE - WATERSIDE**

1. **Dry Storage:** the boiler is drained, flushed, inspected and repaired if required. All fluid removed from the boiler for disposal should be disposed of as required by local jurisdictional regulations. If the fluid removed will be reused, it should be captured and tested to ensure it's quality prior to the boiler being refilled. The surfaces are then thoroughly dried by the means of hot air. If the boiler room is dry and well ventilated, the boiler may be left open to the atmosphere. An alternate procedure is to use a suitable moisture absorbing material. (See the "STEAM BOILER STORAGE – WATERSIDE, DRY STORAGE METHOD" section above.)
2. **Wet Storage:** the boiler is drained, flushed, inspected and repaired if necessary. All water or water/glycol solution removed from the boiler for disposal should be disposed of as required by local jurisdictional regulations. If the boiler fluid was captured for reuse it should be tested prior filling the boiler. The boiler can then be filled to the normal operating level with treated water or water/glycol solution and heated for a short time while venting the boiler system to atmosphere to expel the dissolved gases. The boiler can be left in this state if it may be required on short notice and freezing is not a concern. However, if the boiler is to be completely idle, it is preferable to fill the boiler to the top of the drum. In either case, treated water or water/glycol should be used. During the down time, if feasible, it is good practice to occasionally circulate the water with the circulation pump. This is necessary to prevent stratification and ensure that fresh inhibitor is in contact with the metal throughout the boiler system. Corrosion is apt to be more serious during the down time than when the boiler is actually in service.

### **BOILER STORAGE - FIRESIDE**

The intent of fireside protection is not radically different from waterside protection. The major problem on the fireside is to maintain dry and clean surfaces and to avoid conditions where moisture can condense on metal surfaces. Sulfur-bearing fuels can produce ash deposits that are acidic in nature and can corrode the boiler's surfaces. It is recommended that the relative humidity of the boiler's fireside air be maintained below 50% during storage periods. Low levels of humidity can be achieved by using heat lamps, dehumidifiers with circulation fans, or by the circulation of warm dry air.

### **TUBE LEAKS**

There are several conditions that can cause or contribute to tube leaks. The best prevention is proper operating conditions. The most common conditions that cause tube leaks are:

1. **Overfiring the boiler:** do not operate the boiler above the specified maximum allowable heat input/firing rate.
2. **Overheating due to scale on the waterside:** refer to "INTERNAL DEPOSITS – WATERSIDE" section.
3. **Overheating due to low water condition:** do not operate the boiler in a low water condition and do not drain the boiler until it has sufficiently cooled down.
4. **Corrosion due to oxygen in the water:** refer to "FEEDWATER, CIRCULATING WATER or CIRCULATING WATER/GLYCOL" sections where applicable.
5. **Improper warm up before going to high fire:** refer to the "START UP PROCEDURE" section.

6. **Severe water temperature change:** can cause uneven expansion or contraction of the boiler creating stresses within the boiler.
7. **Excessive start/stop cycling.**

### **REPAIR OR REPLACEMENT OF TUBES**

Repair or replacing of boiler tubes is considered to be a repair to the boiler's pressure boundary. Contact **Saskatoon Boiler** or qualified repair shop with a local jurisdictional accepted quality control program to perform this type of repair.

### **CONDENSATION IN THE BOILER**

Condensation (the temperature at which water will condense on a surface) takes place when the temperature of the flue gas is below it's dew point. It is most common in hot water heating systems. Although condensation is unavoidable during the initial start-up period, it is critical to prevent a prolonged period of condensation to occur within your boiler. An extended period of condensation will cause corrosion on the fireside surfaces of your boiler.

To prevent condensation, the operating controls of the boiler must be set to operate above 180°F at all times, regardless of system demands. If heating demand required by the system is less than 180°F, the boiler must be operated at a temperature at or above 180°F and the boiler's water mixed outside the boiler with water returning from the piping system. Please contact **Saskatoon Boiler** or a competent heating system company if you require additional information on this topic.

### **COMBUSTION CHAMBERS**

Check the furnace and turn chambers periodically to see that there are no carbon formations. If carbon formations occur shut down the boiler and clean the furnace, turn chambers, and tubes. If there are excessive carbon formations a qualified boiler technician should adjust the burner, as such formations are not a part of normal burner operation.

Inspect the furnace, turn chambers, and tubes every year. Repair cracks or expanded joints in rear chamber and doors refractory. If it is necessary to install new refractory, consult **Saskatoon Boiler** or a qualified boiler shop to perform the work.

### **BLOW DOWNS - STEAM BOILERS**

The boiler must be blown down often enough to prevent the buildup of solids in the water. For normal operating conditions, the boiler should be blown down through each blowdown connection for a minimum of five seconds per day for a steam boiler. All fluid removed from the boiler during the blowdown process should be disposed of as required by your local jurisdictional regulations. The actual frequency of the blowdowns may have to be increased depending on how effective your feedwater treatment program is. Boilers that operate with a higher level of feedwater contamination will have to be blown down more often than boilers with less contaminated feedwater.

Similarly, the low water cut off(s) and water column(s) should be blown down once per day while the unit is in operation. This will clear the solids from the water column and help to ensure that the low water cut off(s) continue to operate as intended.

### **WATER LEVEL IN THE BOILER**

1. **Steam boilers:** Must have a minimum water level 2" above the top of the highest tube within the boiler. In order to maintain the required water level, the boiler is equipped with an automatic level control that closes a switch to operate the feedwater pump which maintains the water level above the minimum required level during boiler operation. Your boiler is also equipped with a main and an auxiliary low level cut off. These systems are designed to shut the burner off in the event that the boiler enters a low water condition. This is critical because if the water level is allowed to drop below the highest tube, furnace, or water arch level your boiler could sustain serious damage.
2. **Hot Water and Water/Glycol boilers:** The boiler is full of water during normal operation. An expansion tank is required for these systems. The boiler is equipped with a low level control to shut the burner off in the event that the boiler enters a low water condition. This is critical because if the water level is allowed to drop below the highest tube, furnace, or water arch level your boiler could sustain serious damage.

All water level controls need to be tested on a regular basis to ensure that they are operating correctly.

## **VERY IMPORTANT PRECAUTIONS**

**THESE MUST BE FOLLOWED WITHOUT EXCEPTION.**

1. **NEVER** perform any maintenance work on the boiler without first turning the main fused disconnect switch to the "OFF" position.
2. **NEVER** tamper with or by-pass any of the controls.
3. **NEVER** set the burner to high fire until it has sufficiently warmed up.
4. **NEVER** interrupt the supply of feedwater until the burner is turned off and the pressure is below 10 psig [70kPa] within the boiler.
5. **NEVER** drain the boiler until the burner is off and the boiler's fluid has cooled.
6. **NEVER** supply feedwater to the boiler through any connection other than the factory feedwater connection.
7. **NEVER** introduce chemicals to the boiler through the feedwater pump or upstream of it.
8. **NEVER** allow the boiler fluid to freeze within the boiler or it's associated components.
9. **NEVER** lift the boiler while there is fluid in it.
10. **ALWAYS** ensure that all motors and bearings requiring lubrication are properly lubricated.
11. **ALWAYS** close the manual shut-off valves in the fuel lines before opening the unions or connection points.
12. **ALWAYS** use this manual as a guide for the proper care of the boiler.

**DO NOT OPERATE THE BOILER IN AN UNSAFE MANNER.**

**DOCUMENTS:**

**DRAWINGS and REPORTS, etc.**

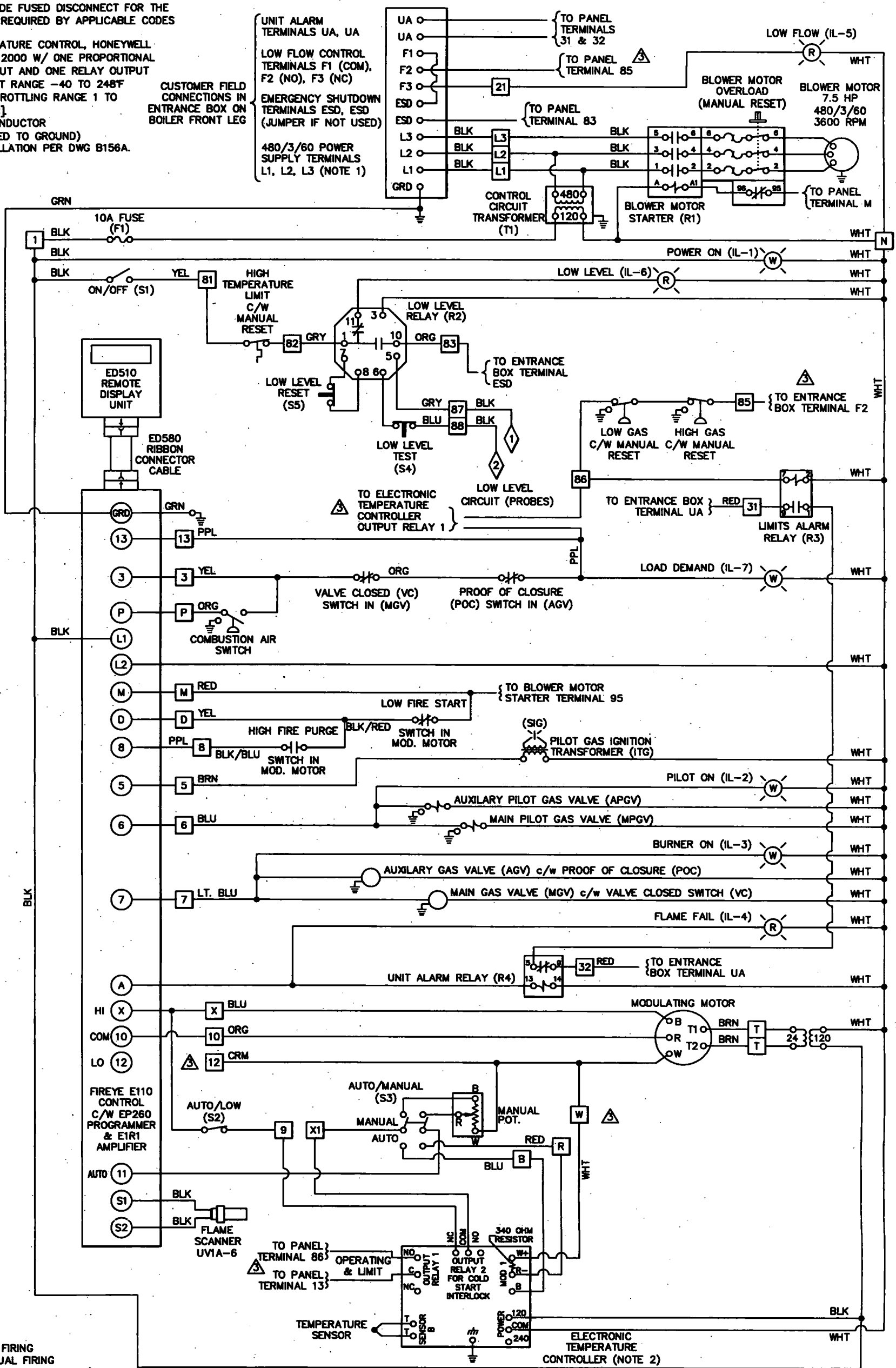


NOTES

1. INSTALLER TO PROVIDE FUSED DISCONNECT FOR THE POWER SUPPLY AS REQUIRED BY APPLICABLE CODES AND REGULATIONS.
2. ELECTRONIC TEMPERATURE CONTROL, HONEYWELL T775M2048 SERIES 2000 W/ ONE PROPORTIONAL (+) INTEGRAL OUTPUT AND ONE RELAY OUTPUT (SPDT). ADJUSTMENT RANGE -40 TO 248°F [-40 TO 120°C]. THROTTLING RANGE 1 TO 150°F [-17 TO 66°C].
3. GROUNDING BY CONDUCTOR (REMAINDER BONDED TO GROUND)
4. FLOW SWITCH INSTALLATION PER DWG B156A.

CUSTOMER FIELD CONNECTIONS IN ENTRANCE BOX ON BOILER FRONT LEG

UNIT ALARM TERMINALS UA, UA  
LOW FLOW CONTROL TERMINALS F1 (COM), F2 (NO), F3 (NC)  
EMERGENCY SHUTDOWN TERMINALS ESD, ESD (JUMPER IF NOT USED)  
480/3/60 POWER SUPPLY TERMINALS L1, L2, L3 (NOTE 1)



- MANUAL SWITCHES  
S1 - ON/OFF  
S2 - AUTOMATIC/LOW FIRING  
S3 - AUTOMATIC/MANUAL FIRING  
S4 - TEST SWITCH (LOW LEVEL CIRCUIT)  
S5 - MANUAL RESET (LOW LEVEL RELAY)
- RELAYS  
R1 - BLOWER MOTOR STARTER  
R2 - LOW LEVEL  
R3 - LIMITS ALARM  
R4 - UNIT ALARM

- LEGEND
- (\*) FIREYE TERMINAL
  - (\*) LIGHT
  - (\*) PANEL TERMINAL
  - FACTORY WIRING
  - FIELD WIRING
  - ⊕ SHIELDED CABLE
  - ⊕ LIGHT
  - ⊕ PRESS. CONTROL
  - ⊕ TEMP. CONTROL
  - ⊕ LEVEL CONTROL
  - ⊕ FLOW CONTROL

REVISIONS: REV.1, MR, 07 DEC 10, CORRECTED TERMINAL NUMBERS.  
REV.2, MR, 01 FEB 11, GENERAL REVISION TO FIREYE CONTROL.  
REV.3, OC, 22 FEB 11, REV'D TO AS-BUILT.

WIRING DIAGRAM - OTS SERIES - FIREYE

PSI GAS, MODULATION, LIQUID SERVICE c/w MAN. POT., PROBE TYPE LLC, FLOW SWITCH, UNIT ALARM, REMOTE SHUTDOWN

SUPPLY VOLTAGE: 480/3/60 CONTROL VOLTAGE: 120/1/60

DRAWN BY: N SKURA CHK'D BY: NS

SASKATOON BOILER MFG. CO. LTD.

2011 QUEBEC AVE., SASKATOON, SASKATCHEWAN, S7K 1W5

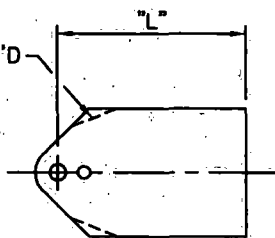
MODEL: OTS-G150W (3 PASS) UNITS: ONE

OWNER: NORTHERN BLIZZARD RESOURCES INC.

LOCATION: MORGAN 16-34-51-64-W4M BATTERY, AB

DATE: 7 JAN 2011 JOB: 10-32 DWG: EPFW3MG-08

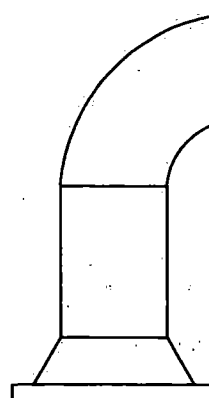
TRIM PADDLE IF REQ'D  
TO AVOID CPLG  
INTERFERENCE AND  
INSURE FULL TRAVEL  
ONCE INSTALLED



PADDLE DETAIL

NOMINAL PIPE SIZE "D": 6"NPS (DN 150)

PADDLE LENGTH "L": 2 7/8" (73 mm)



BOILER  
INLET OR OUTLET

5 x "D" (MIN.)

5 x "D" STRAIGHT RUN (MIN.)

FULL  
PENETRATION  
WELD

1 1/4"NPT 3000# SA-105 HALF CPLG  
FOR M & M FS7-4S FLOW SWITCH  
(NOTE 4)

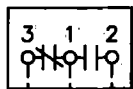
NOMINAL PIPE  
SIZE "D"

HALF CPLG DOWNHILL  
SIDES ARE TO BE  
FLUSH WITH THE INSIDE  
OF THE PIPE

VENT CONNECTION c/w VENT VALVE.  
1/2"NPT 3000# SA-105 CPLG  
MINIMUM. LOCATE THE CPLG AT  
LEAST 15" FROM THE FLOW SWITCH.  
CPLG & VALVE BY CUSTOMER.

**WARNING:** IMPROPER INSTALLATION OF THE 1 1/4"  
HALF COUPLING WILL IMPAIR FLOW SWITCH  
OPERATION AND MAY RESULT IN DAMAGE TO  
THE FLOW SWITCH DURING ITS INSTALLATION.  
DO NOT USE THREDOLET (OR SIMILAR TYPE)  
FITTING.

FLOW SWITCH



FIELD WIRING TO FLOW  
SWITCH TERMINALS IN  
ENTRANCE BOX ON  
BOILER LEG

FLOW SWITCH WIRING

**WARNING:** THE FLOW SWITCH DESCRIBED IN THIS DRAWING  
IS TO BE USED FOR PROTECTION OF THE BOILER  
ONLY. NO OTHER DEVICES ARE TO BE WIRED  
INTO THE FLOW SWITCH CIRCUIT.

NOTES:

1. MINIMUM ALLOWABLE FLOW 169 U.S. GAL/MIN (640 L/MIN).
2. SWITCH MUST BE INSTALLED IN HORIZONTAL PIPING.
3. REFER TO PADDLE DETAIL FOR CORRECT PADDLE LENGTH.
4. FLOW SWITCH, PADDLE & COUPLING SUPPLIED BY SASKATOON BOILER MFG. CO. LTD.  
PIPING, VENT CONNECTION AND INSTALLATION BY OTHERS.

OWNER: NORTHERN BLIZZARD RESOURCES INC.  
MORGAN 10-34-51-04 W4M BATTERY, AB.  
MODEL: OTS-G150W

FLOW SWITCH QTY: ONE

**SASKATOON BOILER MFG. CO. LTD.**

2011 QUEBEC AVE., SASKATOON, SASKATCHEWAN, S7K 1W5

FLOW SWITCH INSTALLATION FOR LIQUID SERVICE HEATERS

DWG BY: MIKE ROWE

CHKD BY:

NS

DATE: 18 NOV 10

SCALE: NONE

REV: 0

DWG: B156A

JOB: 10-32

**SASKATOON BOILER MFG. CO. LTD.**  
**2011 QUEBEC AVENUE, SASKATOON, SK CANADA S7K 1W5**  
**Telephone (306)-652-7022      Fax (306)-652-7870**  
**E-mail: ca@saskatoonboiler.com      Web Site: www.saskatoonboiler.com**

*Job: 10-32, Model: OTS-G150W*  
*Owner: Northern Blizzard Resources Inc., AB*

## **FIELD START-UP REQUIREMENTS**

### **FOR LIQUID SERVICE BOILERS**

**Only personnel employed by Saskatoon Boiler Mfg. Co. Ltd. or its designated agents shall perform start-up. Start-up will not be performed without written permission from the owner or their agent.**

**Local Regulations and applicable Code requirements apply. It is important that the following items are completed and checked before the Saskatoon Boiler Representative arrives on site to start-up the boiler. A copy of this document must be given to field personnel who are responsible for the following:**

#### **POWER SUPPLY**

- Power supply must be checked to ensure it matches that shown on the boiler front door stamping (boiler customer drawing may be used for reference). A fused disconnect power supply is to be connected to the applicable terminals in the entrance box only of the boiler. DO NOT connect power supply to the control panel.
- Remote and flow interlock devices shall be connected to the applicable terminals in the entrance box of the boiler.

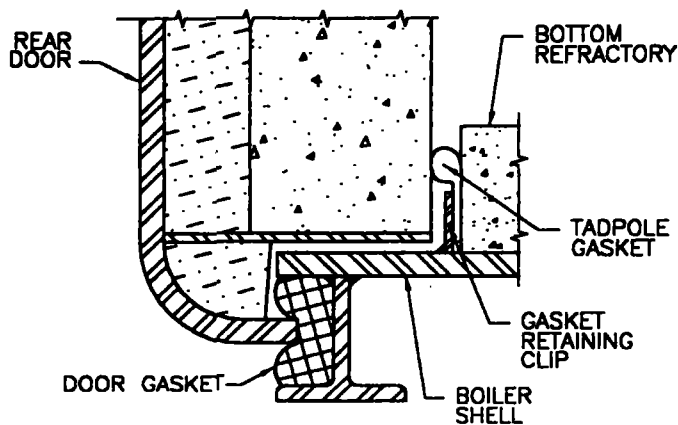
#### **FUEL SUPPLY**

- The owner's gas supply regulators must be checked to determine that they are capable of supplying sufficient gas for the boiler as per the volume requirement of the boiler front door stamping (boiler customer drawing may be used for reference).
- Gas supply pressure must be checked to ensure the maximum pressure does not exceed that indicated for the gas inlet pressure shown on the boiler customer drawing(s). Sufficient gas pressure relief valve(s) must be incorporated in the owner's gas supply train if required.
- Gas train venting must be completed and must meet local regulations and Code requirements.
- The gas supply system must be purged up to the boiler.
- A suitable lubricated plug valve in the owner's gas supply system is recommended to isolate the boiler package.
- Any required gas vent lines from the gas train to the atmosphere are by the customer.

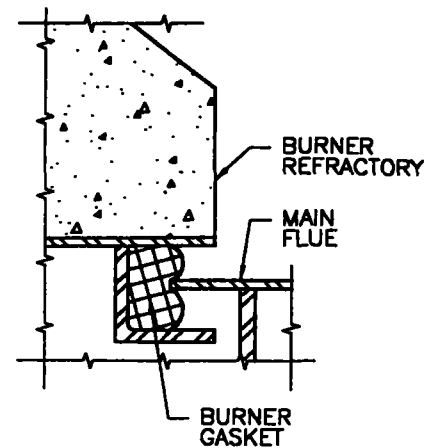
#### **LIQUID SERVICE BOILERS**

- The system must be filled with liquid.
- All air must be bled from the system (except as required for the expansion tank).
- The flow switch(s) must be visually checked to be certain the paddle is not binding and is the proper length to activate the flow switch when the circulation pumps are turned on and off.
- Circulation must be established and maintained for a minimum of 24 hours prior to the startup date.
- All strainers must be checked to ensure all foreign matter is removed from the system.
- Sufficient load must be available to operate the boiler at it's maximum firing rate.

## DOOR & REAR BAFFLE GASKET INSTALLATION FOR OTS MODELS 40 TO 150HP

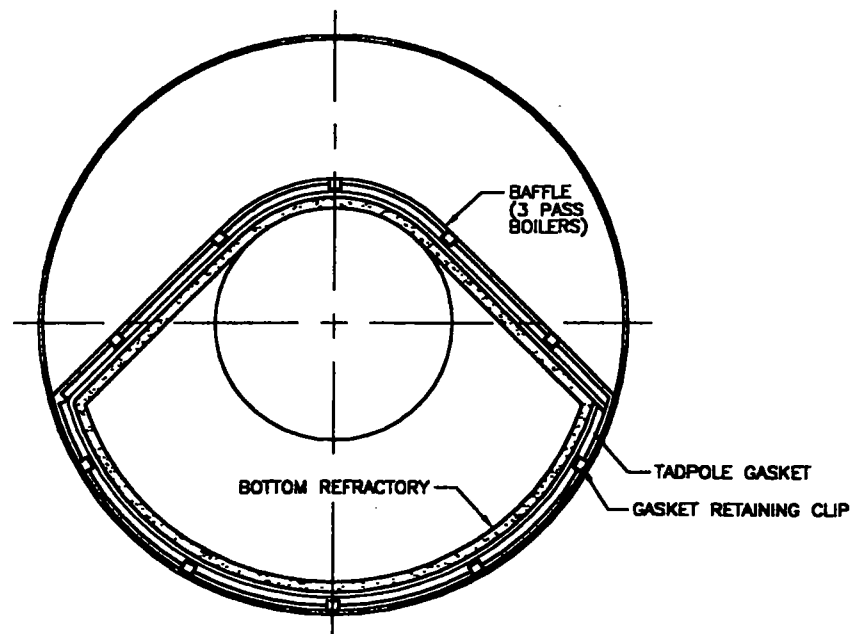


REAR DOOR GASKET SECTION VIEW  
(FRONT DOOR TYPICAL EXCEPT FOR TADPOLE GASKET)



FRONT DOOR BURNER GASKET

1. USE APPROVED DOOR GASKET ONLY (AVAILABLE FROM FACTORY). REMOVE EXISTING DOOR GASKET. INSTALL NEW DOOR GASKET INTO GROOVE. TRIM EXCESS GASKET AS REQUIRED. SEE INSTRUCTIONS BELOW FOR TADPOLE GASKET PROCEDURE (REAR DOOR ONLY).
2. CLOSE BOILER DOOR AND TIGHTEN DOOR BOLTS EVENLY. START BURNER, CHECK DOOR AND TIGHTEN DOOR BOLTS AS NECESSARY TO STOP FLUE GASES FROM LEAKING PAST THE DOOR GASKET.

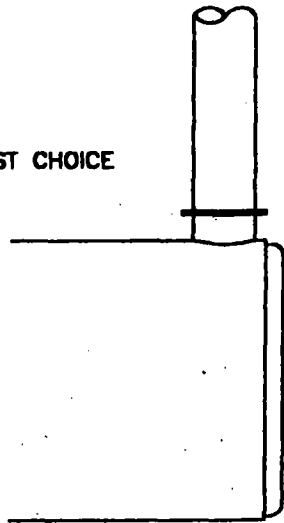


REAR BAFFLE SEALING INSTRUCTIONS, BOILER REAR VIEW  
(DOOR OPEN)

WHENEVER THE REAR DOOR HAS BEEN OPENED, ENSURE THAT THE REAR BAFFLE GASKET IS IN GOOD SHAPE TO AVOID OVERHEATING OF ADJACENT AREA OF THE BOILER SHELL AND DOOR.

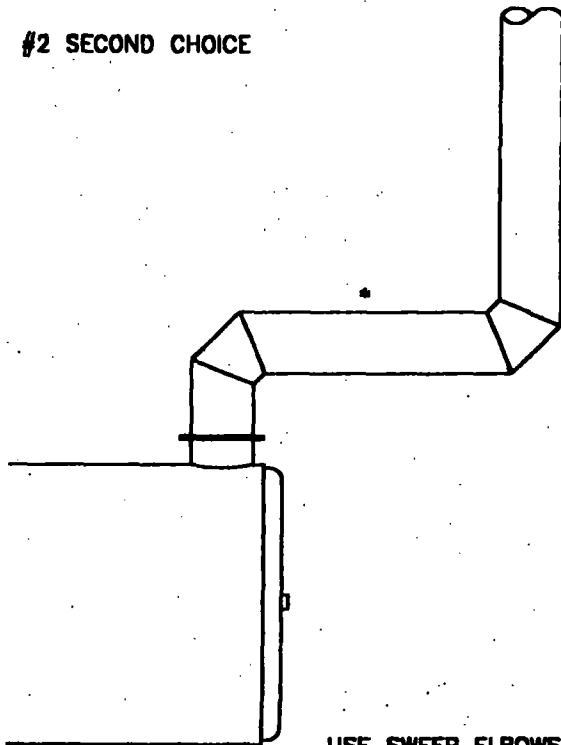
1. REMOVE OLD TADPOLE GASKET BY BENDING ALL TADPOLE GASKET RETAINING CLIPS OUT SLIGHTLY AND PULLING OUT ENTIRE OLD GASKET.
2. BRUSH SURFACES CLEAN OF OLD GASKET AND ANY FOREIGN MATERIAL.
3. INSTALL NEW TADPOLE GASKET BY SLIDING THE FLAT AREA OF THE GASKET BEHIND THE GASKET RETAINING CLIPS. CUT THE NEW TADPOLE GASKET MATERIAL TO LENGTH AS REQUIRED. BEND THE GASKET RETAINING CLIPS BACK TO HOLD THE TADPOLE GASKET IN PLACE.
4. CLOSE BOILER DOOR AND TIGHTEN DOOR BOLTS EVENLY. START BURNER, CHECK DOOR AND TIGHTEN DOOR BOLTS AS NECESSARY TO STOP FLUE GASES FROM LEAKING PAST THE DOOR GASKET.

#1 FIRST CHOICE



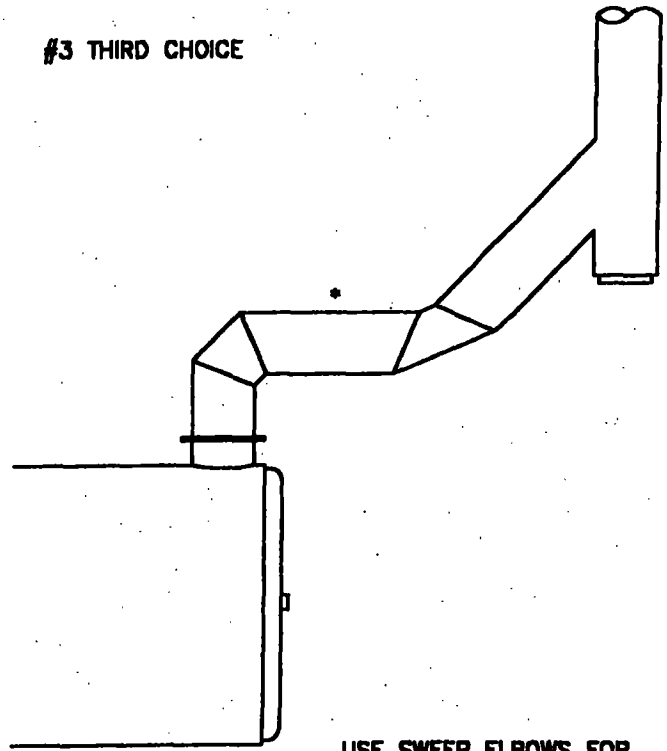
MOUNT STACK STRAIGHT UP FROM BOILER

#2 SECOND CHOICE



USE SWEEP ELBOWS FOR  
CONNECTION TO OFF-SET  
STACK.

#3 THIRD CHOICE



USE SWEEP ELBOWS FOR  
CONNECTION TO OFF-SET  
STACK.

\* NOTE: KEEP HORIZONTAL RUN SHORT AS POSSIBLE

**SASKATOON BOILER MFG. CO. LTD**

2011 QUEBEC AVENUE, SASKATOON, SASK, S7K 1W5

**STACK INSTALLATION**

DWG BY: C SVENSRUD

CHKD BY:

DATE: 07 NOV 01

SCALE: NTS

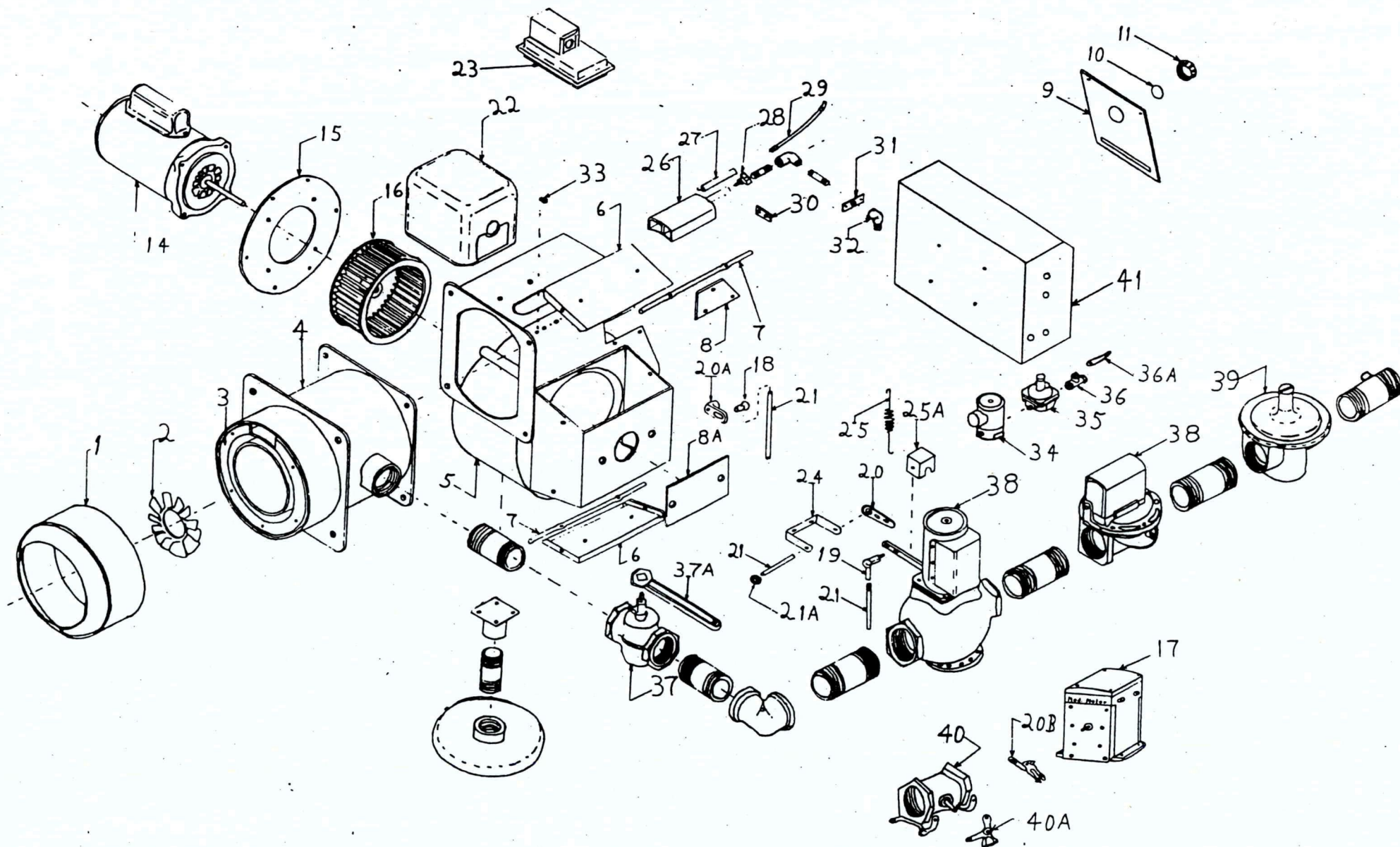
REV:

DWG: SK-1359

JOB:

<b>"CG" Burner Parts List</b> (see Exploded View)			
1	End Cone	36	Pilot Cock
2	Spinners for Modulating Burners	37	Full Port Lubricated Gas Cock
3	Baffle Ring	38	Gas Valve(s)
4	Blast Tube with Mounting Flange	39	Gas Pressure Regulators
5	Blower Housing	40	Butterfly Valve
6	Damper Blade	41	Panel Box
7	Damper Rod		
8	Side Cover Plate for Housing		
9	Rear Cover Plate for Blower Housing		
10	Sight Glass		
11	Sight Glass Nut		
14	Motor 3450 RPM		
15	Motor Mounting Flange		
16	Blower Wheel		
17	Modulating Motor		
18	Ball Joint for Linkage – straight type		
19	Ball Joint for Linkage – Angle Type		
20	Operating Arm		
21	Connecting Rods		
22	Ignition Transformer		
23	Air Switch		
24	Cross Shaft Mounting Bracket		
25	Gas Valve Linkage Spring		
25A	Damper Weight for Gas Valve Linkage		
26	Pilot Body		
27	Ignition Electrode		
28	Pilot Orifice		
29	Ignition Cable		
30	Electrode Holder		
31	Pilot Set Plate		
32	Brass Elbow (Male to Female)		
33	Insulating Bushing		
34	Pilot Gas Valve		
35	Pilot Regulator		





POOR QUALITY

FUEL-MASTER Corporation Limited	by PAGarrett's
Type "CG"- Exploded View	April 73
	FM 73-292-A



Job 10-32  
OTS-150W

FORM H-2 MANUFACTURER'S DATA REPORT FOR ALL TYPES OF BOILERS  
EXCEPT WATERTUBE AND THOSE MADE OF CAST IRON  
As Required by the Provisions of the ASME Code Rules, Section IV

ABSA  
A# A607657

1. Manufactured and certified by Saskatoon Boiler Mfg. Co. Ltd., 2011 Quebec Avenue, Saskatoon, SK, S7K 1W5  
(name and address of manufacturer)
2. Manufactured for Northern Blizzard Resources Inc., 5301 - 62nd Street, Lloydminster, AB, T9V 2E5  
(name and address of purchaser)
3. Location of installation Northern Blizzard Resources Inc., Morgan 10-34-51-04 W4M Battery, AB  
(name and address)
4. Unit Identification Marine Boiler 7119 U1463.23 B1659C(r0) 477 2011  
(complete boiler, superheater, waterwall, economizer, etc.) (manufacturer's serial no.) (CRN) (drawing no.) (National Bd. no.) (year built)
5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction, and workmanship conform to ASME Code, Section IV, 2007 - A09  
(year) (addenda (as applicable)(date)) (Code Case no.)
- Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of this report None

- (name of part, item number, manufacturer's name, and identifying stamp)
6. Shells or drums 1 SA-516-70 0.3125" 60" 105" TS/TS ---- ----  
(no.) (material spec., gr.) (thickness) (inside diameter) (length (overall)) (inside diameter) (length (overall))
7. Joints Double Butt Welded 85% Double Butt Welded Two  
(long. (seamless, welded)) (eff. (compared to seamless)) (girth (seamless, welded)) (no. of shell courses)
8. Tubesheet SA-516-70 0.75" Tube holes 148 x 2.025"  
(material spec., grade) (thickness) (number and diameter)
9. Tubes: No. SA-178-A Straight Diameter 2" Length 105.5" Gauge 0.095" mw  
(material spec., grade) (straight or bent) (if various, give max. and min.) (or thickness)
10. Heads None  
(material spec. no.) (thickness) (flat, dished, ellipsoidal) (radius of dish)
11. Furnace SA-53-B 0.50" Nom. 1 24" OD 105" Pressure Zone 105.75" Plain Seams ERW  
(material spec., gr.) (thickness) (no.) (size (O.D. or W x H)) (length (each section)) (total) (type (plain, corrugated, etc.)) (type (seamless, welded))
12. Staybolts None  
(no.) (size (diameter)) (material spec., gr.) (size) (tail/ale) (net area) (pitch (horizontal and vertical)) (MAWP)
13. Stays or braces:

Location	Material Spec.	Type	Number and Size	Pitch	Total Net Area	Fig. HG-343 L/I	Dist. Tubes to Shell	MAWP
(a) F.H. above tubes	SA-36	Through	2 of 1.75"	11"	4.81 sq in	1.0	14"	160 psig
(b) R.H. above tubes	SA-36	Through	2 of 1.75"	11"	4.81 sq in	1.0	14"	160 psig
(c) F.H. below tubes	-----							
(d) R.H. below tubes	-----							
(e) Through stays	SA-36	Through	10 of 1.0"	7.188"	7.85 sq in	1.0	---	160 psig

14. Other parts: 1. Water Baffle Top & Btm Plates 2. Water Baffle Cap 3. -----  
(brief description, i.e., dome, boiler piping)
1. SA-516-70, 11.625" x 74.688" Lg, 0.50"T, 15 psig Steam, 160 psig Water
2. SA-516-70, 3.313" x 74.688" Lg, 0.375"T, 15 psig Steam, 160 psig Water
3. -----  
(material spec., grade, size, material thickness, MAWP)

15. Nozzles, inspection, and safety valve openings:

Purpose (inlet, outlet, drain, etc.)	No.	Diameter or Size	Type	How Attached	Material	Nominal Thickness	Reinforcement Material	Location
Handhole	8	2.75"x 3.5"	Oround	Bolted	NA	0.75" Cover	NA	Shell & TS
Manhole	None							
Outlet	1	6" 150#	RFSO	Welded	SA-106-B	0.280"	SA-516-70	Shell
Inlet	1	6" 150#	RFSO	Welded	SA-106-B	0.280"	SA-516-70	Shell
Safety Valve	1	2"	NPT Cplg	Welded	SA-105	3000#	NA	Shell
Drain	1	1-1/2"	NPT Cplg	Welded	SA-105	3000#	NA	Shell
Various	11	2" to 3/4"	NPT Cplg	Welded	SA-105	3000#	NA	Shell



## FORM H-2 (Back)

16. Boiler supports 2 Saddles Welded  
 15 psig steam (no.) (type (saddles, legs, lugs)) (attachment (bolted or welded))  
 17. MAWP 160 psig water Based on HW-701.3b Heating surface 707 sq. ft. Shop hydro. test 240 psig  
 (Code par. and/or formula) (total) (complete boiler)  
 18. Maximum water temperature 250 deg F  
 19. Remarks Handhole Covers: Saskatoon Boiler Mfg. Co. Ltd. 300 psig at 422 deg F, CRN 0H0655.324T157.

## CERTIFICATE OF SHOP COMPLIANCE

We certify that the statements made in this data report are correct and that all details of design, material, construction, and workmanship of this boiler conform to Section IV of the ASME BOILER AND PRESSURE VESSEL CODE.

"H" Certificate of Authorization no. 7904 expires 28 February, 2012  
 Date 9 FEB 2011 Signed [Signature] Name Saskatoon Boiler Mfg. Co. Ltd.  
 (by representative) (manufacturer that constructed and certified boiler)

## CERTIFICATE OF SHOP INSPECTION

Boiler constructed by Saskatoon Boiler Mfg. Co. Ltd. at Saskatoon, Saskatchewan, Canada  
 I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the state or province of Saskatchewan and employed by Technical Safety Authority of Saskatchewan  
4, 6-11, 13-19 have inspected parts of this boiler referred to as data items 4, 6-11, 13-19 and have examined Manufacturers' Partial Data Reports for items 4, 6-11, 13-19 and state that, to the best of my knowledge and belief, the manufacturer has constructed this boiler in accordance with the applicable sections of the ASME BOILER AND PRESSURE VESSEL CODE.

By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the boiler described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 9 Feb 2011 Signed [Signature] Commissions SK/057 12287ANB  
 (Authorized Inspector) (National Bd. (incl. endorsements), state, prov., and no.)

## CERTIFICATE OF FIELD ASSEMBLY COMPLIANCE

We certify that the field assembly construction of all parts of this boiler conforms with the requirements of Section IV of the ASME BOILER AND PRESSURE VESSEL CODE.

"H" Certificate of Authorization no. \_\_\_\_\_ expires \_\_\_\_\_  
 Date \_\_\_\_\_ Signed \_\_\_\_\_ Name \_\_\_\_\_  
 (by representative) (assembler that certified and constructed field assembly)

## CERTIFICATE OF FIELD ASSEMBLY INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the state or province of \_\_\_\_\_ and employed by \_\_\_\_\_

\_\_\_\_\_ have compared the statements in this Manufacturer's Data Report with the described boiler and state that the parts referred to as data items \_\_\_\_\_, not included in the certificate of shop inspection, have been inspected by me and that to the best of my knowledge and belief the manufacturer and/or the assembler has constructed and assembled this boiler in accordance with the applicable sections of the ASME BOILER AND PRESSURE VESSEL CODE. The described boiler was inspected and subjected to a hydrostatic test of \_\_\_\_\_.

By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the boiler described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date \_\_\_\_\_ Signed \_\_\_\_\_ Commissions \_\_\_\_\_  
 (Authorized Inspector) (National Bd. (incl. endorsements), state, prov., and no.)

**SASKATOON BOILER MFG. CO. LTD.**

**FACTORY INSPECTION AND FIRE TEST REPORT - GAS FIRED** JOB NUMBER 10-32

USER: NORTHERN BLIZZARD RESOURCES INC.

TEL: OTS-G 150 W SERIAL NO. 7119 ULC NO: AR530050

PROGRAMMER: MODEL NO. E110, EP160, ED510, EUV1 SERIAL NO: 1046-04

BLOWER MOTOR: MODEL NO. BROOKS S/N ILL2285 TYPE: \_\_\_\_\_ FRAME: W-DA184T-S

VOLTS: 480 PH: 3 HP: 7.5 RPM: 3460 AMPS: 8.6 SF: 1.15

MAGNETIC STARTER: CT16 HEATERS: TI16C 8-12 AMPS

FIRE TESTS	LOW	HIGH
Comb Eff%	<u>86.5</u>	<u>82.3</u>
Stack Temp	<u>213</u>	<u>366</u>
O <sub>2</sub> %	<u>5.7</u>	<u>5.2</u>
CO PPM	<u>3</u>	<u>53</u>
CO <sub>2</sub> %	<u>8.6</u>	<u>8.9</u>
Nox PPM	<u>61</u>	<u>49</u>
Input- CFH	<u>1200</u>	<u>6276</u>

BURNER MODEL CRG-165-2  
 S/N 1110-405  
 WATER PUMP MODEL ULC # 95  
 S/N \_\_\_\_\_  
 VOLTS \_\_\_\_\_  
 AMPS \_\_\_\_\_  
 STARTER \_\_\_\_\_  
 HEATER \_\_\_\_\_

CONTROL TESTS	
Hi Limit MR.	<u>OK</u>
Opr Cont	<u>OK</u>
Mod Cont	<u>OK</u>
Lwco # 1	<u>OK</u>
Lwco # 2	<u>—</u>
Flame Monitor	<u>OK</u>
Air Sw	<u>OK</u>
Low Fire Sw	<u>OK</u>
Hi Gas SW	<u>OK 28"</u>
Low Gas SW	<u>OK 12"</u>
Flow SW	<u>✓</u>
Hi Water	<u>—</u>
Ind Lites	<u>OK</u>
Alarms	<u>✓</u>
Dielectric Test	<u>OK</u>
Remote S.D.	<u>✓</u>
Gas Leaks	<u>NIL</u>

**PRESSURES**

	LOW	HIGH
Inlet <sup>gas</sup> psi	<u>5</u>	<u>5</u>
Reg <sup>gas</sup> psi	<u>1.0</u>	<u>0.9</u>
Gas Train "wc"	<u>24.5</u>	<u>17.4</u>
Manifold "wc"	<u>0.2</u>	<u>7.3</u>
Wind Box "wc"	<u>0.3</u>	<u>8.6</u>
Comb "wc"	_____	_____
Pilot "wc"	<u>4.2</u>	_____
Amps Blower	<u>4.7</u>	<u>7.8</u>
Amps Water Pump	<u>—</u>	<u>—</u>
Boiler Temp	<u>240</u>	Pressure <u>13</u> Purge Time <u>60</u>

Air Band 3/4" DIFF PL. Gas Head 1/2" IN Orifice Size 57 X 13/64 Ign Funnel \_\_\_\_\_ Baffle Plate 3" Choke Ring \_\_\_\_\_

AIR BAFFLE 10 7/8 ODX 8 5/8 ID, GAS SPREADING SOLID 8 3/8 ODX 7 1/8 ID

DIFF. PLATE SCOTCH 6 3/8 ODX 3 1/4 ID C/W 4.6 MM HOLES

IS BOILER HAS HONEYWELL MODULATING GAS VALVE

COMPLETED BY: Tygarman/Kelmers DATE: FEB 18/11

# SASKATOON BOILER MFG. CO. LTD.

Job #10-32

Date: March 14, 2011

**SPARE PARTS LIST FOR:** Northern Blizzard Resources, Lloydminster, AB

**BOILER MODEL:** OTS-G150W

**SERIAL NO:** 7119

The spare parts have been divided into three categories as follows:

**RM** - Routine Maintenance - Items which should be on site

**CO** - Items which should be stocked for Critical Operation

**RL** - Remote Locations - items to be stocked, where locations are more than a few hours delivery from Saskatoon

**Burner:** **CRG-165-2 S/N 1110-405**

RM	CO	RL	ITEM	PRICE
X				
X			Electrodes (set)	WP478C
X			Fuses	10 amp
X			Lubricant for plug valves	(3) 3/8" lube sticks
X			Inspection opening gaskets	(8) 2 1/2" x 3 1/2" OB
X			Rear Baffle Gasket	13 ft. Tadpole Tape
X			Burner Gasket	7' - 1 1/4" Rope
	X		Refractory Cement	6# Kel Seal
	X		Programming control	E110-ED510-EP160-EUV1
	X		Hi Limit Control	L4008E1040 Man.
	X		Operating Control	T775M 2048
	X		Modulating Control	T77M 2048
	X		Modulating Motor	M9484F001
	X		Low Level Control	3E2C
	X		Pump Control	N/A
	X		Linkage Arms	(2) 3 1/2" Lg.
	X		Rod Ends	(2) 1/4"
	X		Air Switch	AFS-A
	X		Safety Valve	9.9 x 5 x 1 1 Kunkle 927 set at 160 psi
		X	Blower Fan Wheel (1) set	10.6 x 4.5 x 1-1/8" Bore
		X	Door Gaskets	34 ft.
		X	Ignition Transformer	1092F
		X	Scanner Assembly	UV1A-6
		X	Pilot Solenoid Valve	(2) V4046C 1054 - 3/8"
		X	Main Gas Valve Actuator	(2) V4055D 1019
		X	Main Gas Valve Body	(2) V5055C 1000 & V5055A 1038
		X	Blower Motor	7 1/2 HP. 480V-3-60
X			Burner Refractory	SBM
			Rear Sight Glass	#B-1740-5
			Valve	Honeywell 1 1/2" V51E 1000
<b>FOR GAS/OIL OR OIL FIRED BOILERS</b>				
X				N/A
X			Oil Nozzles	N/A
X			Cartridge for Oil Filter	N/A
X			Filter for air compressor	N/A
	X		Belts (set)	N/A
		X	Air compressor	N/A
		X	Oil Solenoid Valve	N/A
		X	Oil Pump	N/A
		X	Compressor &/or Pump motor	N/A
			Changeover switch	

Prices listed are effective for 30 days only, from date issued, FOB factory, Saskatoon  
All applicable taxes extra

**SK-1068**



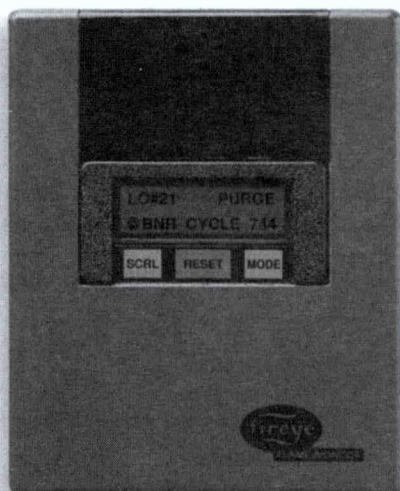
## **APPENDIX**

**Following are specific operating and maintenance instructions for various components associated with the burner. This is information given by manufacturers for the specific components which they make that are incorporated as part of the burner. The instructions should be followed in detail unless other instructions in this manual specifically exclude this.**





E-1101  
MAY 19, 2008



E110 with ED510 Display Module

## E110 FIREYE FLAME-MONITOR™

**BURNER MANAGEMENT CONTROL  
FOR USE WITH THE  
MICROPROCESSOR-BASED  
EP AND EPD STYLE  
PROGRAMMER MODULES**



### DESCRIPTION

The Fireye® E110 FLAME-MONITOR™ System is a microprocessor based burner management control system designed to provide the proper burner sequencing, ignition and flame monitoring protection on automatically ignited oil, gas, and combination fuel burners. In conjunction with limit and operating controls, it programs the burner/blower motor, ignition and fuel valves to provide for proper and safe burner operation. The control also provides current operating status and lockout information in the event of a safety shutdown. The manner in which this information is displayed is dependent on the type of programmer (EP or EPD) and display module (ED510 or ED500).<sup>\*</sup> Refer to Flame-Monitor PROGRAMMER SELECTION later in this document for the various combinations of programmer and display modules.

The E110 consists of the EB700 chassis, dust cover, and shortened mounting screw (P/N 48-1836). The display module (ED510), if required, must be ordered separately. Interchangeable programmer and flame amplifier modules allow for complete versatility in selection of control function, timing, and flame scanning means. Functions such as pre-purge, recycling interlocks, high fire proving interlock, and trial for ignition timing of the pilot and main flame are determined by the programmer module. The E110 Flame-Monitor can be used with ultra-violet, auto-check infrared, flame rod, or self-check ultraviolet flame scanners by choosing the proper amplifier module.

The eighteen (18) terminal wiring base allows for many functional circuits including motors, valves, and ignition transformers as well as multiple interlocks such as high purge, low purge, fuel valve and running interlock circuits. The E110 uses the same wiring base as the Fireye E100 Flame-Monitor control, D Series and C Series Controls and is directly interchangeable with most models without rewiring.

Additional functions of the Flame-Monitor system include:

- A non-volatile memory which allows the control to remember its history and present position even when power is interrupted.
- A constant flame signal read-out via display module or 0-10 VDC output (EPD programmers only).
- Read-out of main fuel operational hours and complete cycles via display module.
- Modbus communications via RS485 multi-drop link.
- Dipswitches located on the EP programmer to allow selectable purge time.
- A run/check switch which allows the operator to stop the program sequence in any of three different positions (Purge, PTFI, or Auto).
- Remote Display Capability.
- Annunciate 16 additional interlocks using E300 Expansion Module.

<sup>\*</sup> The ED500 display was the predecessor of the ED510 display and uses an older design. It does not have the latest features of the ED510 display module.



**CAUTION:** While programmers are mechanically interchangeable in that they mate with a common wiring base, you should select the correct model for your application. Inappropriate application of a control could result in an unsafe condition hazardous to life and property. Selection of a control for a particular application should be made by a competent professional, such as a boiler/burner service technician licensed by a state or other government agency.

## FLAME-MONITOR SPECIFICATIONS

### Supply Voltage:

**E110:** 120 VAC (+10%, -15%) 50/60 Hz

**E120:** 220 VAC (+10%, -15%) 50/60 Hz

### Power Consumption: 25 VA

**Shipping Weight:** (E110 Approx.) 5 lbs. (2.3kg)

### OPERATING TEMPERATURE LIMITS

CONTROL	MAXIMUM		MINIMUM	
E110, E120, EB700, EB701	140°F	60°C	- 40°F	- 40°C
EP, EPD Programmers	140°F	60°C	- 40°F	- 40°C
All Amplifiers	140°F	60°C	- 40°F	- 40°C
ED510 Display	140°F	60°C	32°F	0°C
Scanner UV1A, UV2, UV8A, 45UV3, UV90	200°F	93°C	- 40°F	- 40°C
45UV5-1007, 45UV5-1009	200°F	93°C	- 40°F	- 40°C
Flame Rod (Tip 2460 F)	1500°F	816°C	- 40°F	- 40°C
48PT2	140°F	60°C	- 40°F	- 40°C
Humidity: 85% R.H. (Non-condensing)				

### LOAD RATINGS

TERMINAL	TYPICAL LOAD	A. Maximum Rating @120V-50/60Hz	B. Alternate Rating @120-50/60Hz
5, 6 Individually or Combined	Pilot Valve(s) and Ignition Transformer(s)	50VA Pilot Duty (Solenoid Valves) plus 500VA (Transformer)	125VA Pilot Duty Solenoid Valves plus 250VA (Transformer)
7	Main Fuel Valve(s)	250VA Pilot Duty (Solenoid Valve)	1250 VA Opening 500 VA Holding (Motorized Valve) plus 65 VA Pilot Duty (Solenoid Valve)
M	Burner/Blower Motor	9.8 F.L.A. * 58.8 L.R.A.	240 VA Pilot Duty (Motor Starter Coil)
10-11-12-X	Modulator	125 VA Pilot Duty	
A	Alarm	50 VA Pilot Duty	
Terminal ratings may be selected from either column A or B: (select the rating from the column for each terminal which best applies to the connected load on that terminal).			
* F.L.A. = full load amps L.R.A. = locked rotor amps			

**Maximum Simultaneous Connected Load: 2000 VA**



## ELECTRICAL RATINGS

*VA* ratings (not specified as pilot duty) permit the connection of transformers and similar devices whose inrush current is approximately the same as their running current.

*VA Pilot Duty* ratings permit the connection of relays, solenoid valves, lamps, etc. whose total operating load does not exceed the published rating and whose total inrush current does not exceed 10 times the rating.

*Running and locked rotor* ratings are intended for motors. *VA* and *VA Pilot Duty* loads may be added to a motor load provided the total load does not exceed the published rating.



**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 contact be required to handle inrush current more often than once in 15 seconds. The use of control switches, solenoid, 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 known instance of chattering of any external current consuming devices.

## APPROVALS

**Underwriters Laboratories Inc.:**

MCCZ File MP 1537

Controls, Primary Safety - Listed

MCCZ2 File MP1537

Controls, Primary Safety - Component

MCCZ7 File MP1537

Controls, Primary Safety Certified for Canada

MCCZ8 file MP1537

Controls, Primary Safety Certified for Canada - Component

**Acceptable by:** Industrial Risk Insurers (I.R.I.)

Factory Mutual Approved

*Note: E120 is FM approved only.*



**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 required to take whatever measures which may be required to correct the interference.



## APPLICABLE BULLETINS

E120, Flame-Monitor Chassis, 220 VAC Operation, FM approved	E-1201
Programmers, Non-Recycle Operation	EP-1601, EPD-1601
Programmers, Recycle Operation	EP-2601, EPD-2601
Programmers, Non-Modulating	EP-3801, EPD-3801
Amplifiers	EAMP1
Display, ED510	ED-5101
Expansion Module	E-3001

All bulletins are available in .pdf format at [www.fireye.com](http://www.fireye.com).

## FLAME AMPLIFIER SELECTION

FIREYE P/N	DESCRIPTION	USE WITH SCANNER
EUV1	Standard UV Amplifier	UV1A, UV8A 45UV3, UV2
E1R1	Autocheck Infrared Amplifier	48PT2
E1R2	Autocheck Infrared Amplifier (For special applications - high sensitivity—consult factory)	48PT2
E1R3	Autocheck Infrared Amplifier. (Without oil fog rejection spray circuitry.)	48PT2
ERT1	Rectification Amplifier	69ND1
EUVS4	Self-Check UV Amplifier	45UV5-1007/1008/1009

## SCANNER SELECTION

FIREYE P/N	DESCRIPTION	USE WITH SCANNER	BULLETIN
48PT2-1003 48PT2-9003 48PT2-1007 48PT2-9007 4-263-1	Infrared 1/2" straight mount 96" cable Infrared 1/2" 90° angle mount 96" cable Infrared 1/2" straight mount 48" cable Infrared 1/2" 90° angle mount 48" cable Replacement photo detector	E1R1, E1R2, or E1R3	SC-103
UV1A3 UV1A6 UV8A UV2 UV2A6 45UV3-1050 UV90-3 UV90-6 UV90-9	UV 1/2" straight 36" flex conduit UV 1/2" straight 72" flex conduit UV 1/2" 90° head 72" unshielded leads UV 3/8" straight 36" flex conduit UV 3/8" straight 72" flex conduit UV 3/4" cast aluminum housing 8' cable UV 90° lateral view with 36" flex conduit UV 90° lateral view with 72" flex conduit UV 90° lateral view with 108" flex conduit	EUV1	SC-102
69ND1-1000K4 69ND1-1000K6 69ND1-1000K8	Flame rod 12", 1/2" N.P.T. mount Flame rod 18", 1/2" N.P.T. mount Flame rod 24", 1/2" N.P.T. mount	ERT1	SC-103
45UV5-1007 45UV5-1008 45UV5-1009 4-314-1	Self-check UV 1" British thread mounts, 230V Self-check UV 1" British thread mounts, 120V Self-check UV 1" N.P.T. threads, 120V Replacement UV tube	EUVS4	SC-101



## **FIREYE® FLAME-MONITOR™ Selection Guide**

### **1. SELECT CHASSIS**

E110 FLAME-MONITOR, 120 VAC operation

E120 FLAME-MONITOR, 220 VAC operation

### **2. SELECT PROGRAMMER**

EP Programmers provide selectable operation (e.g. extended purge time)

EPD programmers have integral LED indicator display.

NON-RECYCLE OPERATION		RECYCLE OPERATION		DESCRIPTION	NON-MODULATION		DESCRIPTION
EP160	EPD160	EP260	EPD260	10 and 15 sec. TFI	EP380, EP387, EPD380		30 sec. purge
EP161	EPD161	EPD261		Extended MTFI	EP381	EPD381	15 sec. purge
EP165				Pilot stabilization	EP382	EPD382	1 sec. purge
EP166				Pilot stabilization			
EP170	EPD170	EP270	EPD270	Early spark termination	EP390	EP390	90 sec. purge
NOTE: The EP programmers listed above are available in both Spanish and French languages. Consult factory or your local Fireeye distributor for ordering information.							

### **3. SELECT DISPLAY**

Required for EP Programmers, Optional for EPD programmers

ED510 2 line x 16 character LCD display.

### **4. SELECT AMPLIFIER**

Requires appropriate flame scanner.

	DESCRIPTION	USE WITH SCANNER
EUV1	Standard ultra-violet amplifier	UV1A, UV2, UV8A, 45UV3, UV90
EUVS4	Self-check ultra-violet amplifier	45UV5-1007, 1008, 1009
E1R1	Autocheck infra-red amplifier	48PT2
E1R2	Autocheck infrared amplifier (with high sensitivity circuitry)	48PT2
E1R3	Autocheck infrared amplifier (without oil fog rejection circuitry)	48PT2
ERT1	Flame rectification amplifier	69ND1

### **5. SELECT WIRING BASE**

60-1386-2

Surface mount

60-1466-2

Panel mount

### **6. SELECT ACCESSORIES**

(on following page).



FIREYE P/N	DESCRIPTION	BULLETIN
ED510	Display Module (2 line x 16 characters LCD Display)	ED-5101
129-145-1, -2, -3	Remote Display Mounting Kit (for ED510) with 4', 8' or 2' cable respectively	E-8002
E350-3, -6	Expansion Module cables in 3' and 6' lengths	E-3001
ED150-3, -6, -15, -25	Remote Reset cables in 3', 6', 15' and 25' lengths	E-8001
ED600	Multi-port Cable Adapter	E-8001
ED610	Multi-port Adapter (for ED510 and RS485 communications)	E-8002
E500-3	Communication Interface (up to 6 Flame-Monitor controls)	E-5001
EC485	RS232 to RS485 converter for direct connect	EC-4851
ED512-2, -4, -8	Communications interface cables in 2', 4' and 8' lengths	E-8002
ED580-2, -4, -8	Remote display cables in 2', 4' and 8' lengths	E-8002
IT1000	Wireless communication monitor system for up to 10 Flame-Monitor Controls	INT-1000

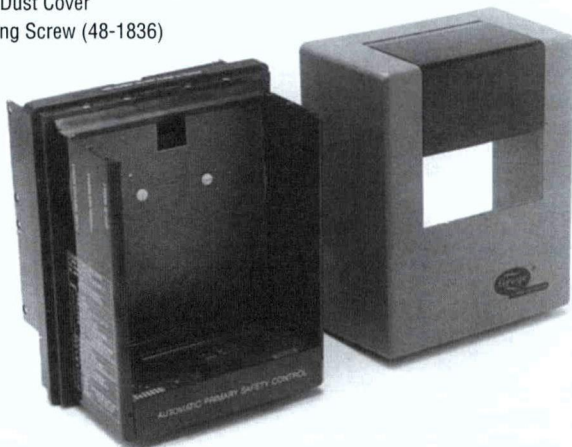




## FLAME-MONITOR Ordering Information

### E110 Flame-Monitor (One required)

E110 consists of:  
EB700 Chassis  
EC600 Dust Cover  
Mounting Screw (48-1836)



### ED510 Display Module

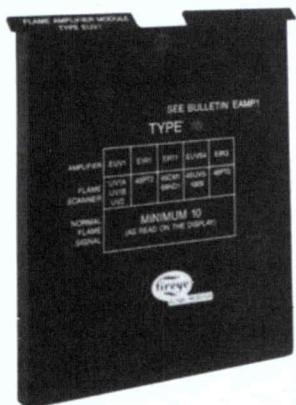
Required with EP Programmers  
Optional with EPD Programmers



EP programmers must have an Eng. code of 28 or later (e.g. 9414-28). EPD Programmers must have an Eng. code of 02 or later.

### Amplifier Module (One Required)

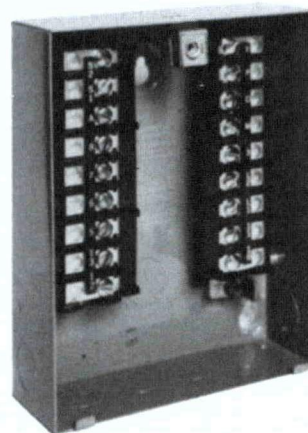
E1R1  
E1R2  
E1R3  
EUV1  
EUVS4  
ERT1



### Wiring Base (One Required)

60-1386-2  
Surface Mount  
(shown)

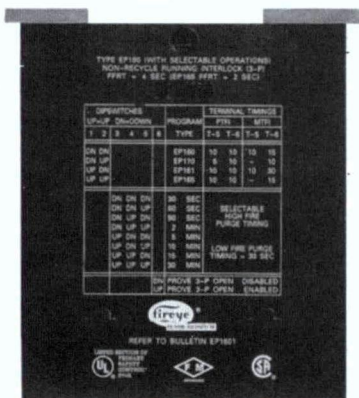
60-1466-2  
Cabinet Mount



## Programmer Module (One Required)

### EP Programmer

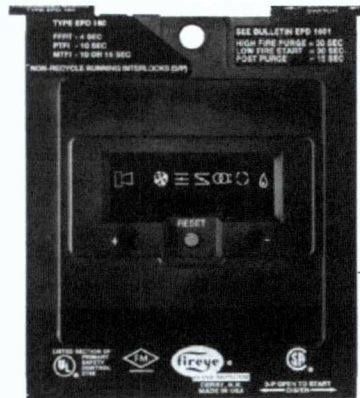
EP160  
EP161  
EP165  
EP166  
EP170  
EP260  
EP265  
EP270  
EP380  
EP381  
EP382  
EP387  
EP390



or

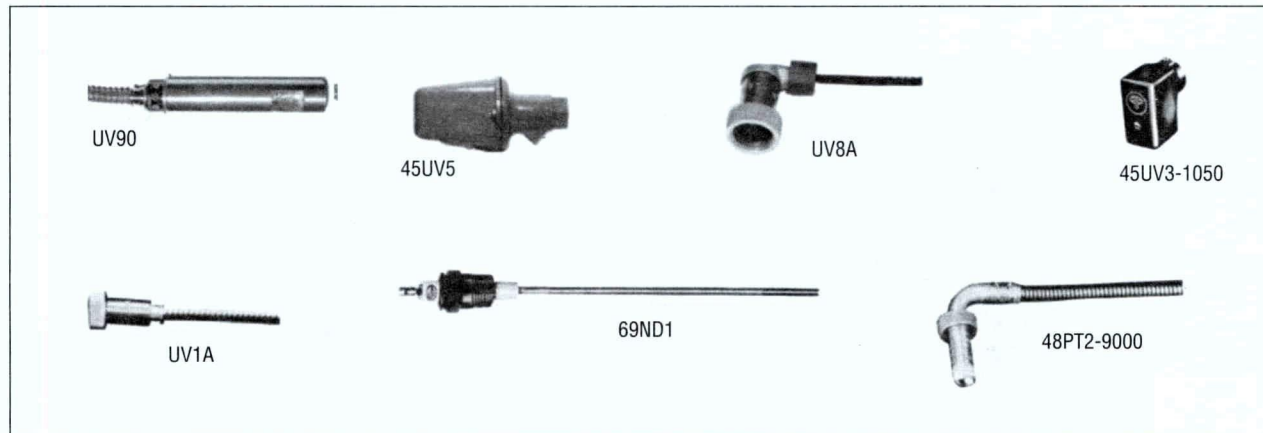
### EPD Programmer

EPD160  
EPD161  
EPD167  
EPD170  
EPD260  
EPD261  
EPD270  
EPD380  
EPD381  
EPD382  
EPD390





## FLAME SCANNERS



**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 (EUVS4), or the infrared flame scanner (48PT2) with associated Auto Check amplifier (E1R1, E1R2, E1R3).

## FLAME-MONITOR PROGRAMMER SELECTION

All programmers for the Flame-Monitor Series are designated with the prefix "EP" or "EPD." The functional operation, flame failure response time, purge timings, firing rate motor circuit, trial for ignition timings, recycling function and display messages are determined by the programmer.

Following is a chart of the most common programmers. Refer to the appropriate product bulletin for a detailed description of the operation of each programmer.

Take note of the programming sequence chart for each programming module for the proper explanation of pre-purge timings.



**WARNING: THE INAPPROPRIATE SELECTION OR APPLICATION OF A PROGRAMMER MODULE COULD RESULT IN AN UNSAFE CONDITION HAZARDOUS TO LIFE AND PROPERTY.** The various programmer modules (EP(D)160, EP(D)260 and EP(D)380) are interchangeable because they plug into a common chassis. Changing the dipswitches modifies the operation of each programmer module. Care should be taken to insure the proper dipswitch settings. Refer to the appropriate programmer bulletin for dipswitch settings. Selection of the programmer module and setting the dipswitches 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.



FIREYE PART NUMBER	Pre-purge program- ming (Seconds)	Proven High Fire Purge Interlock (D/8 Ckt)	Proven Low Fire Start Interlock (M/D Ckt)	Intermittent Ignition/ Pilot	Interrupted Ignition/ Pilot	Early Spark Termination	Pilot Trial-for-Ignition		Main Trial-for-Ignition		Running Interlock (3/P CKT)	Firing Rate Motor Circuit
							Term 5 Term 6	Term 5 Term 6	Term 5 Term 6			
EPD/EP <sup>2</sup> PROGRAMMERS												
EPD160 EP160 EPD167 <sup>8</sup>	30 <sup>1</sup> Supervised	Yes	Yes	No	Yes	No	10 10	10 15			Non Recycle	Yes
EPD161 EP161	30 <sup>1</sup> Supervised	Yes	Yes	No	Yes	No	10 10	10 30			Non Recycle	Yes
EP165 <sup>7</sup>	30 <sup>1</sup> Supervised	Yes	Yes	No	Yes	No	10 10	— 10 <sup>6</sup>			Non Recycle	Yes
EP166 <sup>7</sup>	30 <sup>1</sup> Supervised	Yes	Yes	No	Yes	No	10 10	— 15 <sup>6</sup>			Non Recycle	Yes
EPD170 EP170	30 <sup>1</sup> Supervised	Yes	Yes	No	Yes	Yes	5 10	— 10			Non Recycle	Yes
EPD260 EP260	30 <sup>1</sup>	No	Yes	No	Yes	No	10 10	10 15			Recycle	Yes
EPD261	30 <sup>1</sup>	No	Yes	No	Yes	No	10 10	10 30			Recycle	Yes
EPD270 EP270	30 <sup>1</sup>	No	Yes	No	Yes	Yes	5 10	— 10			Recycle	Yes
EPD380 EP380 EP387 <sup>8</sup>	30	No	Yes	Yes <sup>3</sup>	Yes	Yes <sup>4</sup>	10 10	10 Intermittent <sup>3</sup>			Recycle <sup>5</sup>	None
EPD381 EP381	15	No	Yes	Yes <sup>3</sup>	Yes	Yes <sup>4</sup>	10 10	10 Intermittent <sup>3</sup>			Recycle <sup>5</sup>	None
EPD382 EP382	0	No	Yes	Yes <sup>3</sup>	Yes	Yes <sup>4</sup>	10 10	10 Intermittent <sup>3</sup>			Recycle <sup>5</sup>	None
EPD390 EP390	90	No	Yes	Yes <sup>3</sup>	Yes	Yes <sup>4</sup>	10 10	10 Intermittent <sup>3</sup>			Recycle <sup>5</sup>	None

All programmers have a maximum 4 second Flame Failure Response Time (FFRT) with the exception of the EP165 and EP166 (2 sec. FFRT).  
All EPD Programmers and EP Programmers have selectable 3-P Proven Open to Start feature via dipswitch.

<sup>1</sup> These programmers add a 30 second waiting period to the prepurge while the firing rate motor is driven to the low fire position.

<sup>2</sup> Purge timings can be extended via dipswitches of EP style programmers.

<sup>3</sup> Selectable intermittent or interrupted (15 sec. MTFI) operation of terminal 6 via dipswitch (EP models only).

<sup>4</sup> These programmers can use terminal "X" for spark termination. This requires jumpering terminals 5 and 10 on the wiring base. PTFI timing is 5 seconds on terminal "X."

<sup>5</sup> Selectable Recycle or Non-Recycle Operation via dipswitch.

<sup>6</sup> During MTFI terminal 6 is energized for 5 seconds (pilot stabilization) before energizing terminal 7 for 10 seconds for EP165 and 15 seconds for EP166 only.

<sup>7</sup> EP165 will lockout on power interruption.

<sup>8</sup> The EPD167 and EP387 wait indefinitely for the low fire start switch (M-D) to close.

## PROGRAMMER AND DISPLAY MODULE COMPATIBILITY

All programmers for the Flame-Monitor Series are designated with the prefix "EP" or "EPD." The ED510 is a 2 line by 16 character LCD display with keypad to provide both current and historical information pertaining to the operation of the control. Refer to Bulletin ED-5101 for a complete description of the features and capabilities of the ED510 display module. The ED500 is an eight character LED display, was the predecessor to the ED510 and does not have the latest features of the ED510 display module. EP style programmers with an Engineering code of 28 or later (e.g. 9414-28) are compatible with both the ED510 and ED500 display module. EP style programmers with an Engineering code before 28 are only compatible with the ED500 display. The EPD style programmers (with an Engineering code 02 or later) are compatible with the ED510 display module as well.

**Note:** The EPD style programmers do not require a display module to function.



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

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



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

## INSTALLATION OF CONTROL

### 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 100 separately and General Grounding Rules, later in this document, for recommended 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.

Refer to suggested Wiring Diagram on page 32.



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

## BEFORE INSTALLING THE CONTROL



**CAUTION: Ensure that electric power is turned off. Refer to SN-100 for recommended grounding techniques.**

**Be aware that power to some interlocks (operating controls, air flow switches, modulating circuits, etc.) may be derived from sources other than what is controlling the Flame-Monitor.**

If either a ground or a short circuit is detected, it must be eliminated before the control is plugged into the wiring base and power turned on.

Test the electrical field wiring for short circuits and grounds. The recommended method requires the use of an ohmmeter set on its lowest resistance scale.

***Note:** When using ultra-violet or infrared scanning, be sure to remove any jumpers on the wiring base which ground the S2 terminal.*

1. Touch the meter probes together and calibrate accurately to ensure a reliable test.
2. Disconnect the neutral wire (L2) from the control system at the power source. Clip one meter test lead to the grounded green terminal on the lower right side of the wiring base and with the other probe touch each other terminal. At no time should the meters show continuity or read 0 ohms.





3. Reconnect the neutral wire (L2) at the power source. Remove the test probe from the grounded terminal and reconnect it to Terminal L2 in the wiring base. With the other probe, touch each other terminal. It is normal to obtain a resistance reading on the meter at some terminals during this test as there are resistive loads (coils, transformers, lamps, etc.) connected whose normal DC resistance may be less than 5 ohms. However, at no time should the test meter read zero ohms.



**CAUTION: Restore power for the following test.**

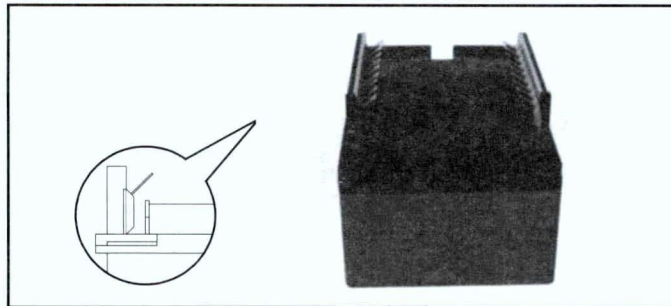
4. With Flame-Monitor removed, measure voltage from L2 to all other terminals. Reading should be zero on all terminals except L1.

## INSTALLING THE CONTROL



**CAUTION: Electric power must be turned off during installation.**

1. Check the electrical tabs on the bottom of the chassis—if they are bent out of position, reposition them with your fingers so that they are in line as shown here.



2. Select the appropriate programmer and amplifier modules for your application. Remove the dust cover from the chassis. Insert the amplifier module into the slot marked Flame Amplifier Module and gently push the module into position. Insert the programmer module into the slot marked Programmer Module and gently push the module into position. Attach the display to the program module and plug ED580-1 into RJ45 connections.
3. Slide the slots at the bottom of the assembled control over the tabs on the wiring base. Push the control into position. Insert a screwdriver through the hole in the top of the control and tighten the retaining screw.
4. Electric power may now be turned on.

## OPERATION

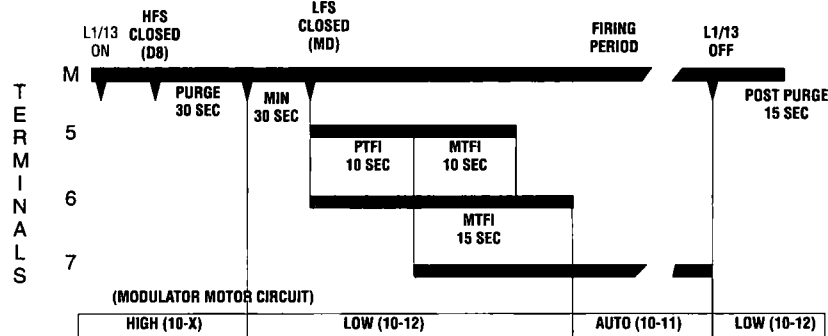
The programmer module determines the functional operation of the E110 control (e.g. purge timing, trial for ignition timings, recycle or non-recycle operation, etc.). For purposes of illustration, we will be looking at the EP160/EPD160 Programmer functions and messages associated with the ED510 display module in this bulletin. **Because the messages change depending upon which EP style programmer is being used, it is necessary to check the bulletin covering the specific programmer for exact details.** Refer to the suggestions shown in this bulletin before proceeding to power the Fireeye E110 Flame-Monitor system. Items such as scanner installation, short circuit tests and safety information should be reviewed.



## TYPE EP(D)160

NON-RECYCLE RUNNING INTERLOCKS (3/P) PURGE TIME - 30 SEC.\*  
FLAME FAILURE RESPONSE TIME 4 SEC.

### PROGRAMMING SEQUENCE



### DIPSWITCH SETTINGS

1	2	3	4	5	6
INACTIVE	Down	Down	Down	Down	Down

Refer to appropriate programmer bulletin for a complete description of the dipswitch functions.



**CAUTION:** On initial power-up and on restarts following a power failure, the control will perform self-test diagnostics for 15 seconds.

### Start-Up (Normal Cycle)

*Note: For direct spark ignited oil burners, substitute the words Main-Oil Valve for Pilot Valve.*

1. Constant 120 VAC should be available to the L1-L2 terminals only on the wiring base.
2. The operating control circuits (L1-13) will close, signaling the burner to start its firing sequence.
3. If the fuel valve end switch (13-3) is closed, the burner/blower motor (terminal M) circuit is energized. The running interlock (limit) circuit (3-P) will close (e.g. all limits, interlocks, etc. are proven).
4. The firing rate motor (Modulator Motor) is driven toward the high purge open damper position (10-X circuit made).
5. When the firing rate motor reaches its open damper position, the Hi Purge switch closes (D-8) and the prepurge interval of 30\* seconds is initiated. The ED510 will display:

**PURGE 0:05  
HIGH FIRE PURGE**

If the D-8 circuit does not close, the program will hold in this position for ten minutes waiting for it to close. If it does not, the control will lockout.

6. When the prepurge is completed, the firing rate motor is driven toward the low purge damper position (10-12 ckt. made). The ED510 will display:

**PURGE 0:35  
LOW FIRE PURGE**

7. Following the minimum 30 second delay (to permit the firing rate motor to get to the low fire position), the control will wait for the low fire switch (M-D) to close. When it closes, the trial for ignition sequence will start. If after ten minutes, the M-D circuit is not closed, the control will lockout. The EPD167 will wait indefinitely for the M-D circuit to close.

\* Prepurge timing is selectable via dipswitches.



8. The trial for ignition period begins with Terminal 5 and 6 being energized simultaneously. This is known as PTFI (Pilot Trial for Ignition). The ED510 will display:

**PTFI 0:02**  
**IGNITION TIMING**

This period is ten seconds in duration. If no flame is detected after ten seconds, the control will de-energize Terminals 5 and 6 and lockout. When flame is detected during this 10 second period, the ED510 will display

**PTFI 20**  
**FLAME SIGNAL**

FLAME SIGNAL	
0-9	NOT ACCEPTABLE
10	MINIMUM ACCEPTABLE
20-80	NORMAL

9. With flame proven at the end of PTFI, the main flame trial for ignition (MTFI) period begins. Terminal 7 is energized. The ED510 will display:

**MTFI 35**  
**FLAME SIGNAL**

Terminal 5 is de-energized 10 seconds later and Terminal 6 is de-energized after another 5 seconds.

10. The firing rate motor is now sent to the auto position (10-11 ckt made) and is under the command of the proportional controller. The ED510 will display:

**AUTO 40**  
**FLAME SIGNAL**

*NOTE: Trial-for-Ignition timings depend on the programmer selected. The timing chart on page 9 points out the differences in the EP(D)160, EP161, EP165, and EP(D)170.*

### **Normal Shutdown**

1. When the operating control circuit (L1-13) opens, the main fuel valve is de-energized. The firing rate motor is driven to the low purge position (10-12 ckt made).
2. Following a 15 second post purge, the burner/blower motor is de-energized.
3. The burner is now off and the ED510 will display

**STANDBY**  
**L1-13 OPEN**

Burner history can be displayed by using ED510 keypad. See bulletin ED-5101.

---

## **BACKLIT DISPLAY**

The ED510 display has a two (2) line by sixteen (16) character backlit LCD display. The backlit function is energized when power is applied to the FLAME MONITOR.

**Contrast Control:** The contrast for the LCD display is factory set. If the contrast must be adjusted for any reason (e.g.: remote mounting), a potentiometer is provided on the back of the ED510 display board. Refer to bulletin ED-5101 for detailed information.





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## LOCKOUTS

When a safety shutdown occurs, the control will display a message indicating LOCKOUT and the reason for the lockout. The alarm circuit (Terminal "A") will be energized. The non-volatile memory will remember the status of the control even if a power failure occurs. By momentarily depressing the reset button on the display, the control can be reset. The button must be held down for one second and then released. Very little force is required to do this. Do not press hard.

### Safety Shutdown

1. If the running interlock circuit does not close, the control will lockout and the blower motor will be de-energized. If the interlock circuit opens during a start-up or firing period, all fuel valves will be de-energized and the control will lockout.
2. If the proven high fire circuit (D-8) has not closed after a ten (10) minute "Hold" period at the start of prepurge, the control will lockout.
3. If the low fire start circuit (M-D) has not closed after a ten (10) minute "Hold" period at the end of prepurge, the control will lockout.
4. If dipswitch 6 is in the "Up" position (3-P prove open to start-enabled), and the 3-P circuit is closed at the start of the operating cycle, the control will hold for one (1) minute waiting for the 3-P circuit to open. If, after one (1) minute, the 3-P circuit does not open, the control will lockout.
5. If pilot flame is not detected during the 10 second trial for ignition period, the pilot valve and ignition transformer will be de-energized and the control will lockout on safety.
6. If main flame is not detected at the end of the main flame trial for ignition period, all fuel valves will be de-energized and the control will lockout on safety.
7. If the main flame fails during a firing cycle, all fuel valves will be de-energized within 4 seconds maximum, after loss of flame signal and the control will lockout on safety.
8. The EP165 and EP166 programmers will lockout on a power interruption.
9. If flame is detected when the operating control (L1-13) is open, the control will wait sixty (60) seconds and then lockout if flame is still present. If the operating control closes and flame is detected during purge, the blower motor (term M) remains energized and the purge sequence is put on hold. If the flame signal goes away within sixty (60) seconds, the control will proceed with a normal start-up. If flame signal is still present after sixty (60) seconds, the control will lockout.

**NOTE:** Manual Reset is required following any safety shutdown.

**NOTE:** Depressing and releasing the reset button during a cycle will cause the control to shut the burner down and recycle.

---

## DESCRIPTION OF FUNCTIONS OF OPERATING CONTROLS

1. **Operating Controls:** Generally pressure or temperature activated, the operating control closes, causing the burner start-up sequence to begin. When the operating control opens, the burner shuts off. The operating control is connected in the L1-13 circuit on the wiring base.
2. **Limit Switches:** These are generally pressure, water level or temperature activated
  - a. Recycle —when it is desired to stop the burner when the limit switch opens and restart it when the limit switch reclosed, they are connected between Terminals L1 and 13.
  - b. Non-Recycle —when it is necessary to stop the burner when the limit switch opens and prevent it from starting until both the limit switch recloses and the manual reset is activated, they are connected between terminals 3 and P.\*

---

\* Refer to programmer selection on page 9 to determine which programmers offer non-recycle operation of the running interlock circuit (ckt. 3-P).



3. **Fuel Valve End Switch Interlock:** This is generally an integral switch mounted on the main fuel valve and activated by the valve stem. It is connected between Terminal 3 & 13. The fuel valve end switch interlock prevents a burner start-up if the valve stem is not in the "valve closed" position.
4. **Purge Interlock:** Generally a firing rate motor linkage position switch or a differential air-pressure switch, that proves a maximum purge air flow rate. It is connected between Terminals D and 8. The purge interlock proves that the purge air flow rate is at maximum during the purge.
5. **Running Interlocks:** These generally are air flow switches, high and low fuel pressure switches, oil temperature switches, atomizing media pressure switches, and excess smoke density controls. These interlocks prove proper conditions for normal operation of the burner. They are wired in series and connected between Terminals 3 and P.
6. **Low Fire Start Interlock:** Generally a firing rate motor linkage position switch or a damper position switch, will prove both the linkage and dampers are in their proper positions to begin burner light off. This switch is connected between Terminals M and D.

---

## IMPORTANT INFORMATION — PLEASE READ CAREFULLY

### DETECTING AIR FLOW SWITCH (3-P) CLOSED AFTER START

In code 39 programmers and above, the method used to detect the air flow switch closed at the beginning of a cycle has been changed to avoid any nuisance lockouts. Currently, after the operating control closes, the programmer waits 10 seconds for the air flow switch to close and if not closed will go into lockout. The EP programmers utilize the open damper switch interlock, D-8, to determine the wait time for the air flow switch to close. If, at the start of a cycle after a blower turns on, the D-8 interlock is detected as closed, most likely indicating a jumped high fire switch, the programmer allows 20 seconds for the air flow switch to close. Alternatively, at startup, if the D-8 interlock is open, indicating the firing rate motor is at the low fire position and the damper is closed, the programmer will not check for the air flow switch closed until 10 seconds after the open damper switch has closed and the purge period has begun. This means the programmer will send the mod motor to the high fire position, forcing the high fire damper switch to close, and will then begin its 10 second timer to check for the air flow switch to close.

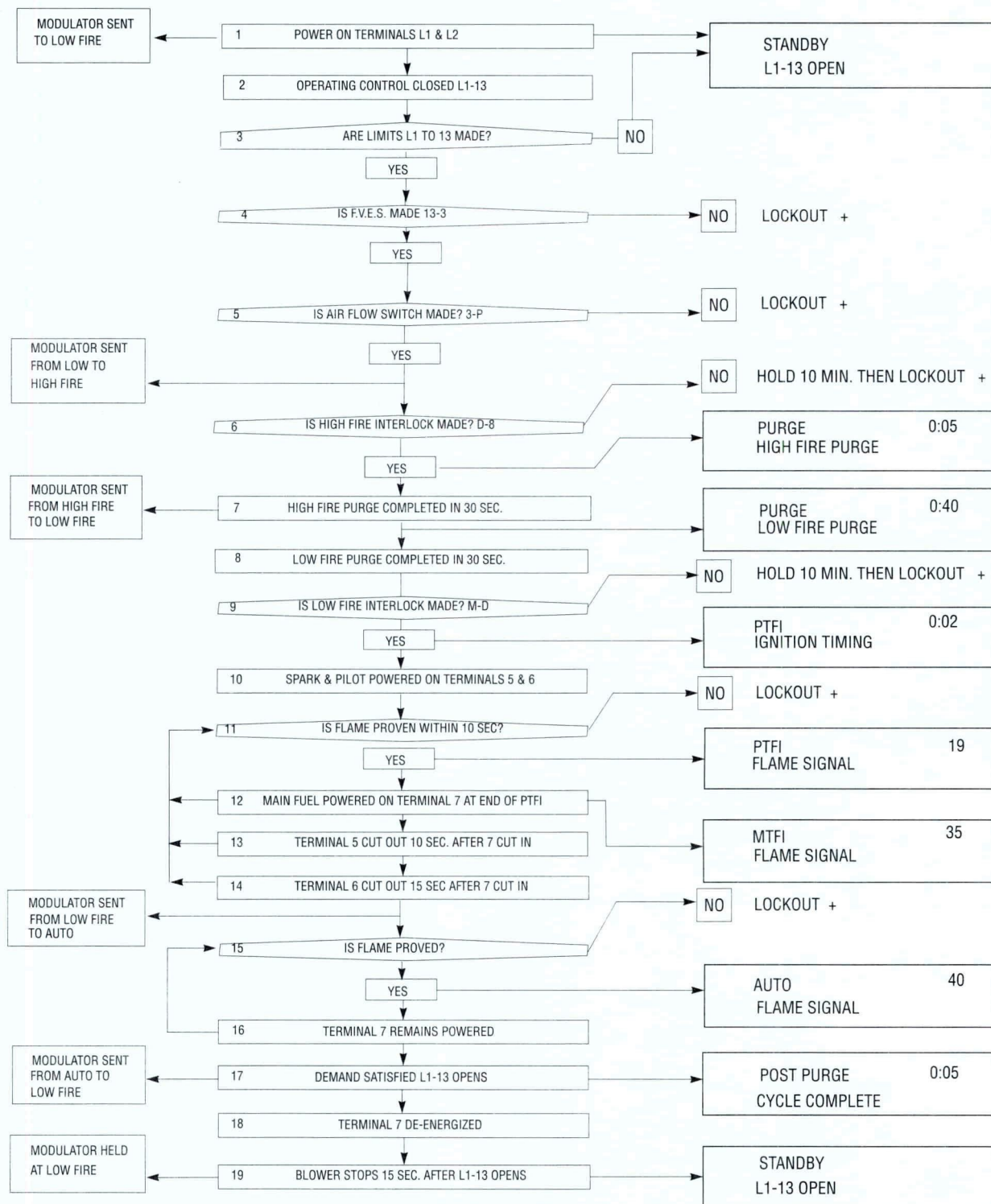
### EP160 - DIP SWITCH 1

When used in conjunction with Nexus PPC5000, dip switch 1 in the UP position provides a 3 second delay between burner cycles. This time period is used to de-energize the blower motor, terminal M. This allows sufficient time for the PPC5000 to realize a new cycle is beginning and it can reset its operating parameters accordingly.

Refer to the specific programming bulletin for additional information regarding dip switch settings.



## EP(D)160 LOGIC FLOW DIAGRAM NORMAL CYCLE



+ LOCKOUT AND HOLD MESSAGES ARE EXPLAINED IN THE FOLLOWING PAGES.



## ED510 MESSAGES

### RUN MESSAGES

STANDBY L1-13 OPEN		The operating control of the FLAME-MONITOR (terminals L1-13) is open.
PURGE HIGH FIRE PURGE	0:05	Firing rate motor sent to high fire (term. 10-X made), purge timing displayed upper right hand corner.
PURGE LOW FIRE PURGE	0:35	Firing rate motor sent to low fire (term. 10-12 made), purge timing displayed in upper right hand corner.
PTFI IGNITION TIMING	0:02	PTFI timing started. Pilot not proven yet. PTFI timing displayed in upper right hand corner.
PTFI FLAME SIGNAL	19	Pilot flame proven during PTFI. Flame signal strength displayed in upper right hand corner.
MTFI FLAME SIGNAL	25	Main flame proven during MTFI. Flame signal strength displayed in upper right hand corner.
AUTO FLAME SIGNAL	40	Modulator motor sent to auto position (term 10-11 made). Flame signal strength displayed in upper right hand corner.
POST PURGE CYCLE COMPLETE	0:05	Demand satisfied. L1-13 open. Blower motor de-energized 15 seconds after L1-13 opens.

### HOLD MESSAGES

HOLD STANDBY 3-P INTLK CLOSED	0:23	Dipswitch #6 (3-P Proven Open to Start) is set in the Up position (Enabled). At the start of the cycle, the 3-P circuit was closed. It will hold in this position for 60 seconds and then lockout if the 3-P circuit does not open.
HOLD PURGE D-8 LIMIT OPEN	0:00	The control has driven the firing rate motor to high purge (term. 10-X made) and is waiting for the high fire switch (term. D-8) to close. It will hold this position for ten (10) minutes and then lockout if the D-8 circuit does not close. <b>Applies to EP(D)160, EP(D)161, EP165, EP166, EPD167 and EP(D)170 programmers.</b>
HOLD PURGE D-8 LIMIT CLOSED	0:00	Dipswitch #6 (3-P Proven Open to Start) is set in the Up position (Enabled). At the start of a cycle the D-8 circuit was closed. It will hold in this position for 30 seconds and then lockout if the D-8 circuit does not open. Possible solution is to remove jumper from D-8 circuit or properly set the firing rate motor and switches. <b>Applies to EP(D)160, EP(D)161, EP165, EP166, EPD167 and EP(D)170 programmers</b>
HOLD PURGE M-D LIMIT CLOSED	0:30	Dipswitch #6 (3-P Proven Open to Start) is set in the Up position (Enabled). At the end of high fire purge and beginning of low fire start, the M-D circuit is closed. It will hold in this position for 30 seconds and then lockout if the M-D circuit does not open. The solution is to remove jumper from the M-D circuit or properly set the firing rate motor and switches. <b>Applies to EP(D)160, EP(D)161, EP165, EP166, EPD167 and EP(D)170 programmers</b>



HOLD PURGE M-D LIMIT OPEN	0:00
------------------------------	------

The control has finished purge and the firing rate motor is driving to the low fire position (term. 10-12 made) waiting for the low fire start switch (term. M-D) to close. It will hold this position for ten (10) minutes and then lockout if the M-D circuit does not close, excluding the EPD167.

HOLD PURGE 3-P INTLK OPEN	0:10
------------------------------	------

The running interlock circuit (3/P) has not closed within the first ten (10) seconds of purge. The control will hold for ten (10) minutes and then lockout. **Applies to recycle programmers only.**

HOLD STANDBY FALSE FLAME	25
-----------------------------	----

Flame has been sensed during the burner off time (term. L1-13 open) or during the purge period. This message will hold for sixty (60) seconds and then lockout if flame is still present. Flame signal strength is displayed in the upper right hand corner.

### LOCKOUT MESSAGES

LOCKOUT STANDBY 3-P INTLK CLOSED
-------------------------------------

Dipswitch #6 (3-P Proven Open to Start) is set in the Up position (Enabled). At the start of the cycle, the 3-P circuit was closed, and the control has waited 60 seconds for the 3-P circuit to open.

LOCKOUT PURGE D-8 LIMIT OPEN
---------------------------------

The control has held for more than 10 minutes waiting for the high fire switch (D-8) to close. **Applies to EP(D)160, EP(D)161, EP165, EP166, EPD167 and EP(D)170 programmers.**

LOCKOUT PURGE D-8 LIMIT CLOSED
-----------------------------------

Dipswitch #6 (3-P proven open to start) is set in the Up position (Enabled). The D-8 circuit has been closed for 30 seconds at the start of cycle. **Applies to EP(D)160, EP(D)161, EP165, EP166, EPD167 and EP(D)170 programmers**

LOCKOUT PURGE M-D LIMIT CLOSED
-----------------------------------

Dipswitch #6 (3-P proven open to start) is set in the Up position (Enabled). The M-D circuit has been closed for 30 seconds at the end of high purge or at the beginning of low fire start. **Applies to EP(D)160, EP(D)161, EP165, EP166, EPD167 and EP(D)170 programmers**

LOCKOUT PURGE 3-P INTLK OPEN
---------------------------------

The running interlock circuit (3-P) has opened during the purge period or failed to close within the first 10 seconds of purge on non-recycle programmers or has not closed within 10 minutes on recycle programmers.

LOCKOUT STANDBY 13-3 FUEL VALVE END SWITCH
---

The fuel valve end switch wired between terminals 13 and 3 opened during purge or at start up.

LOCKOUT PURGE M-D LIMIT OPEN
---------------------------------

The control has held for more than 10 minutes waiting for the low fire switch (M-D) to close. This does not apply to the EPD167 or EP387.

LOCKOUT PTFI 3-P INTLK OPEN
--------------------------------

The running interlock circuit (3-P) has opened during the pilot trial for ignition period. **Applies to non-recycle programmers only.**

LOCKOUT MTFI 3-P INTLK OPEN
--------------------------------

The running interlock circuit (3-P) has opened during the main trial for ignition period. **Applies to non-recycle programmers only.**

LOCKOUT AUTO 3-P INTLK OPEN
--------------------------------

The running interlock circuit (3-P) has opened during the main burner on period. **Applies to non-recycle programmers only.**



LOCKOUT STANDBY FALSE FLAME	Flame has been sensed during the burner off time (term. L1-13 open) or during the purge period for sixty (60) seconds.
LOCKOUT PTFI FLAME FAIL	A flame failure occurred during the pilot trial for ignition period.
LOCKOUT MTFI FLAME FAIL	A flame failure occurred during the main trial for ignition period.
LOCKOUT AUTO FLAME FAIL	A flame failure occurred during the main burner on period.
LOCKOUT PTFI SCANNER NOISE	This message appears because of ignition cable noise. Reroute scanner wires away from high voltage ignition cables. Check for proper spark gap or cracked porcelain. Check for proper grounding of wiring base and power supply. Replace worn ignition cable and/or faulty connections.
LOCKOUT PURGE SHORT CIRCUIT TERM 5,6,7	Excessive current or short circuit detected on terminals 5, 6, or 7 during PTFI, MTFI, or Auto. The control will lockout upon sensing this condition on two consecutive cycles.
LOCKOUT PTFI FUEL VALVE STATE CHANGE	During pilot trial for ignition period, voltage sensed on terminal 7 is different from the previous cycle. (e.g.: jumper added or removed between term. 7 and 5 or 6).
LOCKOUT AUTO LINE FREQUENCY NOISE DETECTED	Electrical noise detected on terminals L1 and L2.
LOCKOUT AC POWER FAIL	A power interruption to terminals L1 and L2 has caused the control to lockout. <b>Applies to EP165 and EP166 programmers only.</b>

### CHECK MESSAGES

CHECK PURGE D-8 HI LIMIT	0:15	The "Run-Check" switch has been placed in the Check position during purge and will hold indefinitely. The firing rate motor is being driven to the high purge position.
CHECK PURGE M-D LOW LIMIT	0:45	The "Run-Check" switch has been placed in the Check position after high fire purge and will hold indefinitely. The firing rate motor is being driven to the low fire position.
CHECK PTFI FLAME SIGNAL	19	The "Run-Check" switch has been placed in the Check position during the pilot trial for ignition period. Flame signal strength is displayed in the upper right hand position. The control will lockout on safety only when no flame signal is sensed for a continuous 30 seconds while the control is in the Check position.
CHECK AUTO LOW FIRE SIGNAL	25	The "Run-Check" switch has been placed in the Check position during the main burner on period, and the firing rate motor is driven to the low fire position. Flame signal strength is displayed in the upper right hand corner.



CHECK STANDBY  
UNIT ADDRESS

00

The "Check-Run" switch has been placed in the Check position with the operating control circuit (L1-13) open. Every time the Reset button is depressed and held for one second will increment the Unit Address by one. Refer to programmer bulletin for additional information on Unit Address.

### DIAGNOSTIC MESSAGES

LOCKOUT AUTO  
CHECK AMPLIFIER

#### POSSIBLE CAUSE

- High electrical noise
- Defective field wiring.
- Defective amplifier.
- Defective IR scanner.

#### SOLUTION

- Check for proper ground on power supply.
- Install noise suppressor on power supply.
- Make sure line phase on interlock circuit is the same as found on L1/L2 power supply to E110.
- Replace amplifier.
- Replace IR cell.

LOCKOUT PTFI  
CHECK CHASSIS

- Voltage on terminal 7 at improper time.
- Defective Chassis.
- Defective Programmer.

- Check wiring to terminal 7.
- Replace Chassis (EB700).
- Replace Programmer.

LOCKOUT PURGE  
CHECK PROGRAMMER

- Voltage on terminal 5 or 6 at improper time.
- High Electrical Noise.
- Failed Programmer.
- Worn Chassis.

- Check wiring to terminals 5 and 6.
- Install noise suppressor on power supply
- Re-route scanner wires away from high voltage wiring.
- Replace Programmer.
- Replace Chassis.

LOCKOUT AUTO  
CHECK SCANNER

- Flame signal detected during shutter close time on 45UV5 scanner.

- Stuck scanner shutter. Replace 45UV5 scanner.

LOCKOUT AUTO  
CHECK EXPANSION MODULE

- The E300 Expansion Module has a defective optocoupler.

- Replace E300 Expansion Module.

LOCKOUT AUTO  
AUTO CHECK AMPLIFIER FAIL

- Amplifier has failed diagnostic checks.

- Replace amplifier.

FIREYE ED510  
SYSTEM ERROR

- Defective programmer.

- Replace programmer.





## HISTORICAL INFORMATION /SYSTEM SUB-MENUS

At any time the control is powered, the SCRL key will scroll through and display the total number of 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 four (4) System Sub-menus providing the following information and/or functions:

- Lockout History (with burner cycle and burner hour time stamp).
- E300 Message Select (to program messages associated with the E300 Expansion Module).
- Program Setup (to display programmer type, purge timing, FFRT timing, etc.).
- System Information (status of M-D circuit, average pilot flame signal, etc.).

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. Every time the SCRL key is pressed the information is displayed as follows:

AUTO BNR HOURS	40 823	Number of hours Terminal 7 (main fuel) is energized.*
AUTO BNR CYCLES	40 385	Number of burner operating cycles. (L1-13 closed).*
AUTO BNR LOCKOUTS	40 21	Number of burner lockouts.*
AUTO SYS HOURS	40 1233	Number of hours the control has been powered.*
AUTO LOCKOUT HISTORY	40 →	Sub-menu to display the cause of the last 6 lockouts. The MODE key is required to display the actual lockouts.
AUTO E300 MSG SELECT	40 →	Sub-menu to program the messages associated with the operation of the E300 Expansion Module. The MODE key is required to enter the sub-menu.
AUTO PROGRAM SETUP	40 →	Sub-menu to display various operating parameters of the programmer and amplifier. The MODE key is required to enter the sub-menu.
AUTO SYSTEM INFO	40 →	Sub-menu to display information pertaining to the operation of the control. The MODE key is required to enter the sub-menu.

\* Refer to SYSTEM INFO to reset value to zero.



## 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. Control has released to auto modulation, flame signal strength = 45.
MODE	LO #158 PURGE D-8 LIMIT OPEN	The last (most recent) lockout condition. This is the 158th lockout of the control.
SCRL	LO #158 PURGE @ BNR HOURS 136	The last lockout occurred after 136 hours of burner operation.
SCRL	LO #158 PURGE @ BNR CYCLE 744	The last lockout occurred on the 744 burner cycle.
SCRL	LO #157 AUTO 3-P INTLK OPEN	The next to last lockout condition. This is the 157th lockout of the control.
MODE	AUTO 45 FLAME SIGNAL	Screen has returned to the run message. Control has released to auto modulation, flame signal strength = 45.

## E300 MESSAGE SELECT

The sub-menu "E300 MSG SELECT" will allow the user to modify the lockout alarm messages associated with the operation of the E300 Expansion Module. The various safety limits had to be wired in the exact order that was shown in the E-3001 Product Bulletin for the E300. For example, the low water cutoff had to be wired between terminals 23 and 24 of the 60-1950 wiring base of the E300. With the EP style programmers (Engineering code 28 or later), the user will now be able to select which message applies to the individual terminals. The messages associated with the E300 are divided into four (4) groups: Recycle, Non-recycle, Gas Select, and Oil Select.

The **Recycle** group pertains to the limits that are connected between terminals L1 and 13 of the E110 Flame-Monitor. These are terminals 20-21, 21-22, and 22-13. Note: Refer to Bulletin E-3001 for a wiring diagram of the E300 terminals.

The **Non-Recycle** group pertains to limits connected between terminals 3 and P of the E110 FLAME-MONITOR. These are terminals 3-23, 23-24, 30-31, 31-32, 32-33, 33-34, 34-35, and 35-P.

The **Gas Select** group pertains to the terminals associated with the gas interlocks of the E300. These are terminals 25-27, 27-30.

The **Oil Select** group pertains to the terminals associated with the oil interlocks of the E300. These are terminals 26-28, 28-29, and 29-30.

The lockout messages associated with the above terminals can be modified via the ED510 Display. The selection of available messages are dependent on each group. For example, the message "Low Oil Pressure" is a selection only for the Oil Select group. The default message for a particular interlock is the standard message for those terminals as indicated in the E-3001 bulletin. For example, the default message for terminals 20-21 is "L1-13 AUX #1 OPEN."



## TO MODIFY THE E300 MESSAGES

All three keys: Mode, Reset and Scroll, are used to modify the E300 messages. The Mode key is used to enter or exit the sub-menu associated with the E300 messages. The Scroll key is used to advance through the various terminals or selectable messages. The Reset key is used to modify a terminal message and select a new message. To modify the E300 messages:

Press the Scroll key until the ED510 displays

### **E300 MSG SELECT.**

Press the Mode key and the screen displays:

### **E300 TERM #20-21**

**L1-13 AUX#1 OPEN** or programmed message.

Press the Scroll key and the screen displays:

### **E300 TERM #21-22**

**L1-13 AUX#2 OPEN** or programmed message.

To change the message, press and hold the Reset key for one (1) second. When the Reset key is released, the screen displays:

### **MDFY TERM #21-22**

**L1-13 AUX#2 OPEN**

Press the Scroll key to display the available messages for the particular group being modified. See attached List of available messages for each group.

When the messages displayed is appropriate for the terminals, press and hold the Reset key for one (1) second. When the Reset key is released, the screen displays:

### **E300 TERM #21-22**

**LOW WATER** or programmed message.

Press the Mode key to exit the E300 Message Sub-menu.

## AVAILABLE E300 MESSAGES

The following messages are available for each of the four E300 terminal groups:

### **GROUP 1 — RECYCLE**

E340 OP.CNTL OPEN	HIGH WATER	CONTROL PANEL SWITCH OPEN
DAMPER POSITION END SWITCH OPEN	BLOWER MOTOR INTLK	HIGH GAS PRESSURE
COMBUSTION AIR END SWITCH OPEN	HIGH STACK TEMPERATURE	LOW GAS PRESSURE
LOW WATER		

### **GROUP 2 — OIL SELECT**

LOW OIL PRESSURE	LOW OIL TEMPERATURE	LOW ATOMIZING MEDIA
HIGH OIL PRESSURE	HIGH OIL TEMPERATURE	

### **GROUP 3 — GAS SELECT**

HIGH GAS PRESSURE	LOW GAS PRESSURE
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### **GROUP 4 — NON-RECYCLE**

E340 SAFETY INTLK OPEN	HIGH TEMPERATURE	BLOWER MOTOR INTLK
HIGH WATER	AIR FLOW OPEN	I.D. FAN INTLK
LOW WATER	OIL GUN END SWITCH OPEN	F.D. FAN INTLK
HIGH PRESSURE	HIGH STACK TEMPERATURE	



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## USER PROGRAMMED E300 MESSAGES

In addition to selecting the lockout alarm messages for the E300 Expansion Module from a menu selection via the ED510 display, the user can also program any message (up to 40 characters in length) for the individual terminals of the E300 using a dumb terminal (or PC with communication software) and the appropriate interface cables. Refer to bulletin E-3001 for complete details.

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### 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.

Press	Screen Displays	Description
SCRL	AUTO 45 PROGRAM SETUP >	SCRL key advances through the historical information until "Program Setup" is displayed. Control has released to auto modulation, flame signal strength = 45.
MODE	AUTO 45 PROGRAMMER EP(D)160	Programmer Type is an EP(D)160.
SCRL	AUTO 45 ENGR CODE NO. 28	Software Engineering code of the programmer module is code 28.
SCRL	AUTO 45 AMP = EUV1 OR ERT1	Amplifier module is an EUV1 or an ERT1.
SCRL	AUTO 45 PURGE TIME 0:30	Purge timing (selected by the dipswitches) is 30 seconds.
SCRL	AUTO 45 PROVE 3-P OPEN = N	Proven 3-P Open To Start is disabled (selected by dipswitches).
SCRL	AUTO 45 FLAME FAIL TIME 4s	Flame Failure Response Time (FFRT) = 4 seconds (maximum).
SCRL	AUTO 45 UNIT ADDRESS #00	Unit Address is 00. Refer to programmer bulletin to modify Unit Address.
MODE	AUTO 45 FLAME SIGNAL	MODE key returns to 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.). This information can be very helpful when setting the damper linkages on the firing rate motor. The MODE key is used to enter the "PROGRAM SETUP" sub-menu, and the SCRL key is used to advance through the sub-menu.

Press	Screen Displays	Description
SCRL	AUTO 45 SYSTEM INFO >	SCRL key advances through the historical information until "System Info" is displayed. Control has released to auto modulation, flame signal strength = 45.
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	AUTO 45 SHORT CKTS. 0	The total number of short circuits (excessive current) detected on terminals 5, 6, and 7. The short circuit condition must be sensed twice consecutively to be considered a short circuit.
SCRL	AUTO 45 D-8 LIMIT CLOSED	The status of the high fire end switch (D-8) is closed.
SCRL	AUTO 45 M-D LIMIT CLOSED	The status of the low fire end switch (M-D) is closed.
SCRL	PRESS RESET TO CLEAR HISTORY	While the control is in STANDBY position (L1-13 OPEN) pressing and releasing the RESET key will clear current burner hours, cycles and lockout history.
MODE	AUTO 45	MODE key returns to run message.



The EP(D) programmer updates the messages to the ED510 display at least once every 8 seconds. If the ED510 display does not receive information from the EP(D) programmer within 10 seconds the ED510 will display:

**FIREYE ED510  
WAITING FOR DATA**

This can be the result of a defective connection between the programmer and display, defective cable, defective drivers in the programmer or display, or an electrical noise transient causing the EP(D) programmer to cease communication.

Removing and restoring power should be executed to recover proper operation. Refer to bulletin SN-100 for recommended techniques for display installation.



## COMMUNICATIONS

The protocol to be used is Modbus RTU. This is implemented by the master (PC, PLC, etc.) issuing a poll to the slave (Flame-Monitor) 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 Flame-Monitor programmers, followed by a description where necessary, EP engineering code 38 or greater and EPD engineering code 4 or greater.

MESSAGE ADDRESS	WORD REQUESTED	RESPONSE	VALUE
00	1-6	STATUS	83 (053H) = RUN; 202 (0CAH) = LOCKOUT
01	1	MSGN	Current message being displayed (see Table 1)
02	1	GSTAT	Defines Timer Type
03	1	TIMER	Time, Flame, Address
04	1	FLAME	Flame Signal
05	1-3	LOGSTAT	Current logic module, PURGE, PTFI, AUTO (See Table 2)
06	1	INPUTS	Input limits state
07	1	OUTPUTS	Output relays state
08	2	SYSMINS	System on minutes
10	2	BNRMINS	Burner on minutes
12	2	CYCLES	Completed Burner Cycles
14	1	LOCKOUT COUNT	Stored Lockout Count
15	1-6	LOCKOUT HISTORY	Last 6 Lockouts, first word is most current lockout
21	1-2	DEVTYP	Programmer device type, 5=EP, 6=EPD, 7=MicroM
22	1	AMPTYP	Amplifier Type; EUVS4=0C0H; EIR1=0A0H; ERT1, EUV1=090H;
23			
24	2	FLAME SIGNAL AVERAGES	PTFI and Auto Flame Signal Averages
35	6	Most Recent Lockout Data	Returns complete lockout description of stored lockout history. Includes lockout message, lockout module, @ burner hours, and @ burner cycles



41	6	2nd Most Recent Lockout Data	
47	6	3rd Most Recent Lockout Data	
53	6	4th Most Recent Lockout Data	
59	6	5th Most Recent Lockout Data	
65	6	6th Most Recent Lockout Data	
71	1-3	Input limits and Expansion Module registers	Returns input limits state and lower and upper expansion module (E300) registers. See Table 3
72	1-2	Expansion Module (E300) registers	Returns lower and upper Expansion Module registers
73	1		Return only upper Expansion Module register

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

Messages 00, 05, 08, 10, 15, 21 and 26 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. Refer to Table 1 for message information.

The Flame-Monitor stores its burner on time and system on time (L1 powered) in minutes. For display purposes, the programmer converts this to hours. 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 Flame-Monitor is 9,999,999 minutes, the maximum value in hex therefore is 98967FH and comprises two data words. The maximum cycle count is 999,999 decimal or F423FH, still two data words. As an example, the System on Minutes data is transmitted from the Flame-Monitor to the interface as high word / low word as shown below:

ADDRESS 8		ADDRESS 9	
HIGH WORD		LOW WORD	
HIGH BYTE	LOW BYTE	HIGH BYTE	LOW BYTE
0	98H	97H	FH

**Note:** Data from address 9 cannot be accessed directly.

All 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 Flame-Monitor 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 Flame-Monitor 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 active where a 1 in any bit position in the OUTPUT register signifies the relay as being energized.

Refer to Fireye bulletin E-3001 for terminal designations

**Table 3:**

**INPUTS**

Bit 7 Term P	Term 5/6	Term D		Term 8	Term 7	Term 3	bit 0 Term 13
Air Flow	Ignition	Low Fire	Ref	High Fire	Main Fuel	FVES or POC	Op Ctrl

A '1' in the opto-coupler position indicates the opto-coupler is on or interlock closed.

**EXPANSION MODULE (E300) LOWER - REFER TO BULLETIN E-3001**

Term 35	Term 34	Term 33	Term 32	Term 23	Term 22	Term 21	Term 20
Aux #6	Aux #5	Aux #4	High Temp	High Water	AUX #2	AUX #1	Op Ctrl

**EXPANSION MODULE (E300) UPPER - REFER TO BULLETIN E-3001**

Term 31	Term 30	Term 29	Term 28	Term 27	Term 26	Term 25	Term 24
High Pressure	Low Gas Pressure or Low Atomizing Media	Low Oil Temp.	Low Oil Pressure	High Gas Pressure	Oil Selected	Gas Selected	Low Water

**OUTPUTS**

Term 11	Term M	Term 6		Term 5	Term 7	Term A	Term X
Auto (RA1)	Blower (RB)	Ignition (RA2)	FVES (RV)	Pilot (RP)	Main Fuel (RF)	Alarm (RL)	High Fire (RH)

LOGSTAT is an indication of what logic module the control is currently in during its operating sequence and is used for diagnostic purposes only. The message displayed corresponds to the current logic module. The range of values are 4EH for Standby, 45H for PostIdle through 4DH for Shut down 2. Note that the above values are represented in hexadecimal format.



Table 2:

EXPLANATION OF LOGSTAT

LOGIC DISPATCHER			
VALUE		MODULE	FUNCTION
DEC	HEX		
69	45H	MPOSTIDLE	
70	46H	MPREPURGE1	Wait for air flow and/or high fire switch to close
71	47H	MPURGE	Open Damper Purge
72	48H	MPOST PURGE	Low Fire Purge
73	49H	MTFI	Pilot Trial
74	4AH	MTFMF	Main Trial
75	4BH	MAUTO	AUTO
76	4CH	MSHTDWN1	Post Purge
77	4DH	MSHTDWN2	Post Purge
78	4EH	MIDLE	Standby

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 the low fire start period where the mod motor is sent to the low fire position in preparation for pilot light-off. MSHTDWN1 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 the high fire proving switch (D-8). If either switch is found open, the control will remain in this state until the respective switch closes or lockout occurs.

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

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.

The Flame-Monitor outputs the current displayed message as well as the historical lockout messages as numbers. The table that follows correlates the message number with the actual displayed test message.



Table 1- Message Table

DEC	HEX		E110 FLAME-MONITOR MESSAGES
1	1	R	L1-13 OPEN
2	2	H	HOLD FALSE FLAME- STANDBY
3	3	R	LOW FIRE PURGE
4	4	H	HOLD D-8 LIMIT OPEN- PURGE
5	5	H	HOLD 3-P AIR FLOW OPEN
6	6	L	LOCKOUT LINE FREQUENCY NOISE DETECTED
7	7	L	LOCKOUT FLAME FAIL - PTFI
8	8	C	CHECK UNIT ADDRESS
9	9	H	HOLD M-D LIMIT OPEN
10	A	R	IGNITION TIMING - PTFI
11	B		
12	C	R	FLAME SIGNAL - AUTO
13	D	R	CYCLE COMPLETE - POST PURGE
14	E	R	L1-13 OPEN (AFTER 2 MINUTES)
15	F	L	LOCKOUT AC POWER FAIL (EP165, EP166)
16	10	L	LOCKOUT SHORT CIRCUIT TERMINAL 5, 6 or 7
17	11	L	LOCKOUT D-8 LIMIT OPEN
18	12	L	LOCKOUT M-D LIMIT OPEN
19	13	L	LOCKOUT FLAME FAIL - MTFI
20	14	L	LOCKOUT FALSE FLAME
21	15	L	LOCKOUT 3-P INTLK OPEN (PURGE)
22	16	L	LOCKOUT 3-P INTLK CLOSED
23	17	H	HOLD 3-P INTLK CLOSED
24	18	H	HIGH FIRE PURGE
25	19	R	PLEASE WAIT (INITIALIZING)
26	1A	L	LOCKOUT 3-P INTLK OPEN -AUTO
27	1B	L	LOCKOUT 3-P INTLK OPEN (MTFI)
28	1C	L	LOCKOUT 3-P INTLK OPEN (PTFI)
29	1D	L	LOCKOUT 13-3 FVES OPEN
30	1E		
31	1F	C	CHECK FLAME SIGNAL - PTFI
32	20	C	CHECK D-8 HI LIMIT
33	21	C	CHECK M-D LOW LIMIT (CHECK)
34	22	R	FLAME SIGNAL - PTFI
35	23	C	CHECK LOW FIRE SIGNAL
36	24	R	FLAME SIGNAL - MTFI
37	25	L	LOCKOUT FLAME FAIL (AUTO)
38	26	H	HOLD 3-P INTLK OPEN - PURGE
39	27	L	LOCKOUT FUEL VALVE STATE CHANGE
E300 EXPANSION MODULE LOCKOUT MESSAGES			
40	28	L	3-P AIR FLOW OPEN
41	29	L	3-P HIGH WATER
42	2A	L	3-P LOW WATER
43	2B	L	3-P HIGH GAS PRESSURE
44	2C	L	3-P LOW GAS PRESSURE
45	2D	L	3-P LOW OIL PRESSURE
46	2E	L	3-P LOW OIL TEMPERATURE
47	2F	L	3-P LOW ATOMIZING MEDIA
48	30	L	3-P HIGH STEAM PRESSURE
49	31	L	3-P HIGH TEMPERATURE
50	32	L	3-P AUX #4 OPEN
51	33	L	3-P AUX #5 OPEN
52	34	L	3-P AUX #6 OPEN
53	35	L	3-P FUEL SELECT

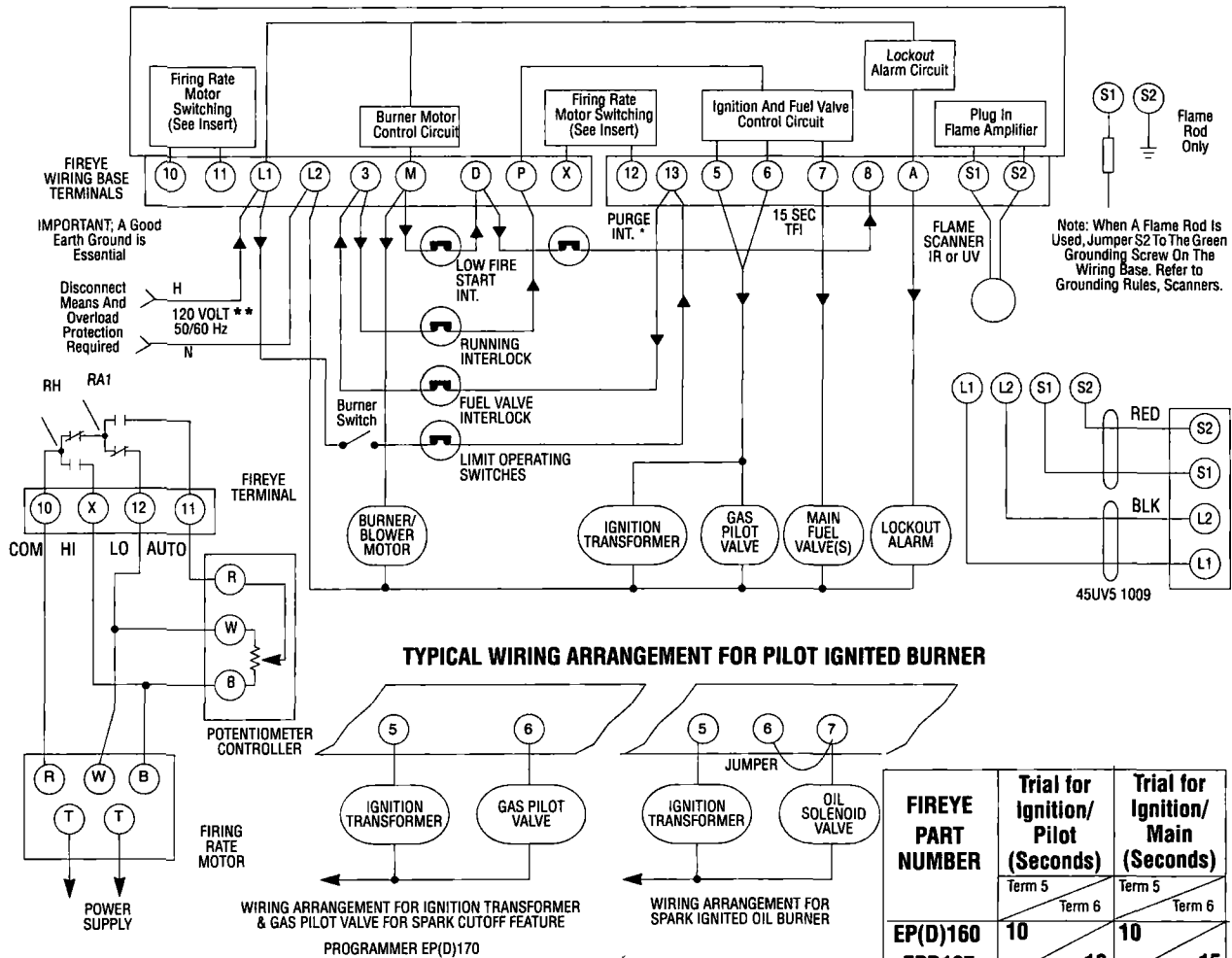


SYSTEM DIAGNOSTIC MESSAGES			
54	36	L	LOCKOUT CHECK CHASSIS
55	37	L	LOCKOUT CHECK PROGRAMMER
56	38	L	LOCKOUT CHECK AMPLIFIER
57	39	L	LOCKOUT CHECK EXPANSION MODULE
58	3A	L	LOCKOUT AMPLIFIER AUTO CHECK FAIL
59	3B	L	LOCKOUT SCANNER NOISE
76	4C	L	LOCKOUT CHECK SCANNER
E300 EXPANSION MODULE HOLD MESSAGES			
60	3C	H	L1-13 AUX #1 OPEN (TERMINAL 20)
61	3D	H	L1-13 AUX #2 OPEN (TERMINAL 21)
62	3E	H	L1-13 AUX #3 OPEN (TERMINAL 22)
63	3F	H	3-P HIGH WATER (TERMINAL 23)
64	40	H	3-P LOW WATER (TERMINAL 24)
65	41	H	3-P HIGH GAS PRESSURE
66	42	H	3-P LOW GAS PRESSURE
67	43	H	3-P LOW OIL PRESSURE
68	44	H	3-P LOW OIL TEMPERATURE
69	45	H	3-P LOW ATOMIZING MEDIA
70	46	H	3-P HIGH PRESSURE (TERMINAL 31)
71	47	H	3-P HIGH TEMPERATURE (TERMINAL 32)
72	48	H	3-P AUX #4 OPEN (TERMINAL 33)
73	49	H	3-P AUX #5 OPEN (TERMINAL 34)
74	4A	H	3-P AUX #6 OPEN (TERMINAL 35)
75	4B	H	3-P FUEL SELECT
PURGE INTERLOCK RELATED MESSAGES			
76	4C	L	LOCKOUT CHECK SCANNER
77	4D	H	HOLD D-8 LIMIT CLOSED
78	4E	L	LOCKOUT D-8 LIMIT CLOSED
79	4F	H	HOLD M-D LIMIT CLOSED
80	50	L	LOCKOUT M-D LIMIT CLOSED
81	51	L	LOCKOUT 13-3 POC CLOSED (CB ONLY)
82	52	R	DYNAMIC CHECK (CB ONLY)

R = Run  
H = Hold  
C = Check  
L = Lockout



## SUGGESTED WIRING DIAGRAM FOR EP(D)160, EP161, AND EP(D)170 PROGRAMMERS



**Caution:** All safety limit switches should be approved as limit controls and should be wired directly in the circuit of the Flame Safeguard control.

The use of electronic switches to close interlock circuits may cause erratic operation.

Refer to Service Note 100 (SN-100) or Suggested Grounding Rules later in this document.

\* EP165 AND EP166 INCLUDE 5 SECOND PILOT STABILIZATION PERIOD.

\*\*ALL FLAME-MONITOR INTERLOCK INPUTS MUST BE THE SAME AC PHASE

FIREYE PART NUMBER	Trial for Ignition/ Pilot (Seconds)		Trial for Ignition/ Main (Seconds)	
	Term 5	Term 6	Term 5	Term 6
EP(D)160	10		10	
EPD167		10		15
EP(D)161	10		10	30
EP165*	10		0	
		10		10
EP166*	10		0	
		10		15
EP(D)170	5		0	
		10		10

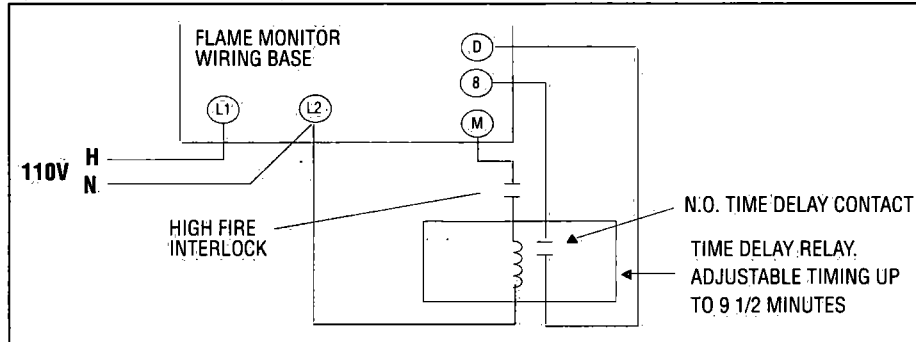




## EXTENDED PREPURGE

With EPD programmers, it may be necessary to extend the pre-purge timing on the Flame Safeguard Control to greater than 30 seconds. This can be accomplished by adding a time delay relay in the L2/M and D/8 circuit and wired in the following manner:

The maximum extended purge time will be 10 minutes. The maximum time delay setting should be 9 1/2 minutes. If the time delay relay does not close the D-8 circuit within 10 minutes of the start, the Flame-Monitor control will LOCKOUT and the message will be LOCKOUT D-8 HI PURGE OPEN.



EP-style programmers provide this feature via dipswitches 3, 4, and 5.



### Auxiliary Device in M-D-8 Circuit at Flame Monitor Control

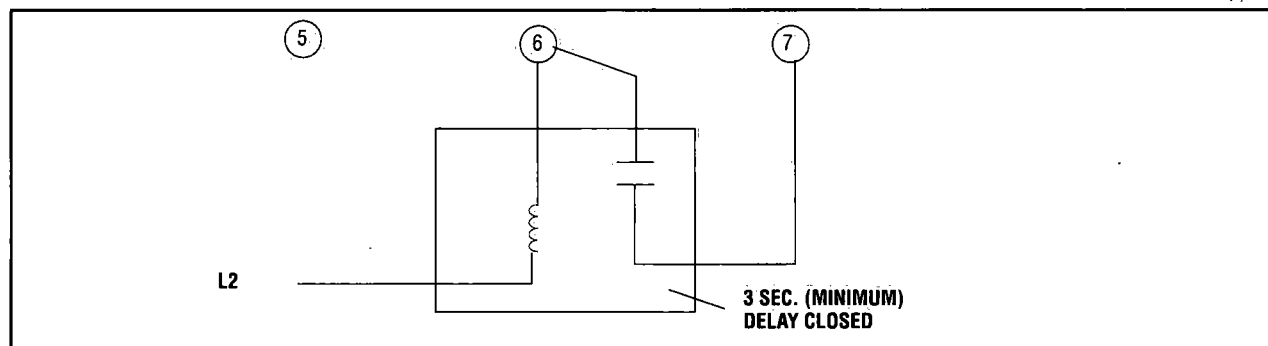
The function of the low fire start and high fire purge interlock circuits internally in a new Fireye Flame-Monitor unit is accomplished by highly reliable solid state electronic circuitry. This prohibits the connection of power consuming devices (i.e. lamps, annunciators, relays, timers, etc.) to the D or 8 terminals.

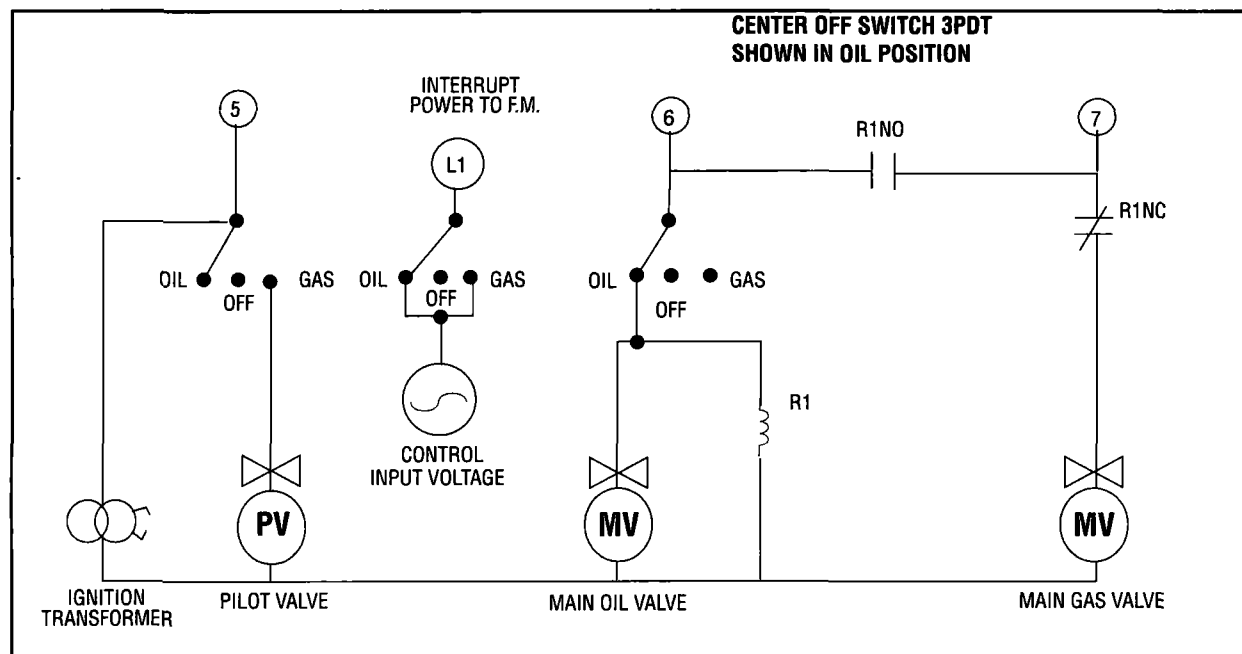
## COMBINATION FUEL BURNERS

*Note: An important safety feature of the FLAME-MONITOR system is the ability to monitor the proper timed operation of critical terminals; fuel valve terminals 5, 6 and 7 for instance. Jumpering of these terminals could therefore cause the control to sense an unusual condition and LOCKOUT.*

When changing fuels on combination fuel burners if DIRECT SPARK IGNITION is used, it is normal to jumper these terminals. To assure that burner operation is not interrupted in this situation, you must do one of the following:

1. Interrupt power to L1/L2 momentarily when changing fuels, before the initial burner cycle on the new fuel. Follow the diagram on page 34.  
OR
2. Install a time delay relay contact in the jumper circuit which is timed to close 3 seconds (minimum) after terminal 6 is energized. This method is only acceptable on programmers labeled "12" or higher (i.e. datecode 8710-12).





## INSTALLATION /TESTING

### Check-Run Switch

The Check-Run switch is located on the top of the EP Programmer Module and can be used to stop the control in its firing sequence at any time except during MTFI. If moved during the MTFI period, it is non-functional and automatic programming continues. It is designed to aid in set-up, start-up and check-out of the burner and its associated interlocks.

Following are the modes of operation:

1. When power is applied to the control (L1-L2) and the operating control circuit is closed (L1-13), the purge period begins and the firing rate motor is sent to the Hi Purge position. If the Check-Run Switch is moved to the Check position before the Hi Fire Switch (D-8) is made and the 30 second purge ends, the control will display:

CHECK PURGE	0:15
D-8 HI LIMIT	

The control will hold in this position indefinitely to allow the operator to make interlock switch and linkage adjustments. To continue in the cycle, move the Check-Run switch to Run to allow the control to advance.

2. If the Check-Run switch is moved to the Check position after the purge period reaches 30 seconds, but before 60 seconds, the control will display:

CHECK PURGE	0:45
M-D LOW LIMIT	

The control will hold in this position indefinitely to allow the operator to make interlock switch and linkage adjustments. To continue the cycle, moving the Check-Run Switch to Run will allow the control to advance.



3. After the PTFI period has begun, switching back to the Check position will stop the program in the PTFI period, allowing for pilot and/or scanner alignment adjustments to be made. The control will display:

CHECK PTFI FLAME SIGNAL	19
----------------------------	----

It will hold in this position indefinitely as long as the flame signal strength is above the threshold of 10. If it drops below 10 for thirty consecutive seconds, lockout will occur and the message on the display will read Flame Fail PTFI.

4. Switching from run to check during the burner on period will drive the modulator circuit to low fire (10-12 Closes). This allows for low fire fuel-air adjustments and holding the burner at low fire. Consult your boiler/burner instructions for low fire hold firing recommendations. The control will display:

CHECK AUTO LOW FIRE SIGNAL	25
-------------------------------	----

As an aid adjusting the burner linkages, pilot, etc., a check-run selector is provided on each EP-and EPD Series Programmer Module.

## OPERATIONAL TEST



**WARNING:** Before testing the control operation on the boiler, close the manual main shut-off fuel valve. Failure to do this may cause injury or property damage.

1. Close the manual main shut-off fuel valve.
2. Recheck all limit circuit wiring for proper operation and correct connection.
3. Confirm that the automatic main fuel valves are wired to terminal "7."
4. Power the control and electronically check the proper sequence of operation according to the Operation section on page 11 of this bulletin.
5. After assuring yourself that all interlocks and valves are properly wired and that the sequence of operation is correct, open the manual main shut-off fuel valve and proceed cautiously through the boiler light off process. Check all safety interlocks for proper shut down of the boiler.

When the installation and all burner adjustments are completed, the entire burner control system should be tested in accordance with the burner manufacturer's instructions. The procedure should verify the correct operation of:

1. Each operating control (temperature, pressure, etc.).
2. Each limit switch (temperature, pressure, low water cutoff, etc.).
3. Each interlock switch (airflow switch, high and low fuel pressure or temperature switches, purge and low fire start switches, fuel valve proof of closure interlock, etc.).
4. Pilot flame failure response and lockout.
5. Main flame failure response and lockout.
6. Tight shut off of all fuel valves.



**CAUTION:** LIVE VOLTAGE IS NECESSARY TO PERFORM THIS TEST.

### Voltage Test

A Voltage Check is necessary to identify a potential problem with the supply to the control. This could be caused by an improperly sized or faulty transformer, faulty load coils or low entry voltage. Follow this procedure:

1. Using the Service Adapter (60-2107), monitor the L1-L2 supply throughout a complete burner cycle. The acceptable voltage range is 102V-132V. At no time during the cycle should the voltage dip below the minimum level.
2. Check other load terminal (M/L2, 5/L2, 6/L2, 7/L2) for voltage at improper times or improper values.



## TEST CHECKOUT PROCEDURES

### Normal Pilot Flame Test



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

1. At the start of PTFI, place the Check-run switch in the check position.
2. Observe the pilot flame signal on the display. If the average signal is below the minimum of 10, readjust the pilot flame or realign the flame detector.
3. During the pilot flame test, if flame is not detected for a continuous 30 seconds, the control will lockout. To re-establish the pilot flame trial for ignition (PTFI), manual reset of the lockout switch is required, and a complete prepurge accomplished.
4. When UV flame detection is used, a test is required to verify that UV radiation from the ignition spark is not being detected. To accomplish this, manually shut off both pilot and main fuels. Initiate a normal start-up, and when the PTFI display comes on, observe the display which should read no signal more than 4. If more than 4 is observed, realign the UV scanner, and/or shield the spark from the scanner's view.
5. With all methods of flame detection, check pilot flame failure response by manually shutting off the pilot fuel and then 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, and the control will lockout. Also check to verify that the ignition spark does not "give" a flame signal on infrared or flame rod applications.

### Main Flame Test

**NOTE:** This test requires an interrupted pilot (a pilot that shuts off after main flame has been established).

1. Proceed through a normal startup. After the pilot flame is shut off, observe the reading on the display. If the signal reading is low, readjust main flame or realign detector.
2. Check main flame failure protection by manually shutting off the main fuel supply. Within 4 seconds after main flame goes out, the fuel valve will be de-energized. The alarm circuit will be energized following safety lockout.

### Minimum Pilot Test



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

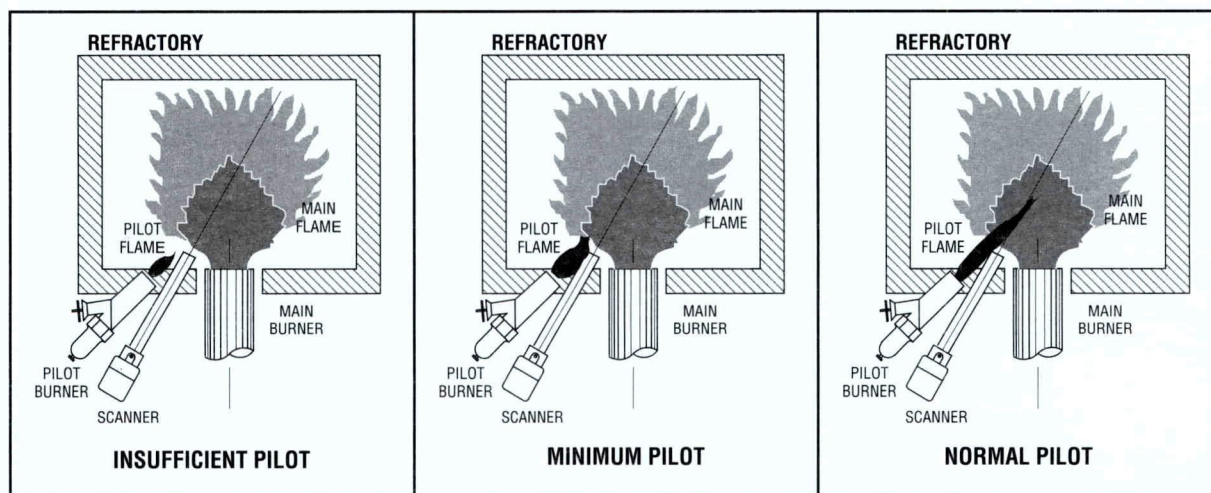
This test assures that the flame detector will not detect a pilot flame too small to reliably light off the main flame. The test should be made on every new installation and following any reapportioning of the flame detector. This procedure should not be used on a direct spark ignited burner.

1. Turn off the main fuel supply manually.
2. At the start of PTFI, place the Check-run switch in the check position.
3. Reduce the fuel supply to the pilot until the display reads below 10.
4. Slowly increase the fuel to the pilot until the display reads 10. This is minimum pilot flame that the flame detector will reliably detect.
5. Place the Check-run switch in the Run position. When the main fuel safety shut-off valve is energized, slowly open the manual main fuel valve.
6. Observe the light-off of the main flame. It must be smooth and normal.



**CAUTION:** If the main flame does not ignite immediately, shut off the main fuel. Realign the detector to require larger minimum pilot flame.

7. Repeat the test until a reliable and smooth light-off occurs with the minimum pilot.
8. After this test is completed, increase the fuel to the pilot to its normal setting.



#### Scanner Wiring

Care should be taken to see that ignitor cables and scanner cables are routed away from one another on all installations. These cables, when crossed or run together, may interfere with the proper operation of the flame safeguard control.

If you are experiencing erratic operation or inappropriate characters on the display during the trial for ignition period, the cause is likely to be ignitor noise. Check for worn ignitor cable insulation, broken or cut insulation or loose connectors at the electrode and transformers.

### SUGGESTED GROUNDING RULES

The Flame-Monitor 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 Flame-Monitor 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 Flame-Monitor chassis (EB700) 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.

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## 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. 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 E-8002 for proper installation.

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## 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 E-8002 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 ERT1 amplifier, it may be beneficial to route a separate return wire from the S2 terminal to the flame rod assembly. This will minimize the effects of transient currents flowing into the Flame-Monitor.

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.

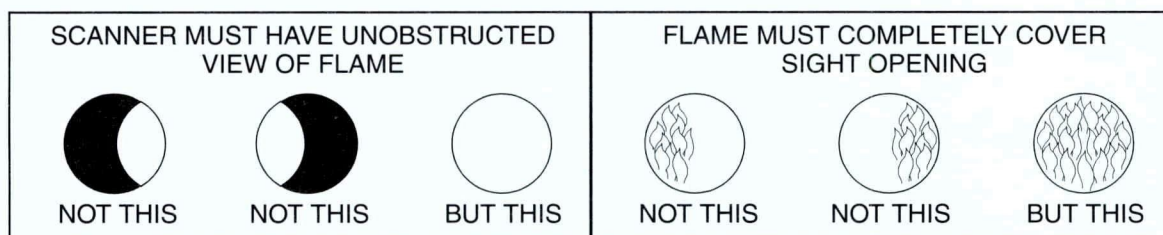
The VA rating of the control transformer must be sized to handle the inrush currents of the pilot solenoid and ignition transformer at PTFI and then the inrush currents of the main fuel valve assembly at MTFI time.

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

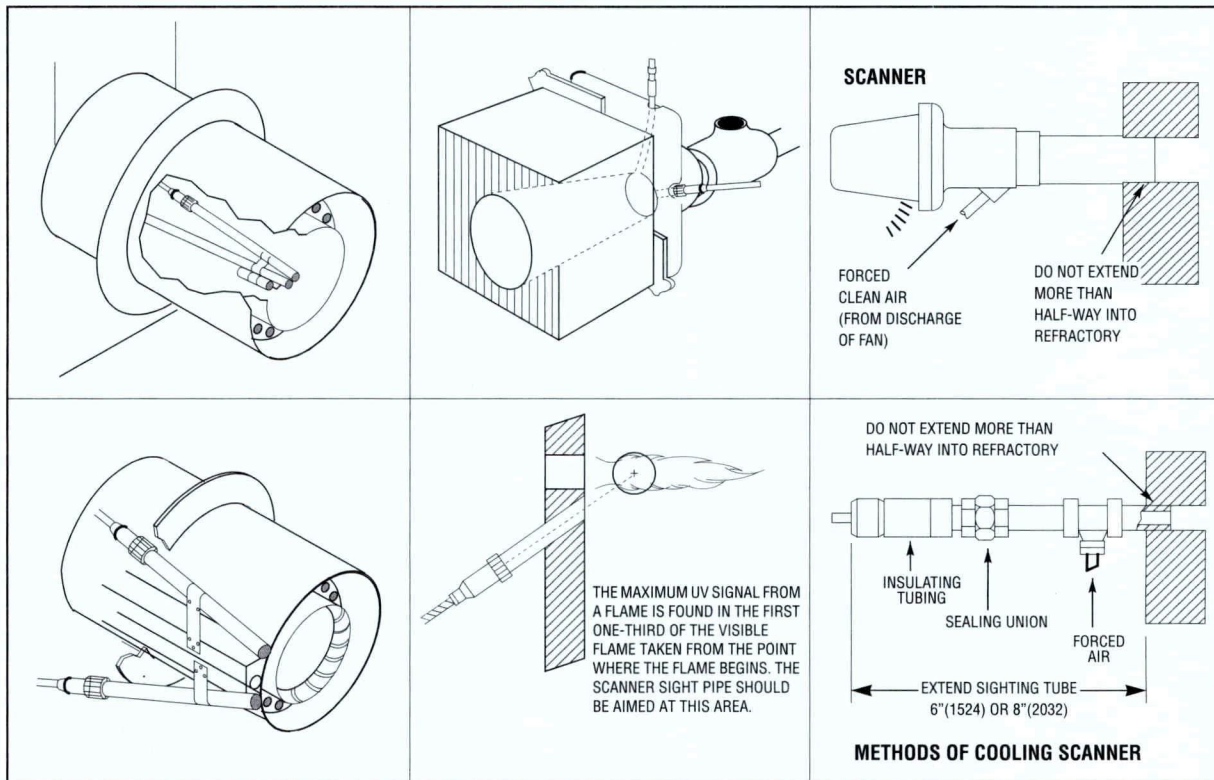
Where possible, obtain the burner manufacturer's instructions for mounting the scanner. This information is available for most standard burners. The scanner mounting should comply with the following general instructions:

1. Position the UV1, UV2 or UV90 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 #35-69 for UV1, UV2 Scanners, #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 #60-1199 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 UV1, 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, UV2 or UV90 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.
7. 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.
8. Request the assistance of any Fireye field office for recommendations of a proper scanner installation on a non-standard application.

## TYPICAL SCANNER INSTALLATIONS



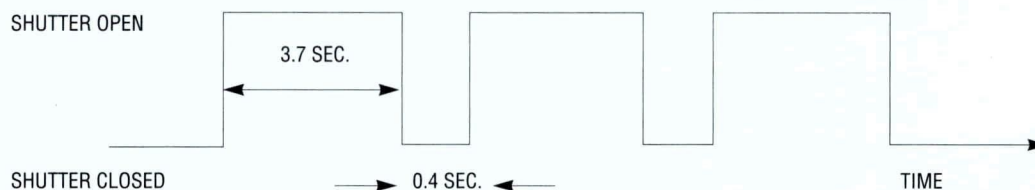
## OPERATION — 45UV5 SELF-CHECKING UV SCANNER

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 Flame-Monitor 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 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.

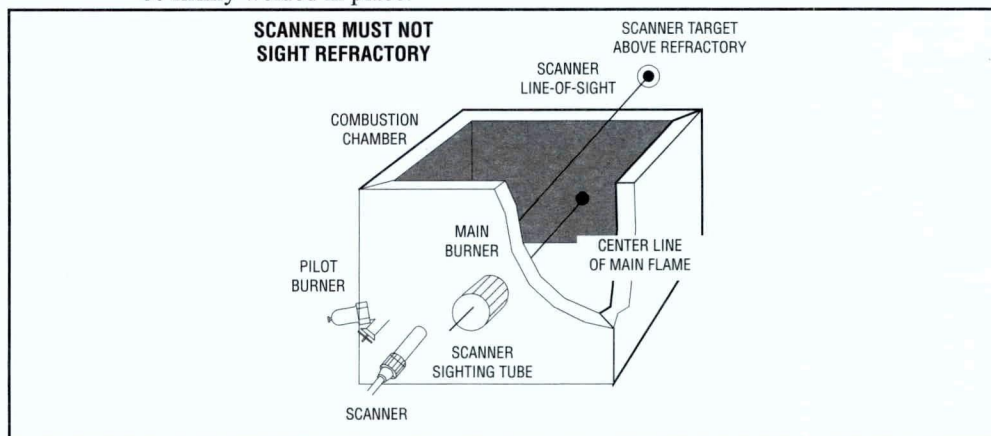
1. Selection of Wire
  - a. Wiring: For extended scanner wiring up to 500 feet, and for shorter lengths to reduce signal loss, use a shielded wire (Belden 8254-RG62 coaxial cable, or equal) for **each scanner wire** of UV1, UV2 and **each red wire** of the 45UV5. The ends of the shielding must be taped 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.
3. 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) (52°C).
7. When the proper position has been established, drill a hole through the furnace wall and install a 4" to 8" length of threaded  $\frac{1}{2}$ " black iron pipe on which to mount the 48PT2 scanner.
8. 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 #18. 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.

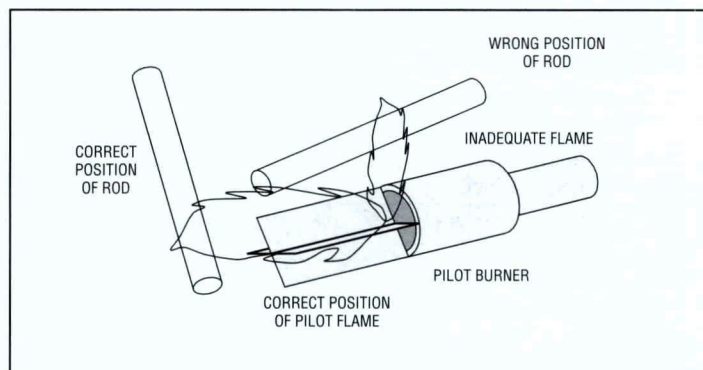
## INSTALLATION - 69ND1 FLAME ROD

The 69ND1 flame rod proves a gas pilot flame and/or main gas flame. It is a spark plug type unit consisting of  $\frac{1}{2}$ " "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  $\frac{1}{2}$ " "NPT" coupling.

The following instructions should be observed:

1. Keep flame rod as short as possible.
2. Keep flame rod at least  $\frac{1}{2}$ " 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  $\frac{1}{2}$ " into the flame, but not more than halfway through.

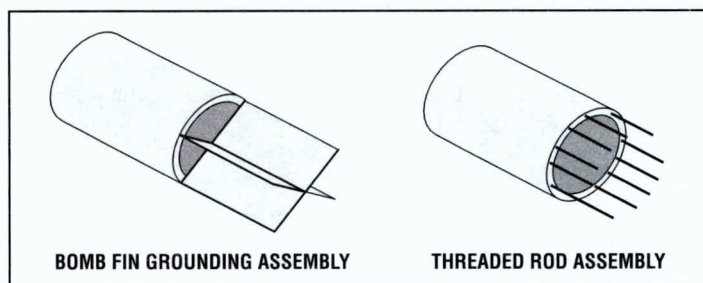


5. If the flame is partly luminous, the electrode tip should extend only to the edge of the flame. It is not necessary to maintain absolutely uninterrupted contact with the flame.
6. It is preferable to angle the rod downward to minimize the effect of sagging and to prevent it from coming in contact 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 minimize the effect of metal oxidation. This assembly may be welded directly over the pilot or main burner nozzle.





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## **MAINTENANCE**

### **Infrared and Ultraviolet 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 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 Flame-Monitor. Where contacts are used, their design assures long trouble-free life when the load circuits are maintained within the published load ratings.

### **Electrical Noise**

In areas of excessive electrical noise, the installation of an electrical noise suppressor to the power supply at the control circuit may be helpful.

### **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**

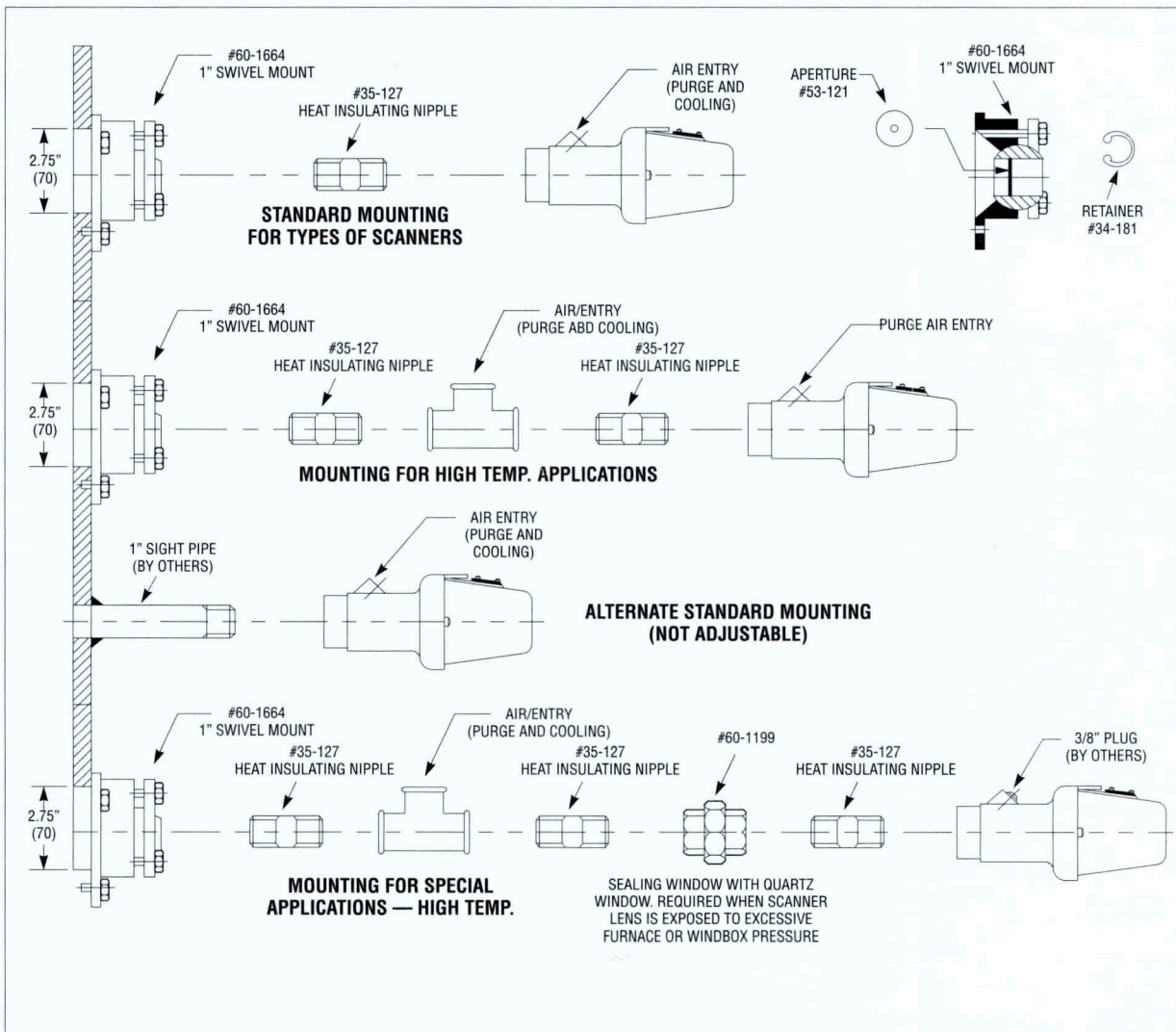
It is recommended that a procedure be established to test the complete flame safeguard system at least once a month. This test should verify the proper operation of all limit switches and safety interlocks as well as flame failure protection and fuel safety shutoff valve tightness.

### **Rotation**

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



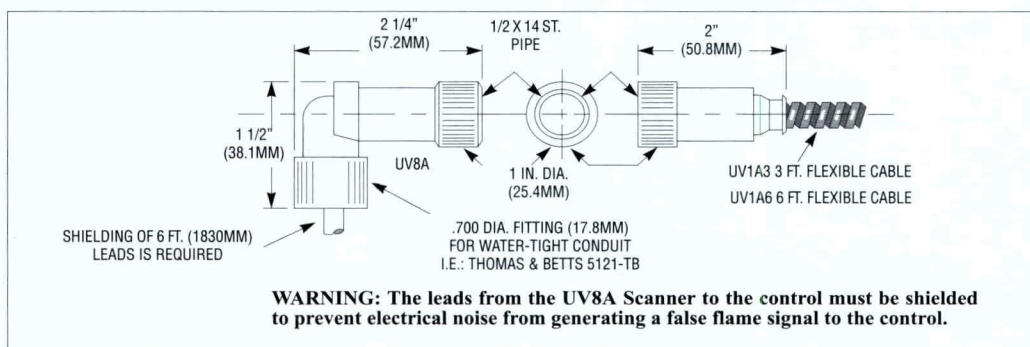
## Mounting 45UV5 Scanner



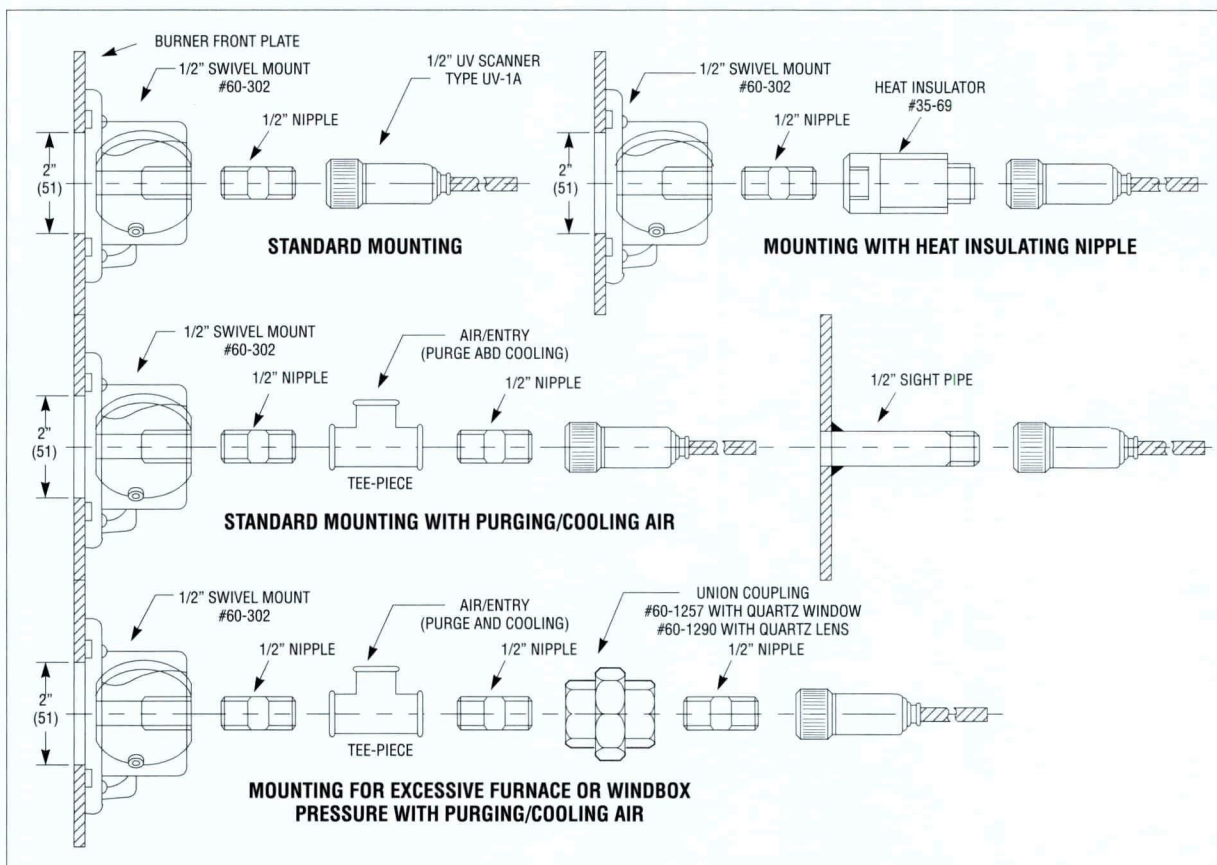


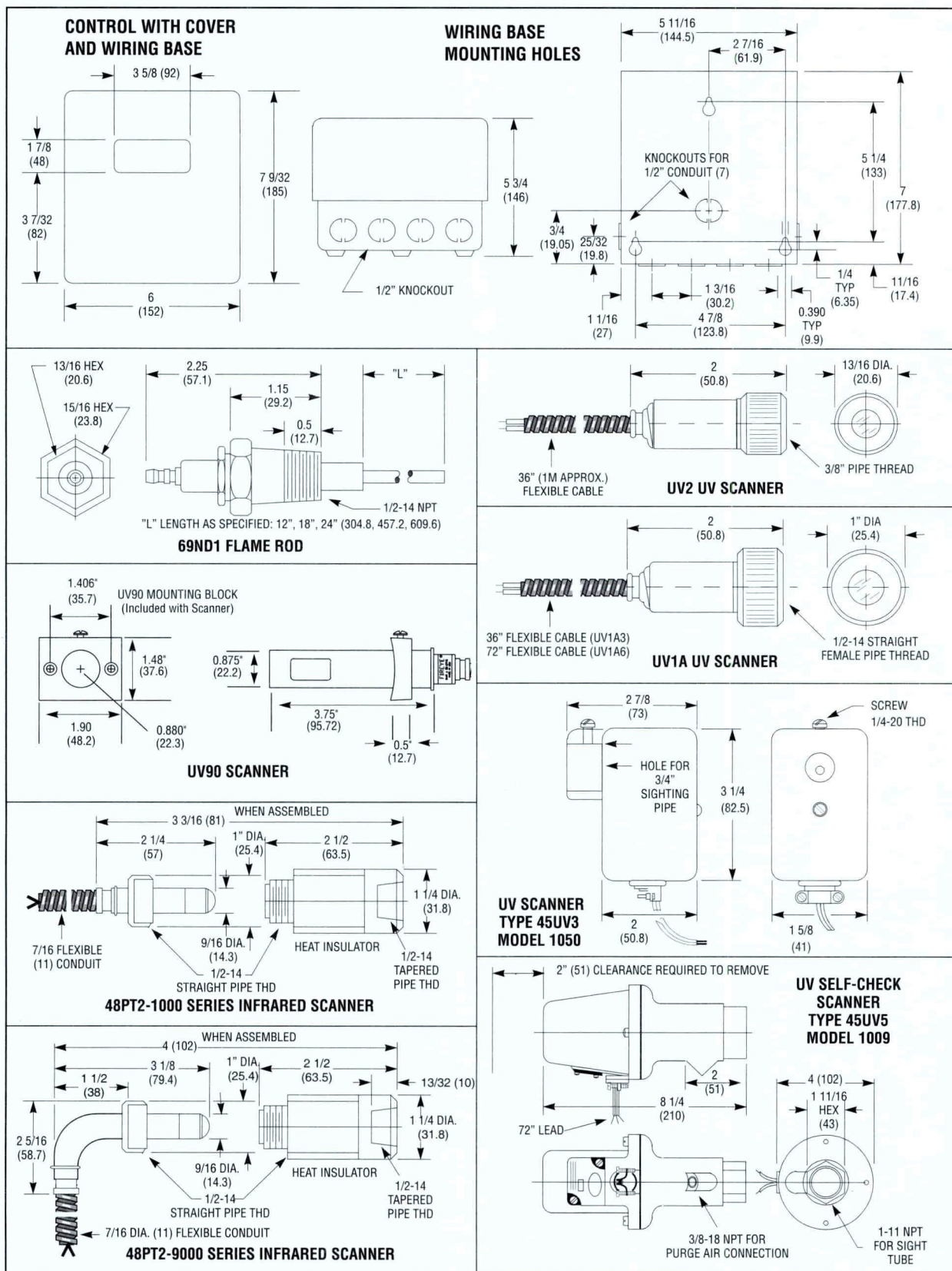


## UV8A Scanner



## Mounting UV1A Scanner





ALL DIMENSIONS IN INCHES (MILLIMETERS IN PARENTHESES).



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## 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.

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## 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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E-1101  
MAY 19, 2008  
Supersedes Aug. 3, 2007



EP-1601  
AUGUST 6, 2007



# **FIREYE® EP160, EP161, EP163, EP165, EP166, EP170, EP174 and EP177 PROGRAMMER MODULES**

**WITH SELECTABLE OPERATION**



## **DESCRIPTION**

The Fireye EP160, EP161 (extended MTFI), EP163 (programmable), EP170 and EP174 (early spark termination), EP165, EP166 (pilot stabilization) or EP177 (early spark termination and programmable operating parameters) programmer modules are used with the FLAME-MONITOR Burner Management Control System (P/N's E100 and E110). Several operational characteristics of the programmer are determined by six (6) dipswitches located on the side of the programmer. These characteristics include forced blower motor start delay (dipswitch 1), extended purge timing (dipswitches 3, 4, 5) and the option requiring the 3-P running interlock circuit to be proven open at the start of the operating cycle (dipswitch 6). Dipswitch 2 is inactive. Models EP163 and EP177 characteristics are programmed via the ED510 Display Module, rather than by dipswitch.

The EP160, EP161, EP163, EP165, EP166, EP170, EP174 and EP177 programmers provide start-up programming, safe-start check, and flame monitoring supervision. They insure open damper (high purge) prepurge, proof of low fire position, and fuel valve end switch safety checks. A running interlock circuit on the FLAME-MONITOR system constantly monitors the limit switches, air flow switches, and fuel pressure switches through the programmer. The programmer control is designed to initiate a safety lockout if any of these circuits are open at the improper point in the control cycle.

The programmer module will de-energize all fuel valve circuits within four (4) seconds (max.) following a flame failure [two (2) seconds for the EP165 and EP166], or at the end of the pilot trial for ignition period if no flame is detected. An alarm circuit will be energized following a safety lockout.

The programmer module includes an RJ45 style connector to interface with an integral or remote alpha-numeric display (P/N ED510). It is also backward compatible with the ED500 display. It includes two (2) additional RJ style connectors to connect to an E500 communication interface in a multi-drop configuration or allow communication via a Modbus protocol. The programmer will also communicate with the E500 via the ED550 cables to provide backward compatibility.

The programmer is the heart of the FLAME-MONITOR System and features a plug-in design for ease of installation. It is micro-processor based and stores the burner cycles, burner hours, system hours, and lockout history (with burner cycle and burner hour time stamp) which are accessible via the ED510 alpha-numeric display, E500 Communication Interface, InTouch Wireless Monitoring System or Modbus communications. If replaced, the new programmer card will begin accumulating a new history.

**Refer to Bulletin E-1101 for detailed information on the FLAME-MONITOR System.**



## INSTALLATION



**CAUTION:** To prevent shock hazard, remove power from the system wiring base before proceeding. Remove control from the wiring base before proceeding.

The EP programmer modules are used with the Fireye EB700 and E110 chassis. They are installed in the chassis by inserting the EP programmer module into the second slot on the control. This slot is marked "Programmer Module" on the side of the chassis. Refer to bulletin E-1101 for complete system information.

The programmer module is designed to fit only in the proper slot. It cannot be snapped into place if inserted in the wrong location. **DO NOT FORCE THEM.**

An amplifier module, display module ED510 (ED500 is obsolete), flame scanner, and wiring base are also required for the FLAME-MONITOR control.

All programmers with an Engineering code of 28 or later (e.g. 9414-28) are compatible with both the ED500 and ED510 display modules. See "Programmer and Display Module Compatibility" later in this document. The Engineering code is located on the back side of the board in the lower right hand corner. The EP163 programmer requires the ED510 display for initial configuration programming.

## APPROVALS

**Underwriters Laboratories Inc.:**

MCCZ File MP 1537

Controls, Primary Safety - Listed

MCCZ2 File MP1537

Controls, Primary Safety - Component

MCCZ7 File MP1537

Controls, Primary Safety Certified for Canada

MCCZ8 file MP1537

Controls, Primary Safety Certified for Canada - Component

**ACCEPTABLE BY: INDUSTRIAL RISK INSURERS (I.R.I.)**

**FACTORY MUTUAL (FM) APPROVED**



**WARNING:** This equipment generates, uses 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 required to take whatever measures may be required to correct the interference.



## ORDERING INFORMATION

PART NUMBER	PURGE <sup>1</sup>	IGNITION TIMING			FFRT <sup>2</sup>
			PTFI	MTFI	
EP160	30 Sec. <sup>1</sup>	Term 5	10 Sec.	10 Sec.	4 Sec.
		Term 6	10 Sec.	15 Sec.	
EP161	30 Sec. <sup>1</sup>	Term 5	10 Sec.	10 Sec.	4 Sec.
		Term 6	10 Sec.	30 Sec.	
EP163	40 Sec. <sup>5</sup>	Term 5	5 Sec. <sup>5</sup>	5 Sec. <sup>5</sup>	4 Sec.
		Term 6	5 Sec. <sup>5</sup>	5 Sec. <sup>5</sup>	
EP165 <sup>4</sup>	30 Sec. <sup>1</sup>	Term 5	10 Sec.	—	2 Sec.
		Term 6	10 Sec.	10 Sec. <sup>3</sup>	
EP166 <sup>4</sup>	30 Sec. <sup>1</sup>	Term 5	10 Sec.	—	2 Sec.
		Term 6	10 Sec.	15 Sec. <sup>3</sup>	
EP170	30 Sec. <sup>1</sup>	Term 5	5 Sec.	—	4 Sec.
EP177 <sup>5</sup> EP174 <sup>6</sup>		Term 6	10 Sec.	10 Sec.	

<sup>1</sup> Purge timings are adjustable. See "Dipswitches — Purge Timing."

<sup>2</sup> FFRT is the Flame Failure Response Time.

<sup>3</sup> During MTFI, terminal 6 is energized for 5 seconds (pilot stabilization) before energizing terminal 7 for 10 seconds (EP165) or 15 seconds (EP166).

<sup>4</sup> EP 165 and EP166 will lockout in the event of a power interruption.

<sup>5</sup> EP163 and EP177 purge and ignition timings are programmable via ED510.

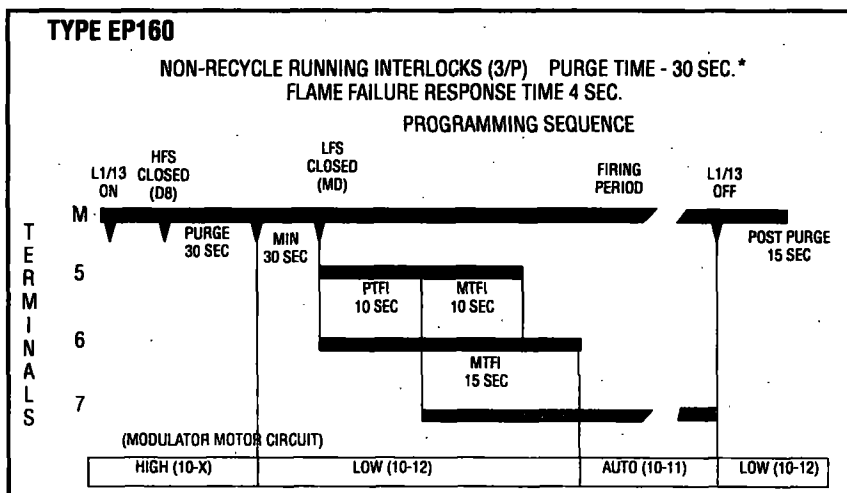
<sup>6</sup> M-D Low Fire start is proven closed during PTFI and MTFI.

*Note: EP160, EP161, EP163, EP165, EP166, EP170, EP174 and EP177 have non-recycle running interlock circuits (3/P).*



**WARNING:** While all controls are mechanically interchangeable because they mate with a common wiring base, you must select the correct model for your application. Inappropriate application of a control could result in an unsafe condition hazardous to life and property.

## TIMING CHARTS



### DIPSWITCH SETTINGS

1	2	3	4	5	6
INACTIVE	Down	Down	Down	Down	Down

\* Purge timings are adjustable.

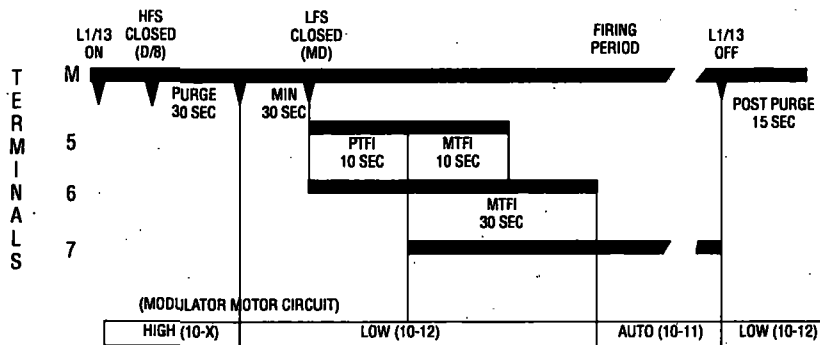




### TYPE EP161

NON-RECYCLE RUNNING INTERLOCKS (3/P) PURGE TIME - 30 SEC.\*  
FLAME FAILURE RESPONSE TIME 4 SEC.

#### PROGRAMMING SEQUENCE



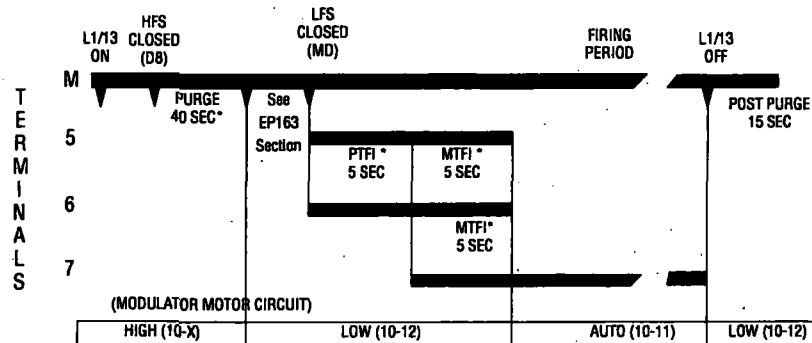
#### DIPSWITCH SETTINGS

1	2	3	4	5	6
INACTIVE		Down	Down	Down	Down

### TYPE EP163

NON-RECYCLE RUNNING INTERLOCKS (3/P) PURGE TIME - 40 SEC.\*  
FLAME FAILURE RESPONSE TIME 4 SEC.

#### PROGRAMMING SEQUENCE



#### DIPSWITCH SETTINGS

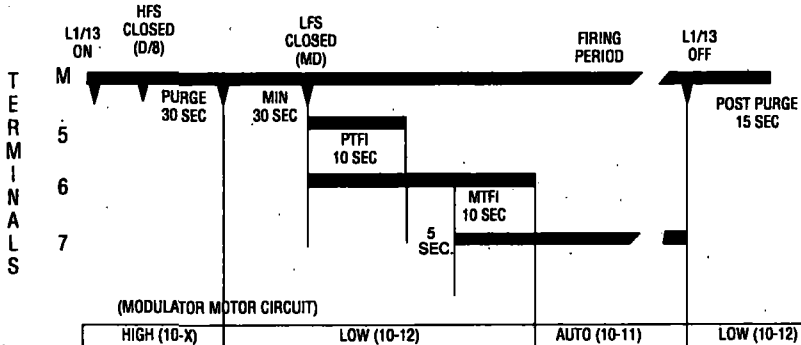
1	2	3	4	5	6
ALL SETTINGS ARE INACTIVE					

- \* Factory default values are shown.
- \* PURGE, PTFI, MTFI, and Post Purge timings are programmable via ED510 display. Refer to EP163 section of this bulletin.

### TYPE EP165

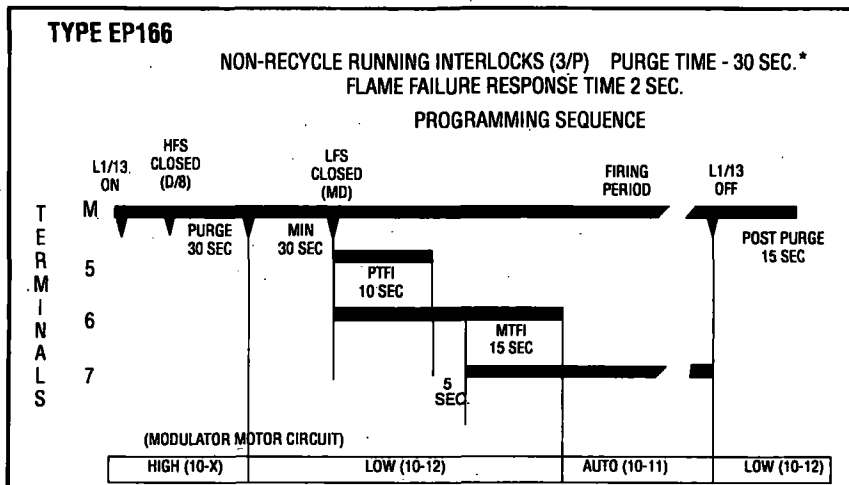
NON-RECYCLE RUNNING INTERLOCKS (3/P) PURGE TIME - 30 SEC.\*  
FLAME FAILURE RESPONSE TIME 2 SEC.

#### PROGRAMMING SEQUENCE



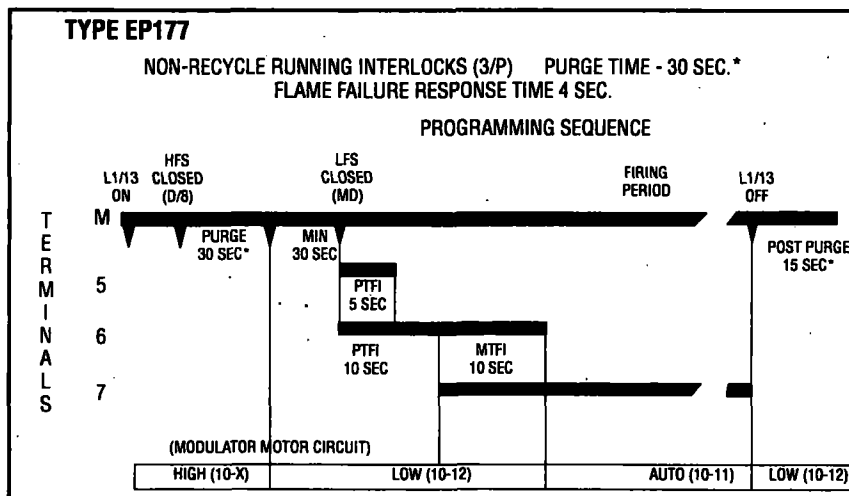
#### DIPSWITCH SETTINGS

1	2	3	4	5	6
INACTIVE		Down	Down	Down	Down



**DIPSWITCH SETTINGS**

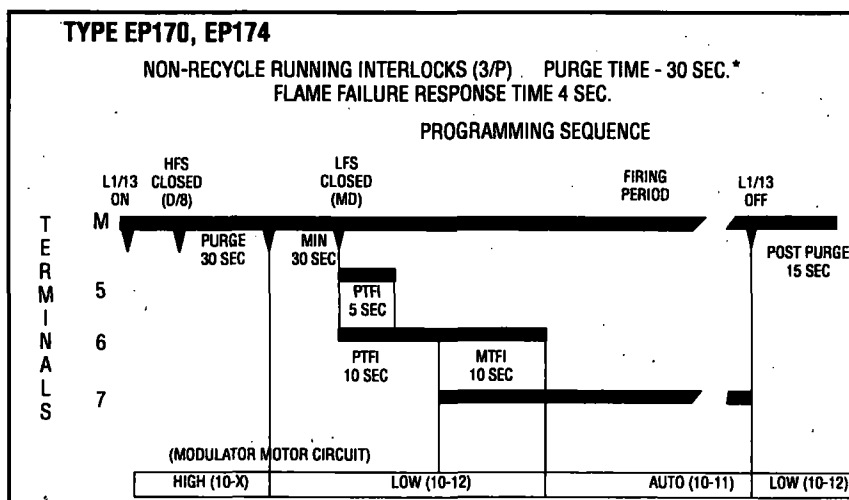
1	2	3	4	5	6
INACTIVE		Down	Down	Down	Down



**DIPSWITCH SETTINGS**

1	2	3	4	5	6
ALL SETTINGS ARE INACTIVE					

- \* Factory default values are shown.
- \* PURGE, PTFI, MTFI, and Post Purge timings are programmable via ED510 display. Refer to EP177 section of this bulletin.



**DIPSWITCH SETTINGS**

1	2	3	4	5	6
INACTIVE		Down	Down	Down	Down



## DIPSWITCHES FOR SELECTABLE OPERATION

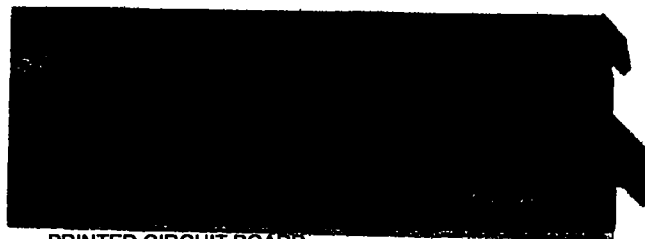
Several operational characteristics of the EP160, EP161, EP165, EP166, EP170 and EP174 programmer modules are determined by six (6) dipswitches located on the side of the programmer. These characteristics include purge timing (dipswitches 3, 4, 5) and the option requiring the 3-P running interlock circuit to be proven open at the start of the operating cycle, and that the D-8 (Purge Interlock) and M-D (low fire start interlock) switches open and close at the appropriate times (dipswitch 6). Dipswitch 2 is inactive. (Refer to later sections in this bulletin describing the EP163 programmer).

In programmer models with engineering code 39 and above, for a PPC5000 to recognize a new cycle, dipswitch 1 now invokes a 3 second delay after the operating switch closes to when the blower motor, terminal M, becomes powered. On a quick recycle, this will all force terminal M to become de-energized for 3 seconds.



**WARNING: THE INAPPROPRIATE SELECTION OR APPLICATION OF A PROGRAMMER MODULE COULD RESULT IN AN UNSAFE CONDITION HAZARDOUS TO LIFE AND PROPERTY.** The various programmer modules (EP160, EP260, and EP380) are interchangeable because they plug into a common chassis. Changing the dipswitches modifies the operation of each programmer module. Care should be taken to insure the proper dipswitch settings. Selection of the programmer module and setting the dipswitches for a particular application should be made by a competent professional, such as a Boiler/Burner technician licensed by a state or other government agency, engineering personnel of the burner, boiler, or furnace manufacturer (OEM) or in performance of duties based on information from the OEM.

FRONT COVER



↑ UP

PRINTED CIRCUIT BOARD

↓ DOWN

## DIPSWITCHES - INACTIVE

### DIPSWITCH 1 - FORCED BLOWER MOTOR START DELAY

When using a PPC5000 for boiler control operation, for the PPC5000 to recognize the beginning of a new burner operating cycle, it is necessary to force the blower motor (terminal M) off or non-powered for a short period of time. Placing dipswitch 1 in the UP position will delay the blower from starting 3 seconds after the operating control (terminal 13) closes or force the blower motor to de-energize for 3 seconds in the event of a quick recycle. The function of dipswitch 1 is not made permanent after 8 hours of operation.

### DIPSWITCHES 3, 4, & 5 - PURGE TIMING

Dipswitches 3, 4, & 5 determine the purge timing for the programmer module. Purge timings are selectable from 30 seconds to 30 minutes. On the EP160, EP161, EP165, EP166, EP170 programmer, the purge timing is not initiated until the firing rate motor is driven to the high fire position (10-X made) and the high fire switch is proven closed (term D-8). At the end of the purge timing, the firing rate motor is driven to the low fire position (10-12), and the control waits an additional 30 second (minimum) until the low fire start interlock is proven closed (M-D). Refer to the table on dipswitch functions to select the various purge timing.



### DIPSWITCH 6 (3-P), (D-8), (M-D) INTERLOCK CHECK\*

Dipswitch 6 provides the option to require that the 3-P, D-8, and M-D interlock circuits be proven closed *and open* at the appropriate times.

1. If this option is enabled (switch 6 is up) the **3-P** Running Interlock circuit must be **proven open** at the start of the operating cycle (when the L1-13 circuit first closes). If the 3-P circuit is closed at the start of the operating cycle, the blower motor will not energize (terminal M), and the control will "Hold" for one (1) minute waiting for the 3-P circuit to open. If, after one minute, the 3-P circuit does not open, the control will lockout. If, within one minute the 3-P circuit does open, the blower motor will energize (terminal M), and the control will wait up to ten (10) seconds for the 3-P circuit to be **proven closed**.
2. If this option is enabled (switch 6 is up), the **D-8** High-Fire Purge interlock circuit must be **proven open** at the start of purge before the Flame-Monitor™ will drive the firing rate motor to the high-fire position, (at which time the switch must then be **proven closed**). If the D-8 interlock circuit is closed at the start of the purge period, the control will "Hold" for ten (10) seconds, then lockout.
3. If this option is enabled (switch 6 is up), the **M-D** Low-Fire-Start interlock circuit must be **proven open** at the end of high-fire purge before the Flame-Monitor will drive the firing rate motor to the low-fire position, (at which time the switch must then be **proven closed**). If the M-D interlock circuit is closed at the end of the high-fire purge period, the control will "Hold" for ten (10) seconds, then lockout.

*Note: If a particular installation does not have operational switches in all three circuits listed above, (such as an installation where there is no High-Fire -Purge switch installed, and a permanent jumper is wired between terminals D-8), dipswitch 6 should not be enabled.*

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\*The EP160, EP161, EP165, EP166, EP170 programmers are shipped with this option disabled (switch 6 is down).



## DESCRIPTION OF DIPSWITCH FUNCTIONS

DIPSWITCH POSITION						TERMINAL TIMINGS			
Up = UP		DN = DOWN			PROGRAMMER TYPE	PTFI		MTFI	
1	2	3	4	5		T-5	T-6	T-5	T-6
LOCKOUT DELAY INACTIVE					EP160	10	10	10	15
					EP170	5	10	—	10
					EP161	10	10	10	30
					EP165	10	10	—	10*
					EP166	10	10	—	15*
		Dn	Dn	Dn	30 sec.	SELECTABLE HIGH FIRE PURGE TIMING  Low Fire Purge Timing added to selected purge — 30 sec. (minimum)			
		Dn	Dn	Up	60 sec.				
		Dn	Up	Dn	90 sec.				
		Dn	Up	Up	2 min.				
		Up	Dn	Dn	5 min.				
		Up	Dn	Up	10 min.				
		Up	Up	Dn	15 min.				
		Up	Up	Up	30 min.				
					Dn	DISABLED			
					Up	ENABLED			

\* During MTFI, terminal 6 remains energized for 5 sec. (pilot stabilization) before energizing terminal 7 for 10 sec (EP165), or for 15 sec. (EP166 only).

### PROGRAMMER AND DISPLAY MODULE COMPATIBILITY

Two display modules are available for the FLAME-MONITOR control system (P/N's ED500 and ED510). The ED500 is an 8 character LED display that physically mounts in the card rack of the EB700 chassis. The ED510 is a 2 line by 16 character LCD with keypad to provide both current and historical information pertaining to the operation of the control. The ED510 display physically mounts onto the front cover of the programmer module. Refer to Bulletin ED5101 for a complete description of the features and capabilities of the ED510 display module. Programmers with an Engineering code of 28 or later (e.g.: 9414-28) are compatible with both the ED510 and ED500 display module. Programmers with an Engineering code before 28 are only compatible with the ED500 display.

## IMPORTANT INFORMATION — PLEASE READ CAREFULLY

### DETECTING AIR FLOW SWITCH (3-P) CLOSED AFTER START

In code 39 programmers and above, the method used to detect the air flow switch closed at the beginning of a cycle has been changed to avoid any nuisance lockouts. Currently, after the operating control closes, the programmer waits 10 seconds for the air flow switch to close and if not closed will go into lockout. The EP programmers utilize the open damper switch interlock, D-8, to determine the wait time for the air flow switch to close. If, at the start of a cycle after a blower turns on, the D-8 interlock is detected as closed, most likely indicating a jumped high fire switch, the programmer allows 20 seconds for the air flow switch to close. Alternatively, at startup, if the D-8 interlock is open, indicating the firing rate motor is at the low fire position and the damper is closed, the programmer will not check for the air flow switch closed until 10 seconds after the open damper switch has closed and the purge period has begun. This means the programmer will send the mod motor to the high fire position, forcing the high fire damper switch to close, and will then begin its 10 second timer to check for the air flow switch to close.



### PERMANENT BURN-IN OF DIPSWITCH FUNCTIONS

The EP Programmer modules have a set of six (6) dipswitches on the side of the programmer to modify various functions associated with the operation of the programmer (e.g. purge timing, prove 3-P circuit open to start, etc.). **THESE FUNCTIONS BECOME PERMANENT AFTER THE CONTROL HAS BEEN POWERED FOR EIGHT (8) HOURS.\*** After this burn-in period, changing position of the dipswitches will not change the operation of the programmer.

*Note: The function of dipswitch 1 is not stored.*

The user can bypass the burn-in period via the ED510 display module. Use the SCROLL and MODE key to select the "Programmer Set-Up" Sub-Menu (Refer to bulletin ED-5101) and then the SCROLL key to display the prompt:

**PRESS RESET TO  
ACCEPT SETTINGS**

Press the Reset key at this prompt and the screen will display:

**YOU AGREED TO  
ACCEPT SETTINGS**

After the above key sequence is completed, changing the position of the dipswitches will not change the operation of the programmer.

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## PROGRAMMING THE EP163 PROGRAMMER MODULE

The EP163 Programmer Module provides a number of operational characteristics that are selected via the ED510 Keypad/Display rather than by dipswitch selection. The following is a list of the programmable functions associated with the EP163 Programmer Module:

- Selectable purge (selectable from 6 seconds to 40 seconds in 2 second increments - default setting is 40 seconds).
- Prove the operation of the 3-P Running Interlock Circuit.
- Prove the operation of the High Fire Purge Interlock (D-8).
- Prove the operation of the Low Fire Start Interlock (M-D).
- Selectable timings on terminals 5 and 6 during Pilot Trial For Ignition (PTFI).
- Selectable timings on terminals 5 and 6 during Main Trial For Ignition (MTFI).
- Selectable Post Purge Timing of 1 or 15 seconds.

### MODIFYING THE PROGRAMMER

1. Insert the EP163 programmer module into the EB700 chassis and connect the ED510 Keypad/Display.
2. Open the operating control (L1-13) circuit. The EP163 cannot be modified unless the operating control is open.
3. The PROGRAM SETUP sub-menu will be used to display the programmable functions. Press the SCRL key until the PROGRAM SETUP sub-menu is displayed.
4. Press the MODE key to enter the PROGRAM SETUP sub-menu. The SCRL key will advance through the selections in the sub-menu. The first four items displayed in the sub-menu are PROGRAMMER TYPE EP163, ENGR CODE, AMPLIFIER TYPE, and FFRT TIME 4 S. These items are not programmable.
5. Press the SCRL key and the next item displayed (and first programmable item) is PURGE TIME followed by the current setting (default setting = 40 seconds). The available purge timings are from 6 to 40 seconds, in 2 second increments.
6. Press and hold the RESET button for 1 second to enter the "Modify" mode (providing the control was not in a lockout condition). After a 2-3 second delay, the control will display SCRL TO MODIFY on the top line of the display (replacing STANDBY).

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\*Programmer module EP163 has a fifty (50) hour burn-in period.





7. Press the SCRL key to advance through the allowable selections. The selections will roll over from the last selection to the first one.
8. Press and hold the RESET button for one second to choose and store in memory the appropriate selection.

*Note: Following the purge period, the EP163 will initiate PTFI as soon as the M/D circuit closes (eliminating the 30 seconds minimum wait period).*

9. The SCRL key will advance through the following selections. Follow steps 1 through 8 to modify the selections.
10. PROVE 3-P OPEN Y  
Available selections are Yes (Y) and No (N). Yes is the default selection. If selected Y, at the start of the operating cycle, the control will check to see if the 3-P circuit is open before energizing the blower motor. If closed, the control will hold for 60 seconds and then lockout.
11. PROVE D-8 OPEN N  
Available selections are Yes (Y) and No (N). No is the default selection. If selected Y, the control will check to see if the D-8 circuit is open before driving the firing rate motor to the high fire position (10-X). If closed, the control will hold for 60 seconds and then lockout.
12. PROVE M-D OPEN Y  
Available selections are Yes (Y) and No (N). Yes is the default selection. If selected Y, the control will check to see if the M-D circuit is open at the end of the purge period before driving the firing rate motor to the low fire position (10-12). If closed, the control will hold for 60 seconds and then lockout.
13. PTFI TIMING 5 SEC  
This selects the timings for terminals 5 and 6 during Pilot Trial For Ignition (PTFI). Available selections are 5 and 10 seconds. The default value is 5 seconds. Timing selection applies to both terminal 5 and 6. The control will begin MTFI as soon as flame is detected (following 2 second check at the start of PTFI). For example, 3 seconds into PTFI, flame signal detected, terminal 7 is energized.



**CAUTION: Main fuel valve (terminal 7) will be powered as soon as PILOT FLAME IS DETECTED.**

14. MTFI TIMING 5/5  
This selects the timings of terminals 5 and 6 during Main Trial For Ignition (MTFI). The first number represents terminal 5, the second number represents timing associated with terminal 6. Available selections are: 0/5, 5/5, 0/10, 5/10, 10/10, 0/15, and 10/15. Default value is 5/5.
15. POST PURGE 15  
Available selections are 15 seconds and 1 second. Default value is 15 seconds.



**CAUTION: PER UL 296, A MECHANICAL DRAFT BURNER HAVING AN INPUT IN EXCESS OF 20 GPH (76 L/H) SHALL PROVIDE A POST-PURGE PERIOD OF NOT LESS THAN 15 SECONDS.**

16. UNIT ADDRESS 00  
Available selections are 00 through 15. Default selection is 00.
17. ACCEPT SETTINGS N  
Available selections are Yes (Y) and No (N). No is the default selection. If selected Y, the system will accept the current settings (overriding the 50 hour normal burn-in time). If selected No, the settings will be permanently burned in after a 50 hour burn-in period. After the 50 burn-in time, the settings will not be able to be changed.
18. Press the MODE key to return to the run message.



**WARNING: THE INAPPROPRIATE SELECTION OR APPLICATION OF A PROGRAMMER MODULE COULD RESULT IN AN UNSAFE CONDITION HAZARDOUS TO LIFE AND PROPERTY. Care should be taken to ensure the proper selection for each setting. Selection of the settings 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 performance of duties based on information from the OEM.**



The pilot valve terminal can be set for interrupted or intermittent operation. If intermittent (INTMT), terminal 6 will remain energized during the firing cycle.

PROVE D-8 OPEN Y/N default is N

**The open damper proving switch must not be closed at the start of a burner cycle.**

PROVE M-D OPEN Y/N default is N

**The closed or low fire start position of the damper must not be closed at the end of open damper pre-purge time.**

PURGE COUNT	UP/DWN	default is DWN
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**If selected as DWN, the pre-purge time will start at the selected time and count down to 0.**

**POST PURGE**                      1s, 15s, 30s, 60s                      default is 15s



**CAUTION: PER UL 296, A MECHANICAL DRAFT BURNER HAVING AN INPUT IN EXCESS OF 20 GPH (76 L/H) SHALL PROVIDE A POST-PURGE PERIOD OF NOT LESS THAN 15 SECONDS.**

UNIT ADDRESS 00

**Available selections are 00 through 15. Default selection is 00.**

ACCEPT SETTINGS N

Available selections are Yes (Y) and No (N). No is the default selection. If selected Y, the system will accept the current settings (overriding the 50 hour normal burn-in time). If selected No, the settings will be permanently burned in after a 50 hour burn-in period. After the 50 burn-in time, the settings will not be able to be changed.

**Press the MODE key to return to the run message.**



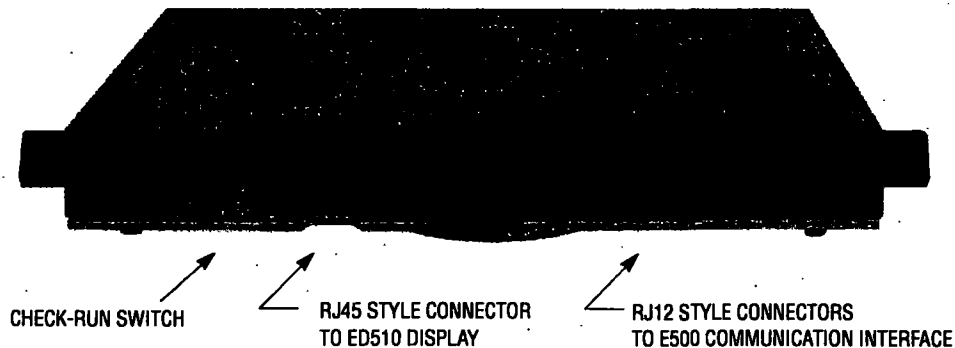
**WARNING: THE INAPPROPRIATE SELECTION OR APPLICATION OF A PROGRAMMER MODULE COULD RESULT IN AN UNSAFE CONDITION HAZARDOUS TO LIFE AND PROPERTY.** Care should be taken to ensure the proper selection for each setting. Selection of the settings for a particular application should be made by a competent 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 performance of duties based on information from the OEM.



## RJ STYLE CONNECTORS

### ED510 Display - See Bulletin ED-5101

Programmer modules (with Engineering code 28 or later) include an RJ45 style connector to connect to an alpha-numeric display (P/N ED510). The ED510 can snap onto the front cover of the programmer module or be mounted remotely (See Bulletin E-8101— Remote mounting kit). The ED580 cable (provided with ED510 Display) then plugs into the RJ45 style connectors on both the ED510 display and programmer module.



### Check-Run Switch

The Check-Run switch is located on the top of the EP Programmer Module and can be used to stop the control in its firing sequence at any time except MTFI. If moved during the MTFI period, it is not functional and automatic programming continues. It aids in the set-up and adjustment of the burner linkages, pilot assembly, etc. Refer to Bulletin E-1101 for a complete description of the Check-Run Switch.

### E500 Communication Interface and InTouch Wireless Monitoring System

Programmer modules include two (2) RJ12 style connectors to connect to the RS485 Interface on the E500 Communication Interface or InTouch Wireless Monitoring System in a multi-drop wiring configuration with other devices or connect to a Modbus network. Refer to Bulletin E-5001 and INT-1000 respectively. Up to six (6) each of EP programmers and E340 Boiler Controls (12 total) can be wired in an E500 multi-drop configuration or up to ten (10) to the InTouch. (Unit address 00 to 31). When connected in this manner, a unit address must be set on each programmer module connected to the RS485 interface. (See Unit Address). Programmers can also be connected to the E500 via the standard flat ribbon cables (ED550).



## UNIT ADDRESS

There are two methods to program the unit address when the programmer module is connected to the E500 via the RS485 interface:

### Method One (ED510 display only)

1. Press the SCRL key until the screen displays PROGRAM SETUP
2. Press the MODE key and the screen displays PROGRAMMER EP160 (or appropriate model).
3. Press the SCRL key until the screen displays UNIT ADDRESS #00 (or appropriate address).
4. Every time the RESET key is held down for 1 second and then released will increase the address by one.
5. Maximum address is 31. Then the address will roll over to 00.

### Method Two (ED510 or ED500)

1. Make sure the control is not in a lockout condition. If so, press the reset button.
2. Open the operating control (term L1-13).
3. Move the "Check-Run" switch to the Check position.
4. The display will indicate Unit Address 00 (or the current address).
5. Every time the reset button is held down for 1 second and then released will increase the address by one.
6. Maximum address is 31. Then the address will roll over to 00.

## FLAME-MONITOR MODBUS COMMUNICATIONS

The protocol to be used is Modbus RTU. This is implemented by the master (PC, PLC, etc.) issuing a poll to the slave (Flame-Monitor) 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 Flame-Monitor programmers, followed by a description where necessary.



**Table 1:**

MESSAGE ADDRESS	WORD REQUESTED	RESPONSE	VALUE
00	1-6	STATUS	83 (053H) = RUN; 202 (0CAH) = LOCKOUT
01	1	MSGN	Current message being displayed (see Table 3)
02	1	GSTAT	Defines Timer Type
03	1	TIMER	Time, Flame, Address
04	1	FLAME	Flame Signal
05	1-3	LOGSTAT	Current logic module, PURGE, PTFI, AUTO (see Table 2)
06	1	INPUTS	Input limits state
07	1	OUTPUTS	Output relays state
08	2	SYSMINS	System on minutes
10	2	BNRMINS	Burner on minutes
12	2	CYCLES	Completed Burner Cycles
14	1	LOCKOUT COUNT	Stored Lockout Count
15	1-6	LOCKOUT HISTORY	Last 6 Lockouts, first word is most current lockout
21	1-2	DEVTYP	Programmer device type, 5=EP, 6=EPD, 7=MicroM
22	1	AMPTYP	Amplifier Type; EUVS4=0C0H; EIR1=0A0H; ERT1, EUV1=090H;
MESSAGE ADDRESS	WORD REQUESTED	RESPONSE	VALUE
23			Not Used
24	2	FLAME SIGNAL AVERAGES	PTFI and Auto Flame Signal Averages
26	1-9	Combined status	See Description Below
35	6	Most Recent Lockout Data	Returns complete lockout description of stored lockout history. Includes lockout message, lockout module, @ burner hours, and @ burner cycles
41	6	2nd Most Recent Lockout Data	
47	6	3rd Most Recent Lockout Data	
53	6	4th Most Recent Lockout Data	
59	6	5th Most Recent Lockout Data	
65	6	6th Most Recent Lockout Data	
71	1-3	Input limits and Expansion Module registers	Returns input limits state and lower and upper expansion module (E300) registers. See Table 3
72	1-2	Expansion Module (E300) registers	Returns lower and upper Expansion module registers
73	1		Return only upper Expansion module register

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

Messages 00, 05, 08, 10, 15, 21 and 26 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. Refer to Table 3 for message information.

Message 26 returns the current operating status as well as stored burner hours and burner cycles as a snapshot of the entire Flame-Monitor system. When all 9 words are requested, the data returned consists of STATUS, MSGN, FLAME, INPUTS, OUTPUTS, BNRMINS, and BNRCYCS

The Flame-Monitor stores its burner on time and system on time (L1 powered) in minutes. For display purposes, the programmer converts this to hours. 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 Flame-Monitor is 9,999,999 minutes, the maximum value in hex therefore is 98967FH and comprises two data words. The maximum cycle count is 999,999 decimal or F423FH, still two data words. As an example, the System on Minutes data is transmitted from the Flame-Monitor to the interface as high word / low word as shown below:

Address 8		Address 9	
High Word		Low Word	
High Byte	Low Byte	High Byte	Low Byte
0	98H	97H	7FH

*Note: Data from address 9 cannot be accessed directly.*

All 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 Flame-Monitor 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 Flame-Monitor 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 active where a 1 in any bit position in the OUTPUT register signifies the relay as being energized.

#### INPUTS

Bit 7							Bit 0
Term P	Term 5/6	Term D		Term 8	Term 7	Term 3	Term 13
Air Flow	Ignition	Low Fire	Ref	High Fire	Main Fuel	FVES or POC	Op Ctrl

A '1' in the opto-coupler position indicates the opto-coupler is on or interlock closed.

#### Expansion Module (E300) Lower

Term 35	Term 34	Term 33	Term 32	Term 23	Term 22	Term 21	Term 20
Aux #6	Aux #5	Aux #4	High Temp	High Water	Main Fuel	FVES or POC	Op Ctrl

#### Expansion Module (E300) Upper

Term 31	Term 30	Term 29	Term 28	Term 27	Term 26	Term 25	Term 24
High Pressure	Low Gas Pressure or Low Atomizing Media	Low Oil Temp.	Low Oil Pressure	High Gas Pressure	Oil Selected	Gas Selected	Low Water

#### OUTPUTS

Term 11	Term M	Term 6		Term 5	Term 7	Term A	Term X
Auto (RA1)	Blower (RB)	Ignition (RA2)	FVES (RV)	Pilot (RP)	Main Fuel (RF)	Alarm (RL)	High Fire (RH)

Refer to Fireye bulletin E-1101 for terminal designations.



LOGSTAT is an indication of what logic module the control is currently operating in during its cycle and is used for diagnostic purposes only. If a lockout occurs the current value of LOGSTAT is stored as part of the lockout information. The message displayed corresponds to the current logic module.

Table 2:

#### EXPLANATION OF LOGSTAT

LOGIC DISPATCHER			
VALUE		MODULE	FUNCTION
DEC	HEX		
69	45H	MPOSTIDLE	ENERGIZING BLOWER MOTOR
70	46H	MPREPURGE1	WAIT FOR AIR FLOW AND/OR HIGH FIRE SWITCH TO CLOSE
71	47H	MPURGE	OPEN DAMPER PURGE
72	48H	MPOSTPURGE	LOW FIRE START
73	49H	MTFI	PILOT TRIAL
74	4AH	MTFMF	MAIN TRIAL
75	4BH	MAUTO	AUTO
76	4CH	MSHTDWN1	POST PURGE
77	4DH	MSHTDWN2	POST PURGE
78	4EH	MIDLE	STANDBY

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 the low fire start period where the mod motor is sent to the low fire position in preparation for pilot light-off. MSHTDWN1 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 the high fire proving switch (D-8). If either switch is found open, the control will remain in this state until the respective switch closes or lockout occurs.

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

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.

The Flame-Monitor outputs the current displayed message as well as the historical lockout messages as numbers. The table below correlates the message number with the actual displayed test message.

Table 3:

DEC	HEX	E110 FLAME-MONITOR MESSAGES
1	1	L1-13 OPEN
2	2	FALSE FLAME - STANDBY
3	3	LOW FIRE PURGE
4	4	D-8 LIMIT OPEN - HOLD
5	5	3-P AIR FLOW OPEN - HOLD
6	6	LINE FREQUENCY NOISE DETECTED
7	7	FLAME FAIL - PTFI
8	8	UNIT ADDRESS
9	9	M-D LIMIT OPEN - HOLD
10	A	IGNITION TIMING
11	B	MTFI
12	C	FLAME SIGNAL - AUTO



DEC	HEX	E110 FLAME-MONITOR MESSAGES
13	D	CYCLE COMPLETE
14	E	L1-13 OPEN
15	F	AC POWER FAIL (COEN)
16	10	SHORT CIRCUIT TERMINAL 5, 6 or 7
17	11	D-8 LIMIT OPEN - LOCKOUT
18	12	M-D LIMIT OPEN - LOCKOUT
19	13	FLAME FAIL - MTFI
20	14	FALSE FLAME - LOCKOUT
21	15	LOCKOUT 3-P INTLK OPEN (PURGE)
22	16	3-P INTLK CLOSED - LOCKOUT
23	17	3-P INTLK CLOSED - HOLD
24	18	HIGH FIRE PURGE
25	19	PLEASE WAIT
26	1A	LOCKOUT 3-P INTLK OPEN -AUO
27	1B	LOCKOUT 3-P INTLK OPEN (MTFI)
28	1C	LOCKOUT 3-P INTLK OPEN (PTFI)
29	1D	LOCKOUT 13-3 FVES OPEN
30	1E	FALSE FLAME - LOCKOUT
31	1F	FLAME SIGNAL - CHECK PTFI
32	20	D-8 HI LIMIT - CHECK
33	21	M-D low LIMIT CHECK - AUTO
34	22	FLAME SIGNAL - PTFI
35	23	LOW FIRE SIGNAL - CHECK AUTO
36	24	FLAME SIGNAL - MTFI
37	25	FLAME FAIL - AUTO
38	26	3-P INTLK OPEN - HOLD PURGE
39	27	FUEL VALVE STATE CHANGE
E300 EXPANSION MODULE MESSAGES		
40	28	3-P AIR FLOW OPEN
41	29	3-P HIGH WATER
42	2A	3-P LOW WATER
43	2B	3-P HIGH GAS PRESSURE
44	2C	3-P LOW GAS PRESSURE
45	2D	3-P LOW OIL PRESSURE
46	2E	3-P LOW OIL TEMPERATURE
47	2F	3-P LOW ATOMIZING MEDIA
48	30	3-P HIGH STEAM PRESSURE
49	31	3-P HIGH TEMPERATURE
50	32	3-P AUX #4 OPEN
51	33	3-P AUX #5 OPEN
52	34	3-P AUX #6 OPEN
53	35	3-P FUEL SELECT
54	36	LOCKOUT CHECK CHASSIS
55	37	LOCKOUT CHECK PROGRAMMER
56	38	LOCKOUT CHECK AMPLIFIER
57	39	LOCKOUT CHECK EXPANSION MODULE
58	3A	LOCKOUT AMPLIFIER AUTO CHECK FAIL
59	3B	LOCKOUT SCANNER NOISE



DEC	HEX	E110 FLAME-MONITOR MESSAGES
E300 EXPANSION MODULE HOLD MESSAGES		
60	3C	L1-13 AUX #1 OPEN (TERMINAL 20)
61	3D	L1-13 AUX #2 OPEN (TERMINAL 21)
62	3E	L1-13 AUX #3 OPEN (TERMINAL 22)
63	3F	3-P HIGH WATER (TERMINAL 23)
64	40	3-P LOW WATER (TERMINAL 24)
65	41	3-P HIGH GAS PRESSURE
66	42	3-P LOW GAS PRESSURE
67	43	3-P LOW OIL PRESSURE
68	44	3-P LOW OIL TEMPERATURE
69	45	3-P LOW ATOMIZING MEDIA
70	46	3-P HIGH PRESSURE (TERMINAL 31)
71	47	3-P HIGH TEMPERATURE (TERMINAL 32)
72	48	3-P AUX #4 OPEN (TERMINAL 33)
73	49	3-P AUX #5 OPEN (TERMINAL 34)
74	4A	3-P AUX #6 OPEN (TERMINAL 35)
75	4B	3-P FUEL SELECT
76	4C	LOCKOUT CHECK SCANNER
77	4D	HOLD D-8 LIMIT CLOSED
78	4E	LOCKOUT D-8 LIMIT CLOSED
79	4F	HOLD M-D LIMIT CLOSED
80	50	LOCKOUT M-D LIMIT CLOSED
81	51	LOCKOUT 13-3 POC CLOSED (CB ONLY)
82	52	DYNAMIC CHECK (CB ONLY)

## OPERATION

The EP160, EP161, EP163, EP165, EP166, EP170, EP174 and EP177 programmers provide the operator with a constant status indication as well as diagnostic information. Programmers with an Engineering code of 28 or later (e.g.: 9414-28) are compatible with either the ED510 (2 line x 16 character LCD display with keypad for local access to historical information) or ED500 (8 character LED display).<sup>\*</sup> For purposes of illustration for this bulletin, we will be looking at the EP160 Programmer functions and messages associated with the ED510 display module. The ED500 display messages will be abbreviated versions of those of the ED510. Refer to the suggestions shown in bulletin E-1101 before proceeding to power the Fireye FLAME-MONITOR system. Items such as scanner installation, short circuit tests and safety information should be reviewed.



**CAUTION:** On initial power-up and on restarts following a power failure, the control will perform self-test diagnostics for 15 seconds.

### Start-Up (Normal Cycle), EP160 Programmer

*Note: For direct spark ignited oil burners, substitute the words Main-Oil Valve for Pilot Valve.*

1. Constant 120 VAC should be wired to the L1-L2 terminals on the wiring base.
2. The operating control circuits (L1-13) will close, signaling the burner to start its firing sequence.
3. Assuming the fuel valve end switch (13-3) is closed, the burner/blower motor (terminal M) circuit is energized. The running interlock (limit) circuit (3-P) will close (e.g.: all limits, interlocks, etc. are proven).
4. The firing rate motor (Modulator Motor) is driven toward the high purge open damper position (10-X circuit made).

<sup>\*</sup>The EP163 programmer must be programmed via the ED510 display.



5. When the firing rate motor reaches its open damper position, the Hi Purge switch closes (D-8) and the prepurge interval of 30\* seconds is initiated. The ED510 will display:

**PURGE 00:05  
HIGH FIRE PURGE**

If the D-8 circuit does not close, the program will hold in this position for ten minutes waiting for it to close. If it does not, the control will lockout

6. When the prepurge is completed, the firing rate motor is driven toward the low purge damper position (10-12 circuit made). The ED510 will display:

**PURGE 00:35  
LOW FIRE PURGE**

7. Following the minimum 30 second delay (to permit the firing rate motor to get to the low fire position), the control will wait for the low fire switch (M-D) to close. When it closes, the trial for ignition sequence will start. If after ten minutes, the M-D circuit is not closed, the control will lockout.

8. The trial for ignition period begins with Terminal 5 and 6 being energized simultaneously. This is known as PTFI (Pilot Trial for Ignition). The ED510 will display:

**PTFI 00:02  
IGNITION TIMING**

This period is ten seconds in duration. If no flame is detected after ten seconds, the control will de-energize Terminals 5 and 6 and lockout. When flame is detected during this 10 second period, the ED510 will display

**PTFI 20  
FLAME SIGNAL**

FLAME SIGNAL	
0-9	NOT ACCEPTABLE
10	MINIMUM ACCEPTABLE
20-80	NORMAL

9. With flame proven at the end of PTFI, the main flame trial for ignition (MTFI) period begins. Terminal 7 is energized. The ED510 will display:

**MTFI 35  
FLAME SIGNAL**

Terminal 5 is de-energized 10 seconds later and Terminal 6 is de-energized after another 5 seconds.

10. The firing rate motor is now sent to the auto position (10-11 circuit made) and is under the command of the proportional controller. The ED510 will display:

**AUTO 40  
FLAME SIGNAL**

*NOTE: Trial-for-Ignition timings depend on the programmer selected. The timing charts in the beginning of this bulletin point out the differences in the various programmers.*

#### **Normal Shutdown**

1. When the operating control circuit (L1-13) opens, the main fuel valve is de-energized. The firing rate motor is driven to the low purge position (10-12 circuit made).
2. Following a 15 second post purge, the burner/blower motor is de-energized.
3. The burner is now off and the ED510 will display

**STANDBY  
L1-13 OPEN**

Burner history can be displayed by using ED510 keypad. See bulletin ED-5101.

\*Prepurge timing is selectable via dipswitches.



## ED510 BACKLIT DISPLAY

With current ED510's (Engineering code 3 or higher), the LED display backlight remains ON at all times. With earlier ED510 versions, the backlight will be lit when the L1-13 (operating control) circuit is closed, and OFF when the L1-13 circuit is open. With the earlier displays, depressing any key will light the display for three (3) minutes.

## LOCKOUTS

When a safety shutdown occurs, the control will display a message indicating LOCKOUT and the reason for the lockout. The alarm circuit (Terminal "A") will be energized. The non-volatile memory will remember the status of the control even if a power failure occurs. By depressing the reset button on the display, the control can be reset. The button must be held down for one second and then released. Very little force is required to do this. Do not press hard.

### Safety Shutdown

1. If the running interlock circuit does not close, the control will lockout and the blower motor will be de-energized. If the interlock circuit opens during a start-up or firing period, all fuel valves will be de-energized and the control will lockout.
2. If the proven high fire circuit (D-8) has not closed after a ten (10) minute "Hold" period at the start of prepurge, the control will lockout.
3. If the low fire start circuit (M-D) has not closed after a ten (10) minute "Hold" period at the end of prepurge, the control will lockout.
4. If dipswitch 6 is in the "Up" position (3-P prove open to start-enabled), and the 3-P circuit is closed at the start of the operating cycle, the control will hold for one (1) minute waiting for the 3-P circuit to open. If, after one (1) minute, the 3-P circuit does not open, the control will lockout.
5. If dipswitch 6 is in the "Up" position (D-8 prove open to start enabled), and the D-8 circuit is closed at the start of the purge period, the control will hold for ten (10) seconds waiting for the D-8 circuit to open. If, after ten (10) seconds, the D-8 circuit does not open, the control will lockout.
6. If dipswitch 6 is in the "Up" position (M-D prove open to start enabled), and the M-D circuit is closed at the end of high-fire purge period, the control will hold for ten (10) seconds waiting for the M-D circuit to open. If, after ten (10) seconds, the M-D circuit does not open, the control will lockout.
7. If pilot flame is not detected during the 10 second trial for ignition period, the pilot valve and ignition transformer will be de-energized and the control will lockout on safety.
8. If main flame is not detected at the end of the main flame trial for ignition period, all fuel valves will be de-energized and the control will lockout on safety.
9. If the main flame fails during a firing cycle, all fuel valves will be de-energized within 4 seconds after loss of flame signal, (2 seconds with programmers EP165, EP166) and the control will lockout on safety.
10. The EP165 and EP166 programmers will lockout on a power interruption.
11. If flame is detected when the operating control (L1-13) is open, the control will wait sixty (60) seconds and then lockout if flame is still present. If the operating control closes and flame is detected during purge, the blower motor (term M) remains energized and the purge sequence is put on hold. If the flame signal goes away within sixty (60) seconds, the control will proceed with a normal start-up. If flame signal is still present after sixty (60) seconds, the control will lockout.

*NOTE: Manual Reset is required following any safety shutdown.*

*NOTE: Depressing and releasing the reset button during a cycle will cause the control to shut the burner down and recycle.*

### Lockout Messages

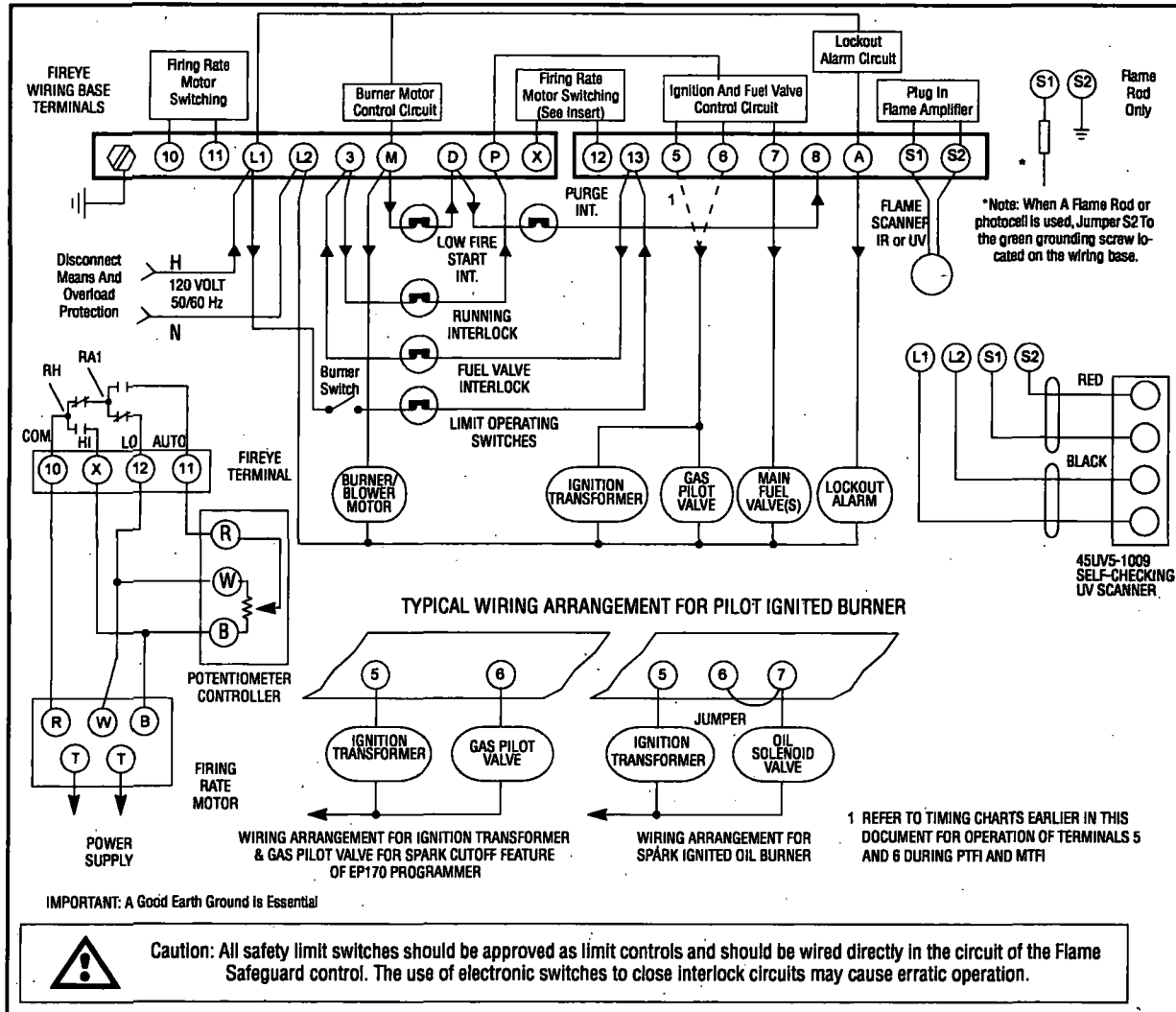
Refer to bulletins ED-5101 or E-1101 for a complete list of all ED510 display messages.



### Lockout History

Lockout and burner history can be displayed by using the ED510 keypad and display. Refer to Bulletins ED-5101 or E-1101.

## SUGGESTED WIRING DIAGRAM FOR EP1XX PROGRAMMERS



### AUXILIARY DEVICE IN M-D-8 CIRCUIT AT FLAME MONITOR CONTROL

The function of the low fire start and interlock circuit internally in a Fireye Flame-Monitor unit is accomplished by highly reliable solid state electronic circuitry. This prohibits the connection of power consuming devices (i.e. lamps, annunciators, relays, timers, etc.) to the D or 8 terminals.

### FLAME-MONITOR ELECTRICAL NOISE

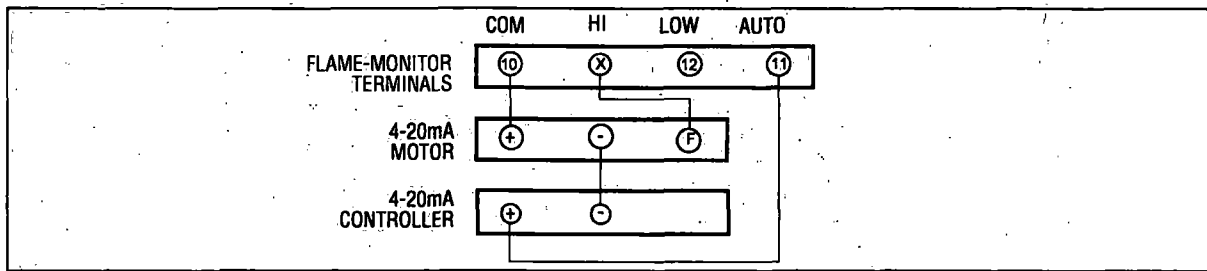
In applications with excessive electrical noise, it may be helpful to add an electrical noise suppressor to the power supply of the control circuit. See Bulletin E-1101 or SN-100.

We recommend Fireye P/N 60-2333 on older EB700 chassis with Engineering Code lower than 3.





### Wiring E100/E110 FLAME-MONITOR to a 4-20mA Firing Rate Damper Motor





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## 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.

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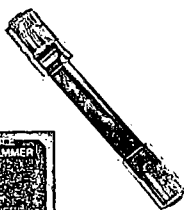
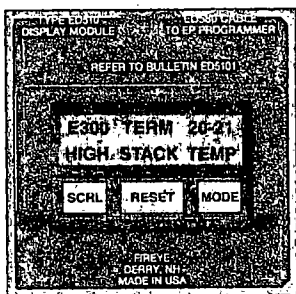
## WARRANTIES

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 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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## ED510 DISPLAY MODULE

FOR USE WITH  
**FIREYE® FLAME-MONITOR™**  
**AND MicroM™ BURNER**  
**MANAGEMENT CONTROLS**



### DESCRIPTION

The ED510 Display Module is designed to operate with the FLAME-MONITOR Burner Management Control System using the EP and EPD style (remote mount only for EPD style) programmer modules as well as the MicroM series of controls. The ED510 display module provides the following features and capabilities:

- Two (2) line by sixteen (16) character backlit LCD display.
- Continuous display of current burner operating status, including first out annunciation in the event of a lockout condition.
- Three (3) key, tactile dome keypad to provide historical information of the burner, last six (6) lockout conditions (with burner cycle and burner hour time stamp), assign messages associated with the operation of the E300 expansion module, and diagnostic messages.
- Design mounts directly onto the front face of the EP style programmers.
- RJ style connector for connection to the EP and EPD programmer.
- Remote display capability with the EP and EPD style programmers and MicroM system using standard DIN sized opening and remote mounting kit. Refer to Bulletin E-8002.
- Weather proof housing (NEMA 4 using remote mounting kit 129-145-1, -2).

### INSTALLATION

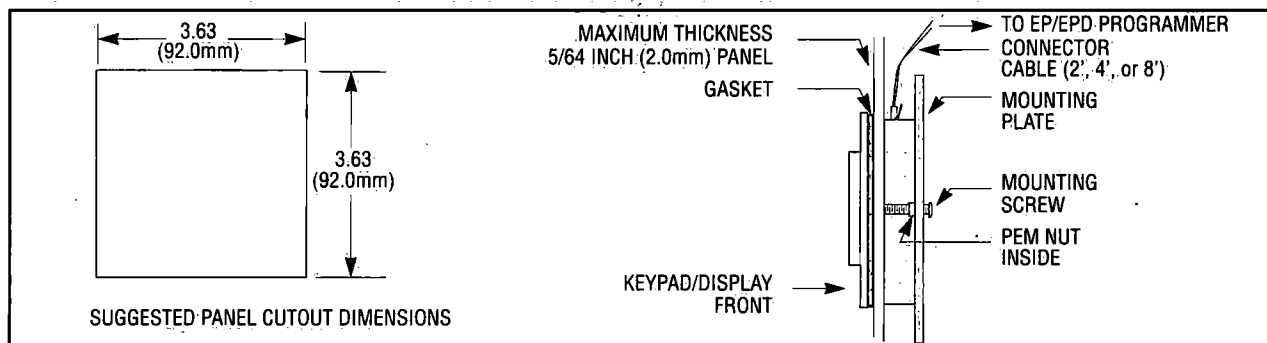
The ED510 display mounts directly onto the front of the EP style programmers. The ED510 can be mounted onto the programmer when the programmer is either installed in the EB700 chassis or not.

- Remove power from the EB700 chassis if the programmer is installed in the chassis.
- Slide the bottom of the ED510 chassis onto the two (2) mounting tabs on the face of the EP style programmer.
- Tilt the ED510 display towards the cover until the mounting tab on top of the ED510 display snaps into position into the opening on the face of the EP programmer.
- Install the ED580 cable (provided) into the RJ style connectors on both the ED510 display and EP style programmers.
  - Insert the EP style programmer and ED510 display into the second slot on the EB700 chassis (marked "Programmer Module") and restore power.

For information on how to mount the ED510 display remotely for the EP, EPD style programmers and MicroM systems, refer to Bulletin E-8002.



**FIGURE 1. INSTALLATION AND MOUNTING DIAGRAM OF ED510 WITH 129-145**



## ORDERING INFORMATION

P/N	DESCRIPTION
<b>ED510</b>	Display module. Includes ED580-1 cable. (1.25 inches).
<b>129-145-1</b>	Remote mounting kit. Includes ED580-4 cable (4 foot).
<b>129-145-2</b>	Remote mounting kit. Includes ED580-8 cable (8 foot)
<b>ED580-1</b>	1.25 inch display cable.
<b>ED580-4</b>	4 foot remote display cable.
<b>ED580-8</b>	8 foot remote display cable.
<b>ED610</b>	Adaptor for cable lengths greater than 8 feet.

### Temperature Rating

32° F — 140°F (0° C — 60°C)

## BACKLIT LCD DISPLAY

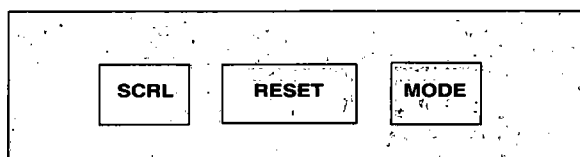
The ED510 display has a two (2) line by sixteen (16) character backlit LCD display. The backlit function is continuously energized.

**Contrast Control:** The contrast for the LCD display is factory set. If the contrast must be adjusted for any reason (e.g.: remote mounting), a potentiometer is provided on the back of the ED510 display board.

## TACTILE DOME KEYPAD

The ED510 has a three (3) key, tactile dome keypad to review both current and historical information associated with the operation of the burner. Following is the function of each key:

<b>SCRL</b>	SCRL key is used to advance through and display historical and operational information associated with the control and various sub-menus.
<b>RESET</b>	RESET key resets the control in the event of a lockout condition. The reset key is also used to modify Unit Address and messages associated with the E300 expansion module.
<b>MODE</b>	MODE key selects and enters a sub-menu (e.g. LOCKOUT HISTORY). The SCRL key then advances through the selections within each sub-menu. The MODE key will also exit the sub-menu. A right-hand arrow (→) displayed on the bottom line indicates the MODE key is operational.

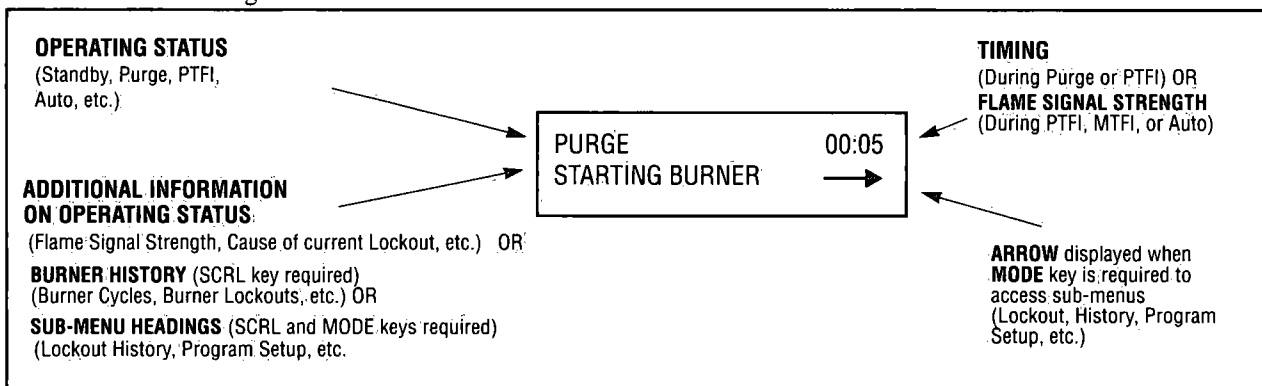




## GENERAL OPERATION

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, diagnostic messages, and the ability to program messages associated with the E300 Expansion Module.

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



The EP(D) and MicroM programmers update the messages to the ED510 display at least once every 8 seconds. If the ED510 display does not receive information from the EP(D) programmer within 10 seconds the ED510 will display:

**FIREYE ED510  
WAITING FOR DATA**

This can be the result of a defective connection between the programmer and display, defective cable, defective drivers in the programmer or display, or an electrical noise transient causing the EP(D) or MicroM programmers to cease communication.

Removing and restoring power should be executed to recover proper operation. Refer to bulletin SN-100 for recommended techniques for display installation.

## ED510 MESSAGES (as used with Flame-Monitor)

### RUN MESSAGES

STANDBY L1-13 OPEN
-----------------------

The operating control of the FLAME-MONITOR (terminals L1-13) is open.

PURGE HIGH FIRE PURGE	00:05
--------------------------	-------

Firing rate motor sent to high fire (term. 10-X made), purge timing displayed upper right hand corner.

PURGE LOW FIRE PURGE	00:35
-------------------------	-------

Firing rate motor sent to low fire (term. 10-12 made), purge timing displayed in upper right hand corner.

PTFI IGNITION TIMING	00:02
-------------------------	-------

PTFI timing started. Pilot not proven yet. PTFI timing displayed in upper right hand corner.



PTFI FLAME SIGNAL	19	Pilot flame proven during PTFI. Flame signal strength displayed in upper right hand corner.
MTFI FLAME SIGNAL	25	Main flame proven during MTFI. Flame signal strength displayed in upper right hand corner.
AUTO FLAME SIGNAL	40	Modulator motor sent to auto position (term 10-11 made). Flame signal strength displayed in upper right hand corner.
POST PURGE CYCLE COMPLETE	00:05	Demand satisfied. L1-13 open. Blower motor de-energized 15 seconds after L1-13 opens.

#### HOLD MESSAGES

HOLD STANDBY 3-P INTLK CLOSED		Dipswitch #6 (3-P Proven Open to Start) is set in the Up position (Enabled). At the start of the cycle, the 3-P circuit was closed. It will hold in this position for 60 seconds and then lockout if the 3-P circuit does not open.
HOLD PURGE D-8 LIMIT OPEN	00:00	The control has driven the firing rate motor to high purge (term. 10-X made) and is waiting for the high fire switch (term. D-8) to close. It will hold this position for ten (10) minutes and then lockout if the D-8 circuit does not close. <b>Applies to EP160, EP161, EP165, EP170 programmers.</b>
HOLD PURGE M-D LIMIT OPEN	01:00	The control has finished purge and the firing rate motor is driving to the low fire position (term. 10-12 made) waiting for the low fire switch (term. M-D) to close. It will hold this position for ten (10) minutes and then lockout if the M-D circuit does not close.
HOLD PURGE 3-P INTLK OPEN	00:10	The running interlock circuit (3-P) has not closed within the first ten (10) seconds of purge. The control will hold for ten (10) minutes and then lockout. <b>Applies to recycle programmers only.</b>
HOLD STANDBY FALSE FLAME	25	Flame has been sensed during the burner off time (term. L1-13 open) or during the purge period. This message will hold for sixty (60) seconds and then lockout if flame is still present. Flame signal strength is displayed in the upper right hand corner.

#### LOCKOUT MESSAGES

LOCKOUT STANDBY 3-P INTLK CLOSED		Dipswitch #6 (3-P Proven Open to Start) is set in the Up position (Enabled). At the start of the cycle, the 3-P circuit was closed, and the control has waited 60 seconds for the 3-P circuit to open.
LOCKOUT PURGE D-8 LIMIT OPEN		The control has held for more than 10 minutes waiting for the high fire switch (D-8) to close. <b>Applies to EP160, EP161, EP165, EP170 programmers.</b>
LOCKOUT PURGE 3-P INTLK OPEN		The running interlock circuit (3-P) has opened during the purge period or failed to close within the first 10 seconds of purge on non-recycle programmers, or has not closed within 10 minutes on recycle programmers.
LOCKOUT 13-3 FUEL VALVE END SWITCH		The fuel valve end switch wired between terminals 13 and 3 opened during purge or at start up.



LOCKOUT PURGE M-D LIMIT OPEN	The control has held for more than 10 minutes waiting for the low fire switch (M-D) to close.
LOCKOUT PTFI 3-P INTLK OPEN	The running interlock circuit (3-P) has opened during the pilot trial for ignition period. <b>Applies to non-recycle programmers only.</b>
LOCKOUT MTFI 3-P INTLK OPEN	The running interlock circuit (3-P) has opened during the main trial for ignition period. <b>Applies to non-recycle programmers only.</b>
LOCKOUT AUTO 3-P INTLK OPEN	The running interlock circuit (3-P) has opened during the main burner on period. <b>Applies to non-recycle programmers only.</b>
LOCKOUT STANDBY FALSE FLAME	Flame has been sensed during the burner off time (term. L1-L3 open) or during the purge period for sixty (60) seconds.
LOCKOUT PTFI FLAME FAIL	A flame failure occurred during the pilot trial for ignition period.
LOCKOUT MTFI FLAME FAIL	A flame failure occurred during the main trial for ignition period.
LOCKOUT AUTO FLAME FAIL	A flame failure occurred during the main burner on period.
LOCKOUT PTFI SCANNER NOISE	This message appears because of ignition cable noise. Reroute scanner wires away from high voltage ignition cables. Check for proper spark gap or cracked porcelain. Check for proper grounding of wiring base and power supply. Replace worn ignition cable and/or faulty connections.
LOCKOUT PTFI SHORT CIRCUIT TERM 5,6,7	Excessive current or short circuit detected on terminals 5, 6, or 7 during PTFI, MTFI, or Auto. The control will lockout upon sensing this condition on two consecutive cycles.
LOCKOUT PTFI FUEL VALVE STATE CHANGE	During pilot trial for ignition period, voltage sensed on terminal 7 is different from the previous cycle. (e.g.: jumper added or removed between term. 7 and 5 or 6).
LOCKOUT AUTO LINE FREQUENCY NOISE	Electrical noise detected on terminals L1 and L2.
LOCKOUT AC POWER FAIL	A power interruption to terminals L1 and L2 has caused the control to lockout. <b>Applies to EP165 programmer only.</b>

#### CHECK MESSAGES

CHECK PURGE D-8 HIGH LIMIT	00:15	The "Run-Check" switch has been placed in the Check position during purge and will hold indefinitely. The firing rate motor is being driven to the high purge position.
-------------------------------	-------	---





CHECK PURGE 00:45  
M-D LOW LIMIT

The "Run-Check" switch has been placed in the Check position after high fire purge and will hold indefinitely. The firing rate motor is being driven to the low fire position.

CHECK PTFI 19  
FLAME SIGNAL

The "Run-Check" switch has been placed in the Check position during the pilot trial for ignition period. Flame signal strength is displayed in the upper right hand position. The control will lockout on safety only when no flame signal is sensed for a continuous 30 seconds while the control is in the Check position.

CHECK AUTO 25  
LOW FIRE

The "Run-Check" switch has been placed in the Check position during the main burner on period and the firing rate motor is driven to the low fire position. Flame signal strength is displayed in the upper right hand corner.

### DIAGNOSTIC MESSAGES

LOCKOUT AUTO  
CHECK AMPLIFIER

#### POSSIBLE CAUSE

- High electrical noise.
- Defective field wiring.
- Defective amplifier.
- Defective IR scanner.

#### SOLUTION

- Check for proper ground on power supply.
- Install noise suppressor on power supply (P/N 60-2333).
- Make sure line phase on interlock circuit is the same as found on L1/L2 power supply to E100.
- Replace amplifier.
- Replace IR cell.

LOCKOUT PTFI  
CHECK CHASSIS

- Voltage on terminal 7 at improper time.

- Check wiring to terminal 7.

LOCKOUT PURGE  
CHECK PROGRAMMER

- Voltage on terminal 5 or 6 at improper time.

- Check wiring to terminals 5 and 6.

LOCKOUT AUTO  
CHECK SCANNER

- Flame signal detected during shutter close time on 45UV5 scanner.

- Stuck scanner shutter. Replace 45UV5 scanner.

LOCKOUT AUTO  
CHECK EXPANSION MODULE

- The E300 Expansion Module has a defective optocoupler.

- Replace E300 Expansion Module.

LOCKOUT AUTO  
AUTO CHECK AMPLIFIER FAIL

- Amplifier has failed diagnostic checks.

- Replace amplifier.



## HISTORICAL INFORMATION /SYSTEM SUB-MENUS

At any time the control is powered, the SCRL key will scroll through and display the total number of 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 four (4) System Sub-menus providing the following information and/or functions:

- Lockout History (with burner cycle and burner hour time stamp).
- E300 Message Select (to program messages associated with the E300 Expansion Module).
- Program Setup (to display programmer type, purge timing, FFRT timing, etc.).
- System Information (status of M-D circuit, average pilot flame signal, etc.).

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. The order in which the information is displayed every time the SCRL key is pressed is as follows:

AUTO BNR CYCLES	40 385	Number of burner operating cycles. (L1-13 closed). (385 burner cycles in this example.)
AUTO BNR LOCKOUTS	40 21	Number of burner lockouts. (21 lockouts in this example.)
AUTO SYS HOURS	40 233	Number of hours the control has been powered. (233 hours in this example.)
AUTO LOCKOUT HISTORY	40 %	Sub-menu to display the cause of the last 6 lockouts. The MODE key is required to display the actual lockouts.
AUTO E300 MSG SELECT	40 %	Sub-menu to program the messages associated with the operation of the E300 expansion module. The MODE key is required to enter the sub-menu.
AUTO PROGRAM SETUP	40 %	Sub-menu to display various operating parameters of the programmer and amplifier. The MODE key is required to enter the sub-menu.
AUTO SYSTEM INFO	40 %	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. Control has released to auto modulation, flame signal strength = 45.
MODE	LO #158 PURGE D-8 LIMIT OPEN	The last (most recent) lockout condition. This is the 158th lockout of the control.
SCRL	LO #158 PURGE @ BNR HOURS 136	The last lockout occurred after 136 hours of burner operation.
SCRL	LO #158 PURGE @ BNR CYCLE 744	The last lockout occurred on the 744 burner cycle.
SCRL	LO #157 AUTO 3-P INTLK OPEN	The next to last lockout condition. This is the 157th lockout of the control.
MODE	AUTO 45 FLAME SIGNAL	Screen has returned to the run message. Control has released to auto modulation, flame signal strength = 45.

### E300 MESSAGE SELECT (Flame-Monitor system only)

The sub-menu "E300 MSG SELECT" will allow the user to modify the lockout alarm messages associated with the operation of the E300 Expansion Module. The various safety limits had to be wired in the exact order that was shown in the E3001 Product Bulletin for the E300. For example, the low water cutoff had to be wired between terminals 23 and 24 of the 60-1950 wiring base of the E300. With the EP style programmers (Engineering code 28 or later), the user will now be able to select which message applies to the individual terminals. The messages associated with the E300 are divided into four (4) groups: Recycle, Non-recycle, Gas Select, and Oil Select.

The **Recycle** group pertains to the limits that are connected between terminals L1 and 13 of the E100/E110 FLAME-MONITOR. These are terminals 20-21, 21-22, and 22-13.

*Note: Refer to Bulletin E-3001 for a wiring diagram of the E300 terminals.*

The **Non-Recycle** group pertains to the limits that are connected between terminals 3 and P of the E100/E110 FLAME-MONITOR. These are terminals 3-23, 23-24, 30-31, 31-32, 32-33, 33-34, 34-35, and 35-P.

The **Gas Select** group pertains to the terminals associated with the gas interlocks of the E300. These are terminals 25-27, 27-30.

The **Oil Select** group pertains to the terminals associated with the oil interlocks of the E300. These are terminals 26-28, 28-29, and 29-30.

The lockout messages associated with the above terminals can be modified via the ED510 Display. The selection of available messages are dependent on each group. For example, the message "Low Oil Pressure" is a selection only for the Oil Select group. The default message for a particular interlock is the standard message for those terminals as indicated in the E3001 bulletin. For example, the default message for terminals 20-21 is "L1-13 AUX #1 OPEN."

#### TO MODIFY THE E300 MESSAGES

All three keys: Mode, Reset and Scroll, are used to modify the E300 messages. The Mode key is used to enter or exit the sub-menu associated with the E300 messages. The Scroll key is used to advance through the various terminals or selectable messages. The Reset key is used to modify a terminal message and select a new message.

To modify the E300 messages:

Press the Scroll key until the ED510 displays:

**E300 MSG SELECT**

Press the Mode key and the screen displays:

**E300 TERM #20-21**



**L1-13 AUX#1 OPEN** or programmed message.

Press the Scroll key and the screen displays:

**E300 TERM #21-22**

**L1-13 AUX#2 OPEN** or programmed message.

To change the message, press and hold the Reset key for one (1) second. When the Reset key is released, the screen displays:

**MDFY TERM #21-22**

**L1-13 AUX#2 OPEN**

Press the Scroll key to display the available messages for the particular group being modified. See attached List of available messages for each group.

When the messages displayed is appropriate for the terminals, press and hold the Reset key for one (1) second. When the Reset key is released, the screen displays:

**E300 TERM #21-22**

**LOW WATER** or programmed message.

Press the Mode key to exit the E300 Message Sub-menu.

---

## AVAILABLE E300 MESSAGES

The following messages are available for each of the four E300 terminal groups:

### GROUP 1 — RECYCLE

E340 OP CNTL OPEN

DAMPER POSITION END SWITCH OPEN

COMBUSTION AIR END SWITCH OPEN

LOW WATER

HIGH WATER

BLOWER MOTOR INTLK

HIGH STACK TEMPERATURE

CONTROL PANEL SWITCH OPEN

HIGH GAS PRESSURE

LOW GAS PRESSURE

### GROUP 2 — OIL SELECT

LOW OIL PRESSURE

HIGH OIL PRESSURE

LOW OIL TEMPERATURE

HIGH OIL TEMPERATURE

LOW ATOMIZING MEDIA

### GROUP 3 — GAS SELECT

HIGH GAS PRESSURE

LOW GAS PRESSURE

### GROUP 4 — NON-RECYCLE

E340 SAFETY INTLK OPEN

HIGH WATER

LOW WATER

HIGH PRESSURE

HIGH TEMPERATURE

AIR FLOW OPEN

OIL GUN END SWITCH OPEN

HIGH STACK TEMPERATURE

BLOWER MOTOR INTLK

I.D. FAN INTLK

F.D. FAN INTLK

---

## USER PROGRAMMED E300 MESSAGES

In addition to selecting the lockout alarm messages for the E300 Expansion Module from a menu selection via the ED510 display, the user can also program any message (up to 40 characters in length) for the individual terminals of the E300 using a dumb terminal (or PC with communication software) and the appropriate interface cables. Refer to bulletin E-3001 for complete details.



---

## 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.

Press	Screen Displays	Description
SCRL	AUTO 45 SYSTEM SETUP >	SCRL key advances through the historical information. Control has released to auto modulation, flame signal strength = 45.
MODE	AUTO 45 PROGRAMMER EP160	Programmer Type is an EP160.
SCRL	AUTO 45 ENGR CODE NO. 28	Software Engineering code of the programmer module is code 28.
SCRL	AUTO 45 AMP=EUV1 OR ERT1	Amplifier module is an EUV1 or an ERT1.
SCRL	AUTO 45 PURGE TIME 0:30	Purge timing (selected by the dipswitches) is 30 seconds.
SCRL	AUTO 45 PROVE 3-P OPEN=N	Proven 3-P Open To Start is disabled (selected by dipswitches).
SCRL	AUTO 45 FLAME FAIL TIME 4s	Flame Failure Response Time (FFRT) = 4 seconds (maximum).
SCRL	AUTO 45 UNIT ADDRESS #00	Unit Address is 00. Refer to programmer bulletin to modify Unit Address.
MODE	AUTO 45 FLAME SIGNAL	MODE key returns to 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.). This information can be very helpful when setting the damper linkages on the firing rate motor. The MODE key is used to enter the "PROGRAM SETUP" sub-menu, and the SCRL key is used to advance through the sub-menu.

Press	Screen Displays	Description
SCRL	AUTO 45 SYSTEM INFO >	SCRL key advances through the historical information. Control has released to auto modulation, flame signal strength = 45.
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	AUTO 45 SHORT CKTS 0	The total number of short circuits (excessive current) detected on terminals 5, 6, and 7. The short circuit condition must be sensed twice consecutively to be considered a short circuit.
SCRL	AUTO 45 D-8 LIMIT CLOSED	The status of the high fire end switch (D-8) is closed.
SCRL	AUTO 45 M-D LIMIT CLOSED	The status of the low fire end switch (M-D) is closed.
MODE	AUTO 45 FLAME SIGNAL	MODE key returns to run message.



---

## 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 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.



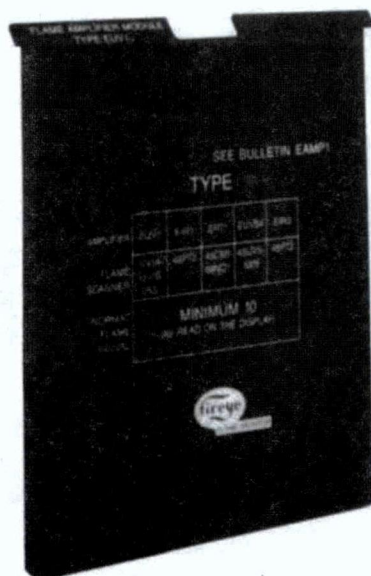
FIREYE®  
3 Manchester Road  
Derry, New Hampshire 03038  
[www.fireye.com](http://www.fireye.com)

ED-5101  
NOVEMBER 15, 2006  
Supersedes Dec. 2000





EAMP1  
AUGUST 3, 2007



# **FIREYE® E1R1, EUV1, ERT1 and EUVS4 Flame Amplifier Modules**

**FOR USE WITH THE  
FLAME-MONITOR™ CONTROL**

(For use with the Phoenix Scanners see 133-674)



**UV90**



**45UV5**



**UV8A**



**45UV3-1050**



**UV1A**



**69ND1**



**48PT2-9000**

## **DESCRIPTION**

The FIREYE E1R1, EUV1, ERT1 and EUVS4 Amplifier Modules are used in conjunction with the FIREYE FLAME-MONITOR system. These modules provide flame scanning using any of the FIREYE AutoCheck infrared scanners, standard ultraviolet scanners, flame rod, and ultraviolet self-check scanners. After scanner selection the proper amplifier module must be inserted in the Flame-Monitor chassis.

**Refer to Fireye Bulletin E-1101 for more detailed information concerning the FIREYE FLAME-MONITOR system and operation. Also, follow the scanner installation and wiring suggestions found in E-1101 for proper flame scanning operation.**

## **APPROVALS**

### **Underwriters Laboratories Inc.:**

MCCZ File MP 1537

Controls, Primary Safety - Listed

MCCZ2 File MP1537

Controls, Primary Safety - Component

MCCZ7 File MP1537

Controls, Primary Safety Certified for Canada

MCCZ8 file MP1537

Controls, Primary Safety Certified for Canada - Component

**Acceptable by:** Industrial Risk Insurers (I.R.I.)

Factory Mutual Approved



## xFLAME AMPLIFIER SELECTION

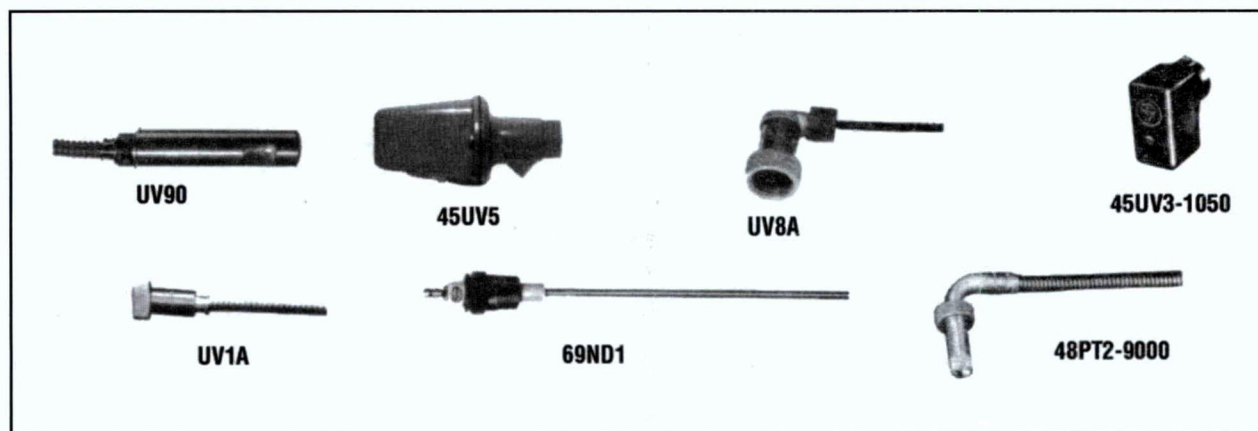
FIREYE PART NUMBER	DESCRIPTION	USE WITH SCANNER
EUV1	STANDARD UV AMPLIFIER	UV1A, UV8A, 45UV3, UV90
E1R1 *	AUTOCHECK INFRARED AMPLIFIER	48PT2
E1R2	AUTOCHECK INFRARED AMPLIFIER (FOR SPECIAL APPLICATIONS ONLY) CONSULT FACTORY	48PT2
ERT1	RECTIFICATION AMPLIFIER	69ND1
EUVS4	SELF-CHECK UV AMPLIFIER	45UV5-1007/1008/1009
E1R3 *	AUTOCHECK INFRARED AMPLIFIER	48PT2

\* The E1R1 is not to be used with solid fuel applications. It is designed for oil fog rejection. The E1R3 is suitable for all fuel applications and *does not* contain oil fog rejection. Equipment should be tested for the proper application of this amplifier to avoid property damages or personal injury.



**WARNING: E1R2 and E1R3 are not replacements for E1R1. E1R2 has increased flame sensitivity which may result in unsafe operation if not properly applied. E1R3 does not provide oil spray rejection protection which may result in unsafe operation if not properly applied. Consult factory before installation.**

## FLAME SCANNERS



**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 after (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 (EUVS4) or the infrared flame scanner (48PT2) with associated AutoCheck amplifier (E1R1).**



## SCANNER SELECTION

FIREYE PART NUMBER	DESCRIPTION	USE WITH AMPLIFIER	BULLETIN
48PT2-1003 48PT2-9003 48PT2-1007 48PT2-9007	Infrared 1/2" straight mount 96" (2438mm) flex conduit Infrared 1/2" 90° angle mount 96" (2438mm) flex conduit Infrared 1/2" straight mount 48" (1219mm) flex conduit Infrared 1/2" 90° angle mount 48" (1219mm) flex conduit	E1R1, E1R2 * and E1R3 *	SC-103
UV1A3 UV1A6 UV8A UV2 UV2A6 UV2C 45UV2-1020 45UV3-1050 UV90-3 UV90-6 UV90-9	1/2" NPT, 36" (915mm) shielded leads 1/2" NPT, 72" (1830mm) shielded leads 1/2" NPT, 72" (1830mm) unshielded leads, 90° right angle mount 3/8" NPT, 36" (915mm) shielded leads 3/8" NPT, 72" (1830mm) shielded leads 3/8" NPT, 36" (915mm) unshielded leads 1" NPT mount 60 Hz, 72" (1830mm) unshielded leads 3/4" Sleeve/setscrew mount, 72" (1830mm) unshielded leads 36" (915mm) shielded leads 72" (1828mm) shielded leads 108" (2742mm) shielded leads	EUV1	SC-102
69ND1-1000K4 69ND1-1000K6 69ND1-1000K8	Flame rod 12", 1/2" NPT mount Flame rod 18", 1/2" NPT mount Flame rod 24", 1/2" NPT mount	ERT1	SC-103
45UV5-1007 45UV5-1008 45UV5-1009	Self-check UV 1" BSP, 72" (1830mm) unshielded leads, 230 VAC Self-check UV 1" BSP, 72" (1830mm) unshielded leads, 120 VAC Self-check UV 1" NPT, 72" (1830mm) unshielded leads, 120 VAC	EUVS4	SC-101



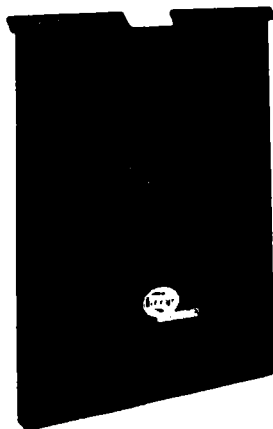
**\* WARNING: E1R2 and E1R3 are not replacements for E1R1.**

**Consult factory before installation.**

The flame amplifier module is installed in the third set of guide channels found in the EB700 FLAME-MONITOR chassis. It is marked "AMPLIFIER MODULE." Do **not** force the module into position.

**Amplifier Module** (One Required)

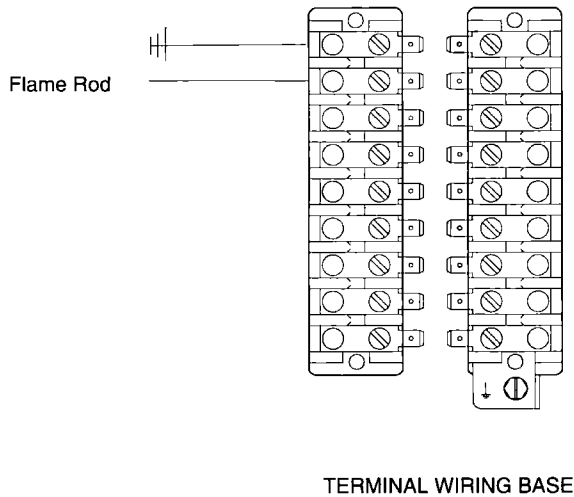
E1R1  
E1R2  
E1R3  
EUV1  
EUVS4  
ERT1



**CAUTION: REMOVE POWER FROM THE WIRING BASE BEFORE TRYING TO REPLACE THE FLAME AMPLIFIER MODULE.**



## IMPORTANT



When wiring to the FLAME-MONITOR control wiring base, scanner terminal S2 must be grounded when using a flame rod. When using an infrared scanner (48PT2), ground S2 on all EB700's labeled "ENG CODE 00." All other ENG CODE models do not require that S2 be grounded. *Do not* ground S2 when using ultra violet scanners.

Voltage measurements, S1-S2 with no flame present:

AMPLIFIER	S1-S2
EUV1	560 VAC
EUVS4	
ERT1	270 VAC
E1R1	12 - 15 VDC
E1R2	
E1R3	

Refer to Service Note SN-100 for recommended grounding techniques.

## NOTICE

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## 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.

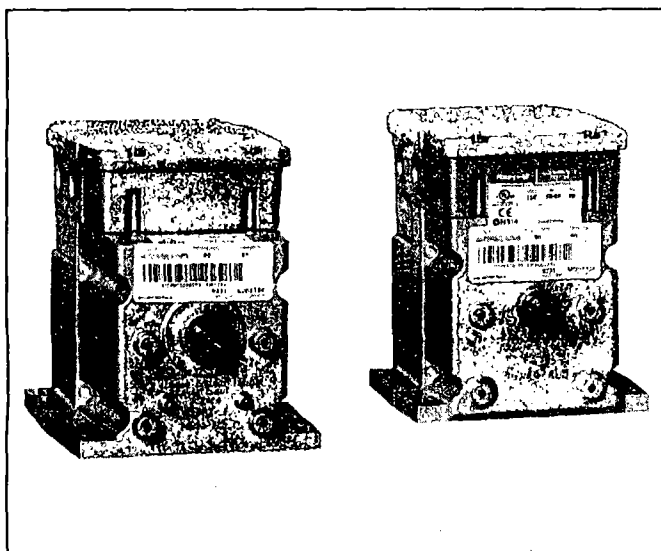


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EAMP1  
AUGUST 3, 2007  
Supersedes Nov. 1, 2005

## Series 90 Modutrol IV™ Motors

### PRODUCT DATA



### APPLICATION

The Series 90 Modutrol IV™ Motors are spring return and non-spring return modulating proportional control motors. Use these motors with controllers that provide a Series 90 output to operate dampers or valves.

### FEATURES

- Replaces M934A,D, M941, M944A,C,D, M945A,D,F, M954, M965, and M975 motors.
- Integral junction box provides NEMA 3 weather protection.
- Integral spring return returns motor to normal position when power is interrupted.
- Motor and circuitry operate from 24 Vac. Models available with factory installed transformer, or a field added internal transformer.
- Quick-connect terminals are standard—screw terminal adapter is available.
- Adapter bracket for matching shaft height of older motors is available.
- Motors have field adjustable stroke (90° to 160°).
- Die-cast aluminum housing.
- Integral auxiliary switches are available factory mounted, or can be field added.
- Nominal timing standard of 30 seconds (90° stroke), and 60 seconds (160° stroke). Other timings available.
- Spring return motors can operate valve linkages from power end or auxiliary end shafts for normally closed or normally open valve applications.
- All models have dual shafts (slotted and tapped on both ends).
- All models have auxiliary switch cams.
- Fixed torque throughout the entire voltage range.
- Motors are designed for either normally open or normally closed valves and dampers.
- Field addable interface modules can be mounted in the junction box to upgrade the motor to Series 70 (electronic) control.

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# SPECIFICATIONS

**TRADELINE Models:** Selected and packaged to provide ease of stocking, ease of handling and maximum replacement value. Specifications are the same as those of standard models unless specified otherwise.

**NOTE:** Auxiliary switches can only be added to motors that include auxiliary switch cams. (These cams cannot be field-added.)

**Modutrol IV Order Number Guide:** See Table 1.

**Table 1. Modutrol IV Series 2 Version Order Number Guide**

M Motor				
91	Proportioning Series 90 Control			
94	Flame Safeguard Firing Rate Motor			
6	60 lb-in. Spring Return	35 lb-in. Non-Spring Return		
7		75 lb-in. Non-Spring Return		
8		150 lb-in. Non-Spring Return		
9		300 lb-in. Non-Spring Return		
1	Dual-ended shaft	Non-Spring Return		
2		Normally Closed (NC) Spring Return		
4		Non-Spring Return		
5		Normally Closed (NC) Spring Return		
A		0 Auxiliary Switches	Adjustable Stroke	Normally Closed
B		1 Auxiliary Switch		
C		2 Auxiliary Switches		
D		0 Auxiliary Switches		

M	91	8	4	A	XXXX	See Catalog for Complete O.S. Number
---	----	---	---	---	------	--------------------------------------

**NOTE:** Torque designation corresponds to torque rating at standard timing (nominally 60 sec for 160° and 30 sec for 90° except for 300 lb-in. motors which have timings of 2 or 4 min).

**Dimensions:** See Fig. 1.

**NOTE:** 25% duty cycle indicates that the motor operates for 6 out of every 24 hours.

**Electrical Ratings:** See Table 2.

**Control Inputs:** Proportional, Series 90.

**Dead Weight Load On Shaft:**

Power or Auxiliary End: 200 lb (90.8 kg) maximum.

Maximum Combined Load: 300 lb (136 kg). (Dual shaft motors only.)

**NOTE:** Motor Series 90 control can be either Electronic, or Mechanical (135 ohm).

**Crankshaft:** 3/8 in. (9.5 mm) square. (Some models have double-ended shafts.)

**Auxiliary Switch Ratings:** See Table 3.

**Ambient Temperature Ratings:**

Maximum: 150°F (66°C) at 25% duty cycle.

Minimum: -40°F (-40°C).

**Stroke:** Models available with field adjustable stroke from 90° to 160° (See Settings and Adjustments on page 7).

# 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.

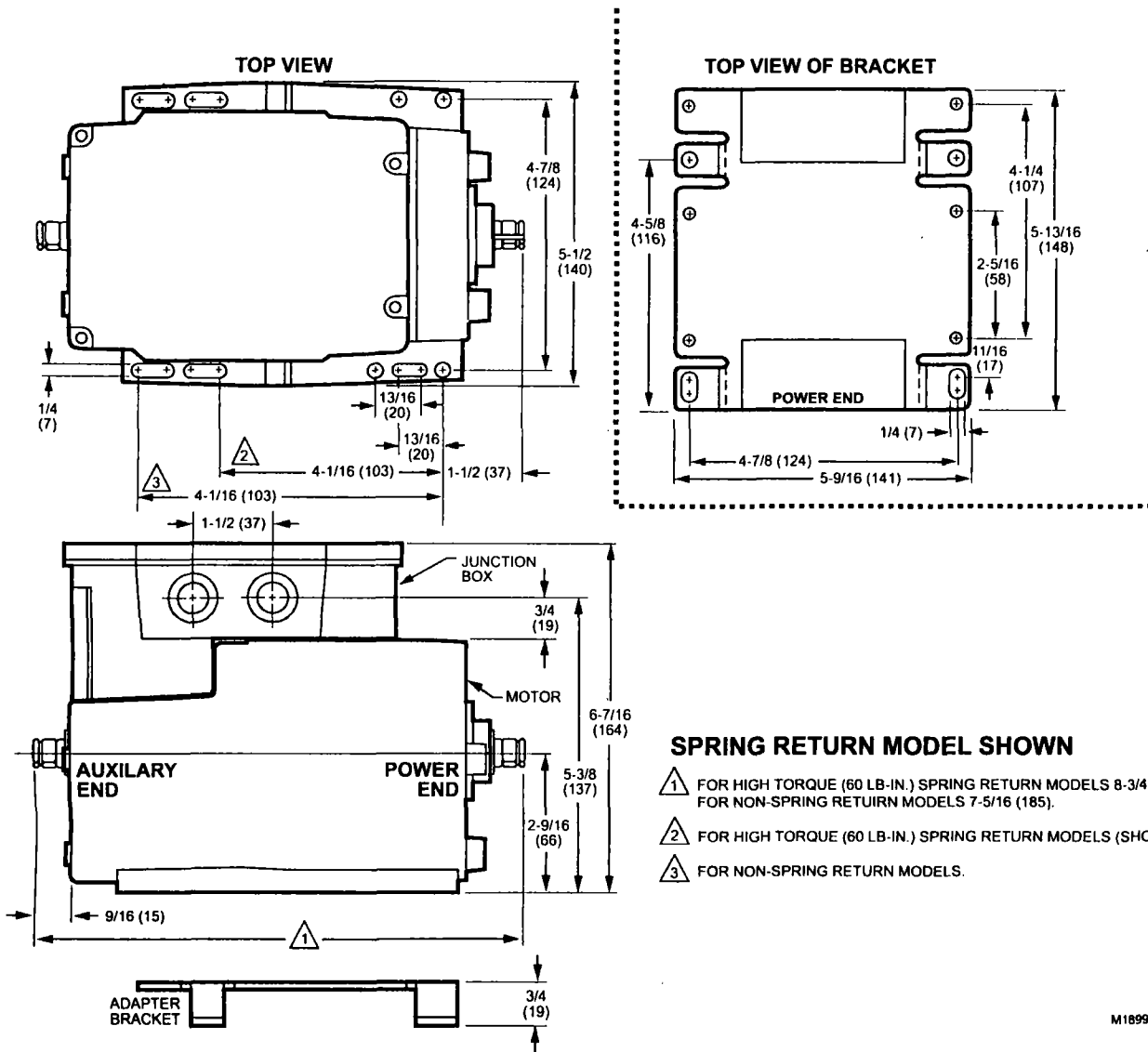
If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Honeywell Automation and Control Products Sales Office (check white pages of your phone directory).
2. Honeywell Customer Care  
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.





M18998

Fig. 1. Modutrol IV Motor mounting dimensions in inches (mm).

Table 2. Series 90 Modutrol Motor Power Consumption Ratings.

Internal Transformer	Power Consumption					
	Non-Spring Return Motors				Spring Return Motors	
	75, 150 and 300 lb-in. Torque		35 lb-in. Torque		60 lb-in. Torque	
	(VA)	(W)	(VA)	(W)	(VA)	(W)
	No	Yes	No	Yes	No	Yes
No	14	12			18	16
Yes	16	14			20	18

Table 3. Auxiliary Switch Ratings (in Amps).

Single Contact Rating <sup>a</sup>	120 V	240 V
Full Load	7.2	3.6
Locked Rotor	43.2	21.6

<sup>a</sup> 40 VA pilot duty, 120/240 Vac on opposite contact.

Timing And Torque: See Table 4.

**Approvals:**

Underwriters Laboratories Inc. Listed: File No. E4436, Guide No. XAPX.  
 Canadian Standards Association Certified: General Listed File No. LR1620, Guide 400-E.  
 U.S. Patents: pending



Table 4. Series 90 Modutrol Motor Timing and Torque Ratings.

Nominal Timing <sup>a</sup> in sec		Rated Torque in lb-in. (N•m) <sup>b</sup>			
		Normal Running Torque		Breakaway Torque <sup>c</sup>	
90°	160°	Spring Return	Non-Spring Return	Spring Return	Non-Spring Return
30	60	—	35 (4)	—	70 (8)
15 <sup>d</sup> /30	30 <sup>d</sup> /60	60 (6.8)	75 (8.5)	120 (13.6)	150 (17)
30	60	—	150 (17)	—	300 (34)
60	120	—	300 (34)	—	600 (68)

<sup>a</sup> Timings apply to all TRADELINE models. Some OEM models are available with non-standard timing/torque.

<sup>b</sup> The torque rating for dual-ended shaft motors is the sum of the shaft torques (power-end torque plus auxiliary-end torque).

<sup>c</sup> Breakaway torque is maximum torque available to overcome occasional large loads such as a seized damper or valve.

<sup>d</sup> Low timing is for M9184D1005 only.

NOTE: Some 150 lb-in. and 300 lb-in. torque adjustable stroke motors have timings that are twice that of the nominal timing.

### IMPORTANT

*Never use a Modutrol Motor continuously at the Breakaway Torque rating.*

### Accessories:

220736 Internal Auxiliary Switch Kit can be field-installed. One- (220736A) and Two- (220736B) switch kits available.

220738A Adapter Bracket raises motor shaft height by 19 mm to match that of previous Modutrol Motor models.

220741A Screw Terminal Adapter converts the standard quick-connect terminals to screw terminals.

221455A Infinitely Adjustable Crank Arm approximately 0.75 inch shorter than the 4074ELY Crank Arm, can rotate through downward position and clear base of motor without requiring use of adapter bracket.

221508A Resistor Board plugs onto Series 90 Motor quick-connect wire terminals. Provides same functionality as 4074BYK, 4074EAU, 4074EDC, or 4074EED Resistor Kits.

4074BYK Series 90 Resistor Kit provides for unison control of up to six Series 90 Motors.

4074EAU W973 Resistor Kit provides for control of two or three Series 90 Motors from a W973 Single-zone Logic Panel or W7100 Discharge Air Controller.

4074EDC 4-20 mA Resistor Kit drives one Series 90 Motor from a 4-20 mA controller.

4074EED Unison Control 4-20 mA Resistor Kit provides for control of up to four Series 90 Motors from one 4-20 mA controller.

4074ERU Weatherproofing Kit provides NEMA 3 rating for Modutrol IV Motors mounted in position other than upright.

50017460-001 Internal Transformer; 24/120/230 Vac 50/60 Hz primary, 24 Vac secondary, quick connect terminals.

50017460-003 Internal Transformer; 120 Vac 50/60 Hz primary, 24 Vac secondary, quick connect terminals.

7617ADW Crank Arm approximately 0.75 inch shorter than 7616BR Crank Arm. Can rotate through downward position and clear base of motor without requiring use of adapter bracket.

Q100 Linkage connects Modutrol Motor to V51 Butterfly Valve. Requires the 220738A adapter bracket (packed with TRADELINE Modutrol IV Motors).

Q181 Auxiliary Potentiometer for sequence or unison control of 1 to 4 additional modulating (Series 90) motors.

Q209E,F Potentiometer limits motor minimum position.

Q5001 Bracket and Linkage Assembly connects Modutrol Motor to a water or steam globe valve.

Q605 Damper Linkage connects motor to damper. Includes motor crank arm.

Q607 External Auxiliary Switch controls auxiliary equipment as a function of motor position.

Q7130A Interface Module with selectable voltage ranges (4-7 Vdc, 6-9 Vdc, and 10.5-13.5 Vdc) adapts motor to M71XX function.

Q7230A Interface Module with selectable control (2-10 Vdc or 4-20 mA) and adjustable zero and span adapts motor to M72XX function.

Q7330A Interface Module for W936 Economizer applications adapts motor to M73XX function.

Q7630A Interface Module for 14-17 Vdc control with minimum position capability adapts motor to M76XX function.

ES650-117 Explosion-Proof Housing encloses motor for use in explosive atmospheres. Not for use with Q5001 (or any other valve linkages). Order separately from Nelson Enclosures. To order, contact: Nelson Enclosures and Controls, (281) 449-6271; or write to: Nelson Enclosures and Controls, P.O. Box 471650, Tulsa, OK 74147-1650. Requires Honeywell 7617DM Coupling.

Table 5. Modutrol Motor Cross-Reference.

Original Motor	Replacements
M944A,C,D, M954	M9181, M9194, M9191, M9194
M965, M975	M9172, M9175
M934D	M9161, M9164, M9171, M9174
M945A,D,F, M955	M9182, M9185, M9183, M9186
M941	M9481, M9484, M9491, M9494

# 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

**Electrical Shock or Equipment Damage Hazard.**  
Can shock individuals or short equipment circuitry.  
Disconnect all power supplies before installation.  
Motors with auxiliary switches can have more than one disconnect.



## CAUTION

**Equipment Damage Hazard.**  
Can damage the motor beyond repair.  
Never turn the motor shaft by hand or with a wrench.  
Forcibly turning the motor shaft damages the gear train and stroke limit contacts.

### IMPORTANT

*Always conduct a thorough checkout when installation is complete.*

## Location

Allow enough clearance for installing accessories and motor servicing when selecting a location (see Fig. 1). If located outdoors, use liquid-tight conduit connectors with the junction box to provide NEMA 3 weather protection. If mounted outdoors in a position other than upright, install a 4074ERU Weatherproofing Kit and liquid-tight connectors to provide NEMA 3 protection.



## CAUTION

**Motor Damage Hazard.**  
Deteriorating vapors and acid fumes can damage metal parts.  
Install motor in areas free of acid fumes and other deteriorating vapors.

In excessive salt environments, mounting base and screws should be zinc or cadmium plated, not stainless steel or brass. Use the 220738A Adapter Bracket for mounting on these surfaces.

## Mounting



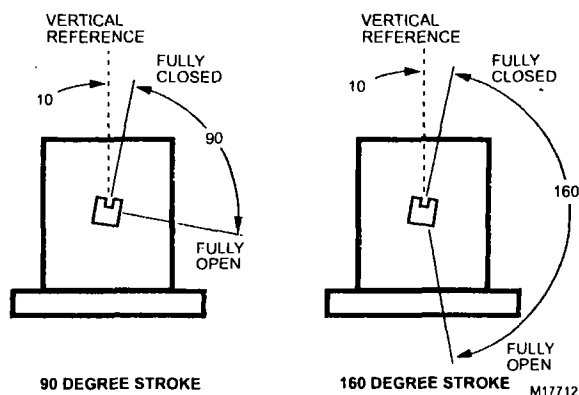
## CAUTION

**Equipment Damage Hazard.**  
Can damage the motor beyond repair.  
Always install motors with the crankshaft horizontal.  
Improper motor mounting can result in inadequate motor gear train lubrication.

Use the following guidelines for proper motor mounting:

- Always install motors with the crankshaft horizontal.
- Mounting flanges extending from motor housing base are drilled for 1/4 inch (6.4 mm) machine screws or bolts.
- Non-Spring Return Motors are shipped from the factory in the closed position (at the limit of counterclockwise rotation, as viewed from the power end of the motor).
- Spring Return Motors are shipped from the factory in their normal position:
  - Normally closed models: shipped at limit of counterclockwise rotation, as viewed from the power end of the motor.

**NOTE:** Refer to Fig. 2 for graphical representation of full open and full closed.



**Fig. 2. Motor shaft positions at stroke limits (viewed from power end of motor).**

## Adapter Bracket

The 220738A Adapter Bracket, positioned between the motor and the equipment, raises motor shaft height by 0.75 in. (19 mm) to match that of the former Modutrol Motor.

The following applications require this bracket:

- Q607 External Auxiliary Switch.
- Damper linkage applications require added clearance to allow:
  - crank arm rotation through the downward position.
  - sufficient damper linkage to reach the motor shaft.
- All valve linkages except the Q5001.

**NOTE:** When no bracket is used in replacement applications, damper linkages require adjustment for the new shaft position.

To mount the motor with the bracket (see Fig. 3):

1. Mount the bracket to the equipment with existing or standard bolts.
2. Using the provided bolts, mount the motor to the bracket threaded holes.

For valve linkage applications (other than the Q5001):

1. Mount the bracket to the linkage.
2. Position the motor on the bracket to align the motor shaft with the linkage.
3. Attach the motor to the bracket with the four bolts provided. See Fig. 4.

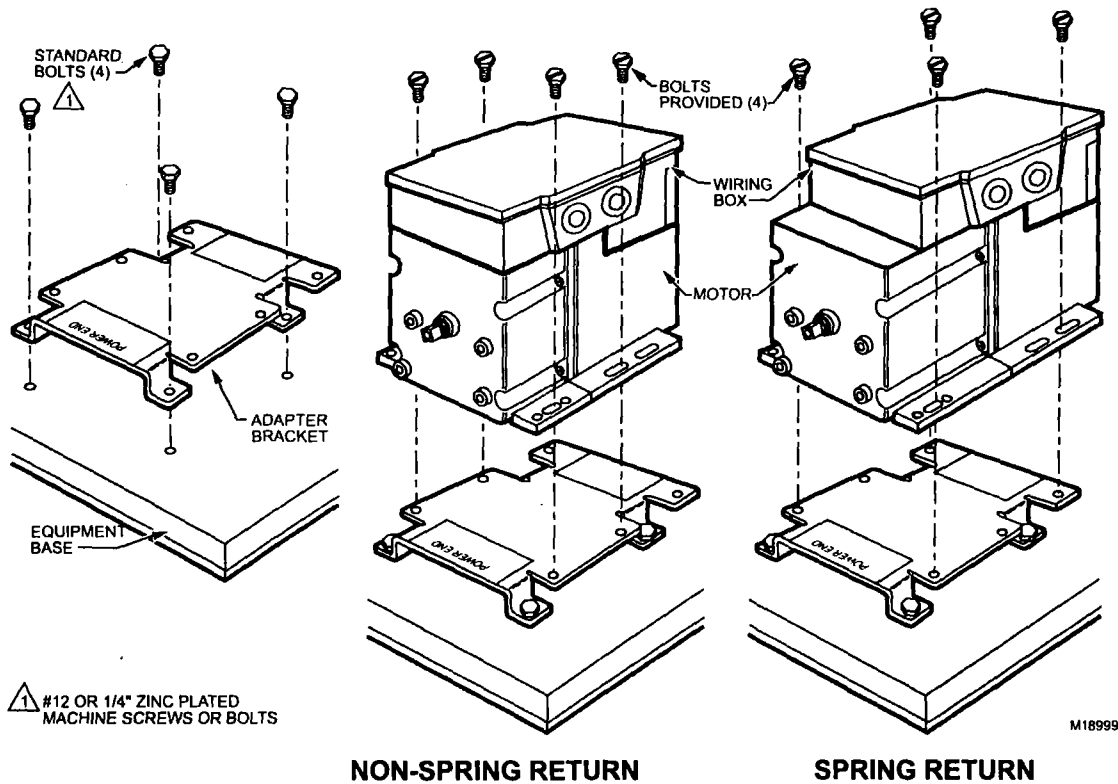


Fig. 3. Mounting the motor with an adapter bracket.

## Damper Linkages

The motor does not include a crank arm. Order the crank arm, included in the Q605 Linkage, separately (see Accessories in the Specifications section). For detailed instructions on the assembly of specific linkages, refer to the instruction sheet packed with the linkage.



## CAUTION

**Equipment Damage Hazard.**  
Stalling a motor can damage the drive shaft.  
Ensure installation of motors and linkages allows the motor to drive through full stroke without obstruction.

## Valve Linkages

The Q100 Linkage requires the 220738A Adapter Bracket for all valve applications. Applications with the Q5001 Valve Linkage do not require the 220738A Adapter Bracket (see Fig. 4).

## Junction Box

When used with liquid-tight conduit connectors, the junction box provides NEMA 3 weather protection for the motor. The junction box, standard with replacement motors, encloses the terminals and provides knockouts for wiring conduits. Housing an internal transformer or internal auxiliary switches requires use of the junction box.

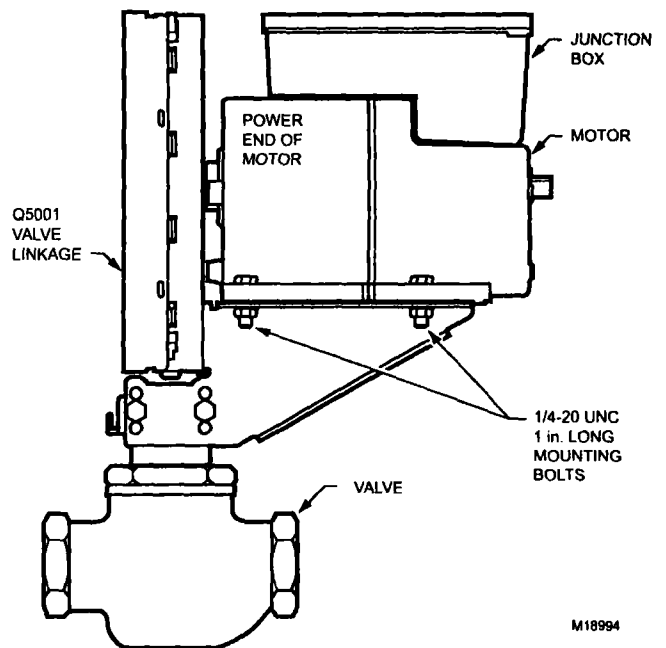


Fig. 4. Mounting the motor on a Q5001 Valve Linkage.

## Wiring



### CAUTION

**Electrical Shock or Equipment Damage Hazard.**  
Can shock individuals or short equipment circuitry.

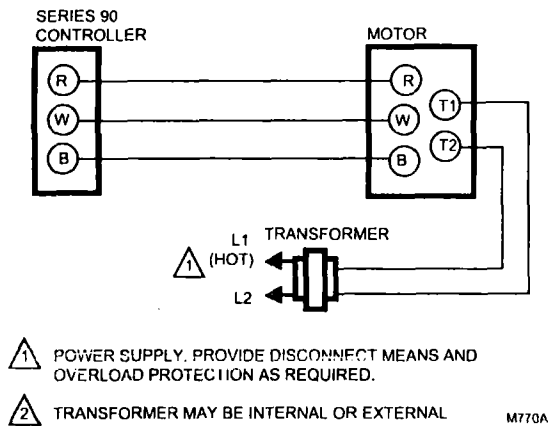
Disconnect power supply before installation.

### IMPORTANT

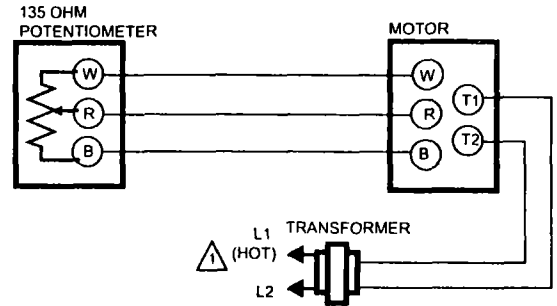
*All wiring must agree with applicable codes, ordinances and regulations.*

1. Ensure that the voltage and frequency stamped on the motor correspond to the power supply characteristics.
2. When connecting several motors in parallel, ensure that the power supply VA rating is large enough to provide power to all motors used without overloading.
3. Fig. 9 shows that the motor terminals are quick-connects located on top of the printed circuit board.
4. To access the wiring compartment:
  - a. Remove the four screws from the junction box top.
  - b. Lift off the cover.
5. Refer to Fig. 5 for typical wiring, and Fig. 7 for internal auxiliary switch connections.

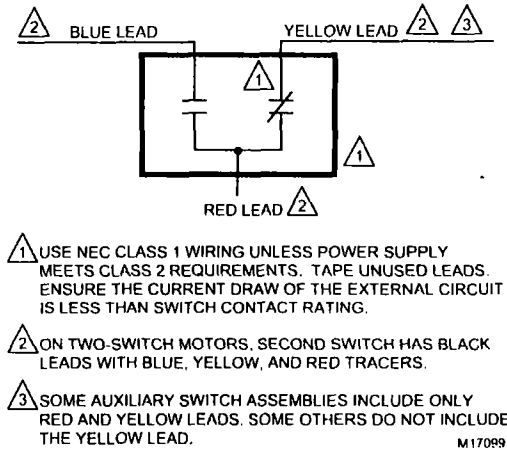
**NOTE:** Reverse motor rotation by switching wires at either the motor or the panel. Reverse rotation on the Series 90 models by reversing the wires at terminals W and B.



**Fig. 5. Typical Series 90 wiring.**



**Fig. 6. Wiring for potentiometer control.**



**Fig. 7. Auxiliary switch schematic.**

## SETTINGS AND ADJUSTMENTS



### Before Setting Stroke

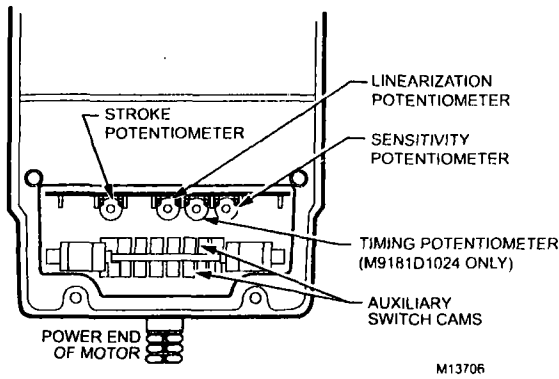
1. Remove the top cover from the motor.
2. Disconnect the controller from the motor.
3. Connect a potentiometer to the motor as shown in Fig. 6.

### IMPORTANT

*Detach linkage from motor before adjusting stroke.*



### Adjustable Stroke

The stroke adjustment is made by means of two potentiometers, the stroke and sensitivity potentiometers. When viewing from the power end of the motor, the stroke potentiometer is to the far left and sensitivity potentiometer is to the far right (see Fig. 8). To set the stroke to 160° (maximum position) turn the both potentiometers fully clockwise , using a 1/8 in. straight-blade screwdriver. To set the stroke at 90° (minimum position) turn both potentiometers fully counter-clockwise .





**Fig. 8. Potentiometer location and stroke adjustment setup for non-spring return Series 90 Motors**

To set the stroke between 90° and 160° follow the procedure below:

1. Turn the stroke potentiometer fully CW , using a 1/8 in. straight-blade screwdriver to set 160° stroke.
2. Set the maximum position using an external 135 Ohm potentiometer.
3. Turn the sensitivity potentiometer, so that the shaft reaches the final position of selected stroke.
4. Turn the stroke potentiometer CCW  until the shaft begins to move. Then turn potentiometer back slightly to have the position correspond to the sensitivity potentiometer.
5. Make sure the minimum position corresponds, as well.



### Linearization Potentiometer

Series 90 motors use a linearization potentiometer. This potentiometer should be adjusted only when Series 90 is used with an interface module, which converts the control from series 90 to series 70. If you use an interface module, set the linearization potentiometer according to the switch on the interface module. Turn the potentiometer fully CW  for driving the motor CW, turn the potentiometer fully CCW  for driving the motor CCW. Table 6 summarizes the modules and the positions of the linearization potentiometer.

**Table 6. Position of Linearization Potentiometer**

Interface Module	Control signal	Linearization Potentiometer	Notes
Q7130	4-7V; 6-9V; 10.5-13.5V; CW or CCW	CW or CCW according to the CW/CCW switch on the module	
Q7230	Voltage/current could be adjust by Span and Zero potentiometer on module CW or CCW	CW or CCW according to the CW/CCW switch on the module	Customer is able to adjust the range of input signal the same way Series 70 units with adjustable span and zero.
Q7630	14-17V; CW or CCW	CW or CCW according to the CW/CCW switch on the module	
221508A with shunt resistor	Series 90 controller; more Series 90 units as slaves CW or CCW	Middle point (no linearization)	Customer is able to select the number of slave units to connect together
221508A used as a converter to Series 70 with no slaves	4 - 20mA	Just CW	Only one unit (no slaves)
221508A used as a converter to Series 70 with 1 or more slaves	4-20mA	Middle point (no linearization)	Customer is able to select the number of slave units to connect in parallel
Q7330A1004	W936 controller	Only CW	Voltage range is approximately 0.7 (fully closed) to 1.9 Vdc (fully open)

### Adjustable timing for M9181D1024

The timing potentiometer (the second from the right, see Fig. 8) sets the timing to 1 minute, if turned fully CCW , 2 minutes if turned to its middle point and 4 minutes if turned fully CW .



## CAUTION

**Careless Installation Hazard.**

**Use of excessive force while adjusting cams damages the motor.**

To avoid damaging motor end switches, set cams by moving only the top of the screwdriver.



## CAUTION

**Careless Installation Hazard.**

**Forcibly turning the motor shaft damages the gear train and stroke limit contacts.**

Never turn motor shaft manually (by hand or with a wrench).

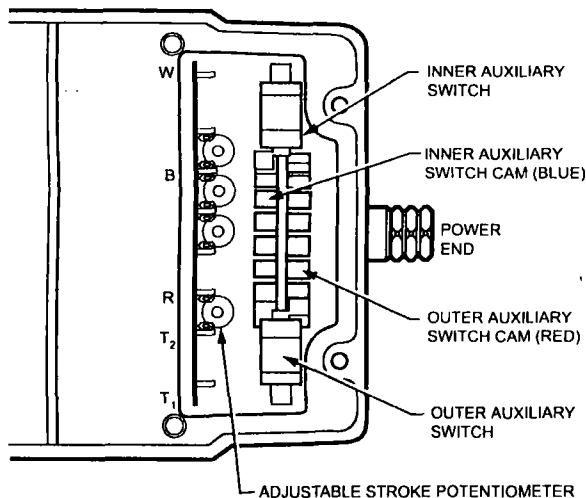


## CAUTION

**Equipment Damage Hazard.**

**Can damage the motor beyond repair.**

Set cams by moving the top of the screwdriver only. Pressing screwdriver against cam slot sides or use of excessive force can damage motor end switches.



NOTE: NOT ALL FEATURES AVAILABLE ON ALL MODELS.

M13707

Fig. 9. Terminals and adjustments.

## Auxiliary Switches

Adjustable cams actuate the auxiliary switches. These cams can be set to actuate the switches at any angle within the stroke of the motor. Select switch differential of 1° or 10°.

Motors with factory-added auxiliary switches are shipped in the closed position (fully counterclockwise, as viewed from the power end). Auxiliary cam default actuates the switches 30° from full open with a 1° differential. With the motor in the closed (fully counterclockwise) position, the auxiliary switch breaks contacts R-B. See Fig. 7 (or the auxiliary switch Instruction Sheet) for auxiliary switch wiring.

NOTE: Auxiliary switches can only be added to motors that include auxiliary switch cams. (These cams cannot be field-added.)

NOTE: Series 2 Motors are shipped with auxiliary switch cams that permit acceptance of 220736A,B Internal Auxiliary Switch Kits. Refer to Form no. 63-2228 for 220736A,B Installation Instructions.

## Auxiliary Switch Adjustment

1. Remove the top cover from the motor to gain access to the motor terminals and auxiliary cams.
2. Disconnect the controller from the motor.
3. Connect a potentiometer to the motor as shown in Fig. 6.
4. Using the potentiometer, drive the motor to the position where the auxiliary equipment is to be switched.
5. For a 1° switch differential, check continuity of the auxiliary switch contacts R-B and rotate the cam as follows:
  - a. If the contacts are open, rotate the cam clockwise until the R-B contacts close.
  - b. If the contacts are closed, rotate the cam counterclockwise until the R-B contacts open.
6. For a 10° switch differential:
  - a. Spring return models: rotate the cam approximately 180° so that the slow-rise portion of the cam actuates the switch. Then check continuity of the auxiliary switch contacts R-B.
  - b. Non-spring return models: check continuity of the auxiliary switch contacts R-B.
7. Rotate the cam as follows:
  - a. If the contacts are open, rotate the cam counterclockwise until the R-B contacts close.
  - b. If the contacts are closed, rotate the cam clockwise until the R-B contacts open.
8. Check for proper auxiliary equipment differential and switching by driving the motor through the full stroke in both directions.
9. Disconnect the potentiometer, reconnect the controller, and replace the motor top cover.

NOTE: Changing the differential from 1° to 10° reverses the switching action. For example, with a 10° differential, switch contacts R-B make and R-W break on a counterclockwise (closed) rotation. With a 1° differential, switch contacts R-W make and R-B break on a counterclockwise (closed) rotation.

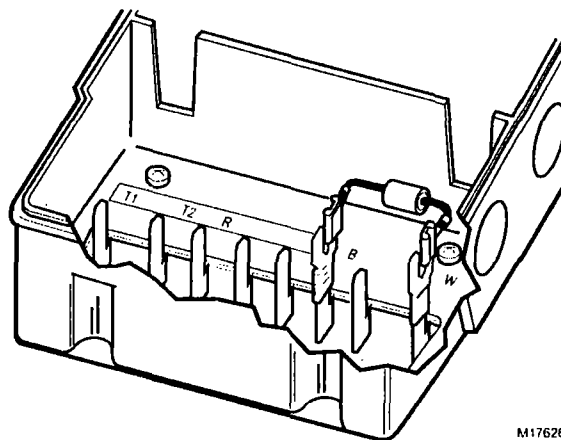
## OPERATION

Use Series 90 Modutrol IV Motors for standard Series 90 operation (see Table 7):

1. Two potentiometers, one in the controller and one in the motor, along with the motor resistor network, form a bridge circuit. As long as the value of the controlled medium remains at the setpoint, the circuit remains balanced and the motor does not run.
2. When the controlled medium value changes, the controller potentiometer wiper moves, unbalancing the bridge circuit.
3. The imbalance is amplified and the microcontroller then drives the motor in the direction necessary to correct the controlled medium change.
4. As the motor shaft rotates, it turns the feedback potentiometer, rebalancing the bridge circuit, stopping the motor.

Table 7. Modutrol IV Motor Operation.

Motor Type	Signal	Resulting Action
Non-Spring Return or Spring Return	Open W and short R to B	drives open
	Open B and short R to W	drives closed
	Jumper R-W-B	drives to midstroke
	None	drives closed
Non-Spring Return	Power Loss	stops (none)
Spring Return	Power Loss	spring returns (closed)



M17626

Fig. 10. Attaching a shunt resistor to TRADELINE motors.

Table 8. Cam Arrangements.

Motor	Inner Cam	Outer Cam
M9164D1009, M9174D1007	Red	Blue
M9175D1014		
M9172W1004	Red	Red
ALL OTHER M9164, M9172, M9175	Blue	Red
M9161, M9171		
M9184, M9194		
M9185, M9186		
M9484, M9494		
All Other M9174	Blue	Blue



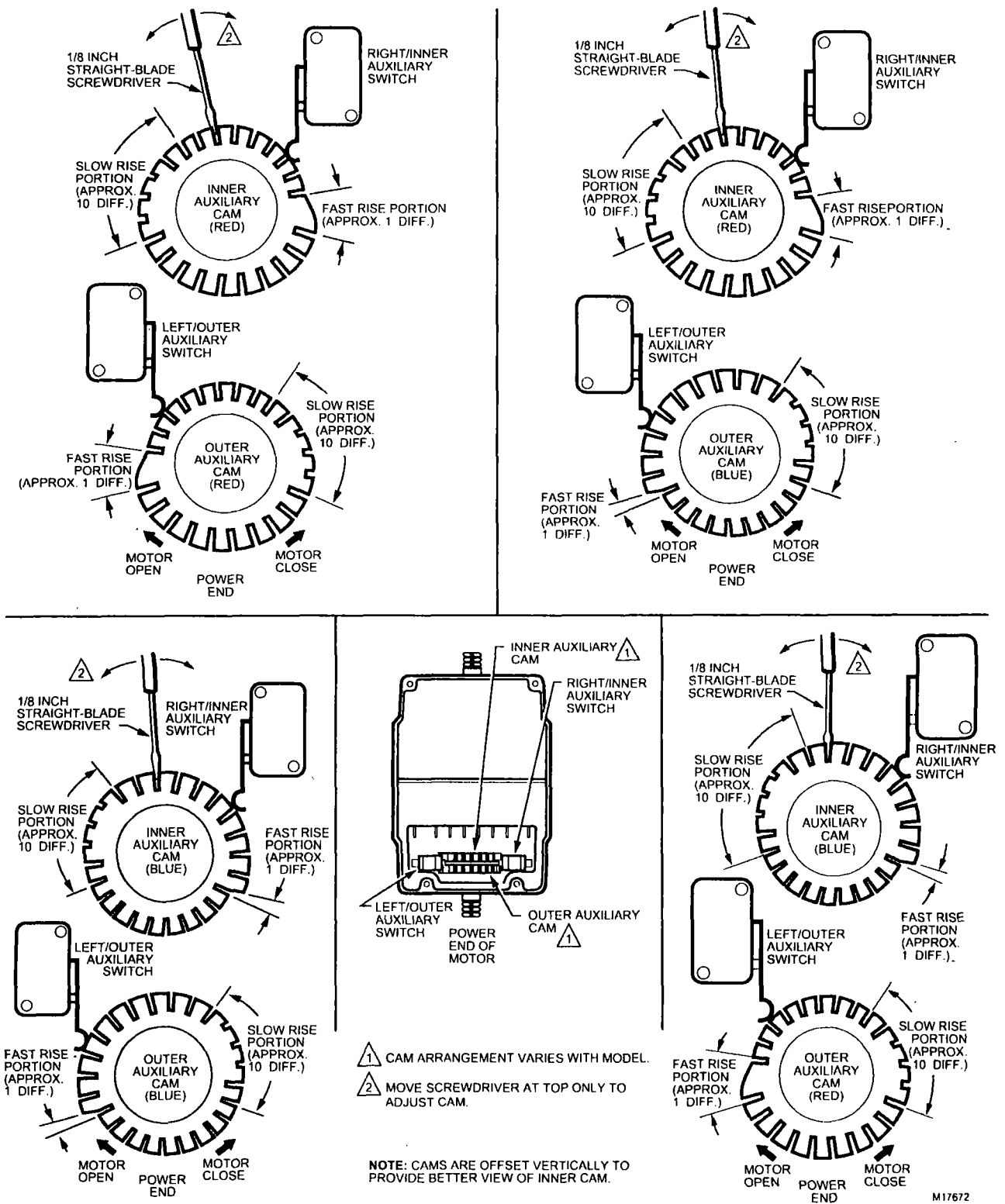


Fig. 11. Auxiliary switch adjustment.

## CHECKOUT

After the installation and linkage adjustment, check the entire motor and control hookup. Proper checkout ensures that:

- The motor operates the load (damper or valve) properly.
- The motor responds properly to the controller as the input varies. See Table 7.
- The auxiliary switch, if used, operates at the desired point of motor rotation.

1. Inspect motor, linkage, and valve or damper to ensure all mechanical connections are correct and secure.

NOTE: In damper installations, the pushrod should not extend more than a few inches past the ball joints.

2. Ensure that there is adequate clearance for the linkage throughout the entire motor stroke without binding or striking other objects.
3. Ensure the motor transformer is properly sized.

NOTE: If a common transformer is used to power multiple motors, ensure the power input is in phase with all motors.

4. Drive the motor fully open and fully closed. See Table 7.

NOTE: Refer to controller or system instructions for additional checkout procedures.

5. For spring return motors, ensure that the valve or damper returns to normal position upon power interruption.
6. Return the controller to the desired setting before leaving the job.

## REPLACEMENT

### Damper Application

1. Turn off power and remove wiring from the old motor.
2. Remove the crank arm from shaft of old motor and remove the old motor.
3. Determine necessity of the mounting bracket. If the linkage can reach the new motor shaft position and the crank arm has clearance for the necessary rotation, the bracket is not required. Use the 220738A Adapter Bracket or the 221455A Crank Arm if the crank arm must rotate through the bottom plane of the motor.
  - a. If no bracket is required, mount the new motor directly to the equipment and refer to the Installation, Settings and Adjustments, and the Operation and Checkout sections of these instructions.
  - b. If the bracket is required, refer to the Adapter Bracket section and Fig. 3 in addition to the Installation, Settings and Adjustments, and the Operation and Checkout sections of these instructions.
4. Use No. 12 or 1/4 inch machine screws or bolts to mount the new motor.
5. Mount damper crank arm and linkage to the new motor shaft.
6. Use the Checkout procedures to test the crank arm and linkage adjustment.

### Valve Application

When replacing a motor in a valve application, the linkage determines the necessity of the 220738A Adapter Bracket. With Q100, Q601 or Q618 Linkages, it is necessary to use the 220738A to raise the motor shaft to the appropriate height. Valve applications with a Q5001 Linkage do not require the 220738A Adapter Bracket. To operate Honeywell V5011 two-way or V5013 three-way valves through full stroke, use a 160° stroke motor.

#### Automation and Control Solutions

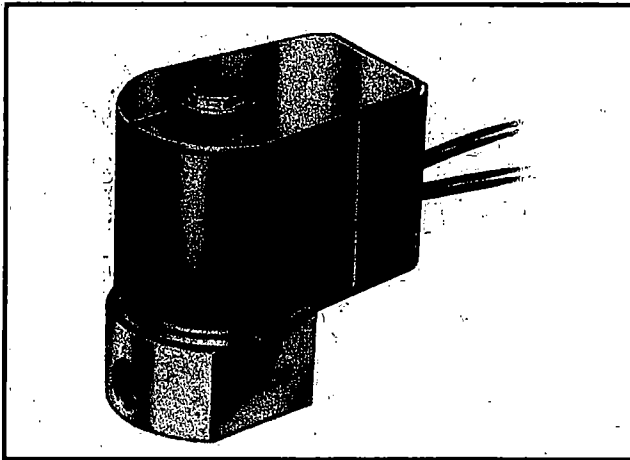
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## V4046C, V8046C Magnetic Valves

PRODUCT DATA



### APPLICATION

The V4046C and V8046C Magnetic Valves provide on-off control of gas flow in supply line.

### 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 installer.
- Powerhead assembly can be rotated 360 angular degrees.
- Solenoid coil is field-replaceable without removing the valve body from the piping connection.

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## SPECIFICATIONS

Models: See Table 1.

Table 1. Model Specifications.

Model	Pressure Rating <sup>a</sup>		Gas Flow		Gas Heat Capacity <sup>a</sup>	Operation Energized	Voltages (60 Hz)
	psi	kPa	cfh <sup>b</sup>	m/hr	btuh <sup>c</sup>		
V4046C	10	69	20	0.57	20,000	Opens Immediately	120 208
			55	1.56	55,000		
			67	1.90	67,700		
V8046C			20	0.57	20,000		24
			55	1.56	55,000		
			67	1.90	67,700		

<sup>a</sup> 1/2 psi in AGA rating.

<sup>b</sup> 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.

<sup>c</sup> Natural gas, 1000 btu/cu ft measured at one inch pressure drop, 0.84 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	—	—

**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.

**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 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

## 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

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.

## 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 (Btuf) 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:  

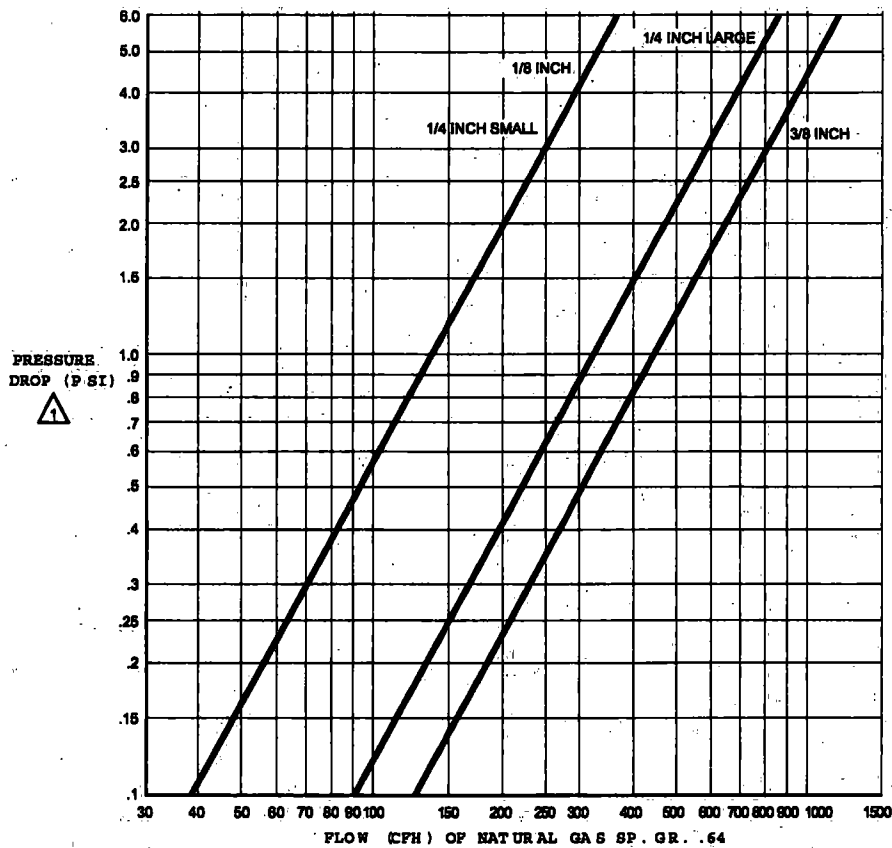
$$\text{Capacity in cfh} = \frac{\text{Btuh (burner nameplate)}}{\text{Btu/cu ft (gas utility)}}$$
4. For gases with specific gravity other than 0.64, multiply the burner cfh using the proper conversion factor in Table 4.

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.



1 TO CONVERT PRESSURE DROP IN INCHES WC TO PSI UNITS, MULTIPLY UNITS IN INCHES WC BY .0381.

TO CONVERT PRESSURE DROP FROM PSI TO INCHES WC, MULTIPLY UNITS IN PSI BY 27.7.

M20743B

Fig. 1. Pressure drop (psi) vs. flow capacity (cfh) on V4046C, V8046C gas valves only.

Dimensions. See Fig. 2.

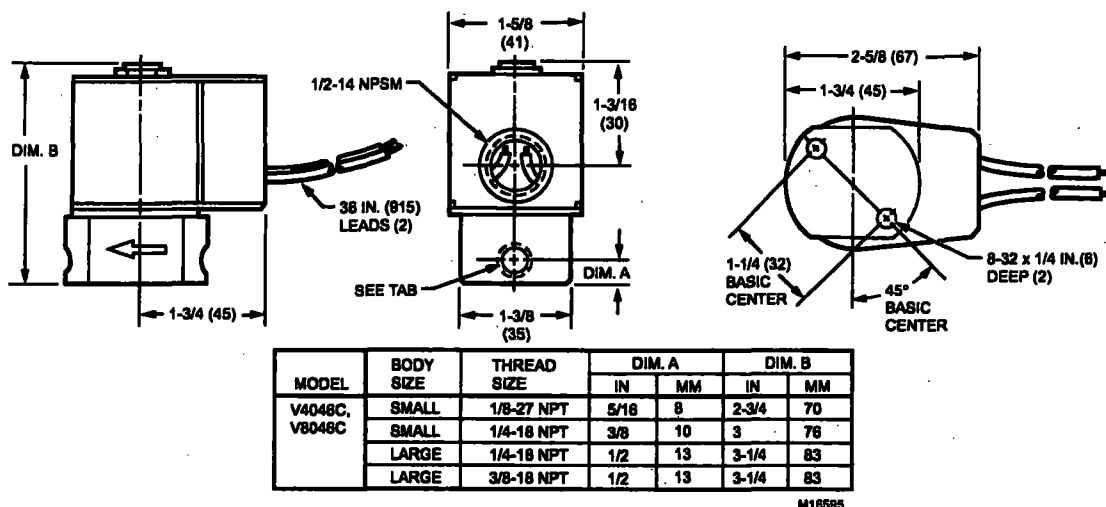


Fig. 2. V4046C, V8046C approximate dimensions in in. (mm).

## 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. The installer must be a trained, experienced flame safeguard technician.
4. After installation is complete, check out product operation as provided in these instructions.

## ⚠ WARNING

**Explosion and Electrical Shock Hazard.**  
Can cause serious injury, death or property damage.

1. Turn off gas supply before beginning installation.
2. Disconnect electrical power before beginning installation or servicing procedure. More than one disconnect can be involved.
3. To avoid damage or distortion of the valve when installing rigid or flexible conduit, the conduit fittings should not be subjected to more than 5 ft-lbs torque when screwing the fitting into the valve coil case (powerhead). An approximation of 5 ft-lbs torque is hand-tightened plus 1/8 turn. When securing the rigid or flexible conduit in the conduit fitting using the setscrew, use only enough force to secure the conduit to avoid damage/distortion of the valve.
4. Always loosen the coil nut before attempting to rotate the powerhead.
5. Do not tighten the valve on the gas pipe using the coil housing (powerhead) as a handle.

### Gas and Air Installations

Mount the gas valves in the pilot gas supply line upstream from the burner. Ambient temperatures at the valve location must be within -40°F to +125°F (-40°C to +54°C).

### Mounting

The V4046C and V8046C Valves will operate in any mounting position required by the installation, as long as gas flow is in the direction indicated by the arrow.

Use iron pipe for at least one of the valve connections to insure adequate support and to confirm with recommendations of Underwriters Laboratories, Inc.

If the installation does not support the valve adequately, a mounting bracket should be devised and installed.

### Preparing Piping and Installing Valve

1. Use new, properly reamed pipe, free from chips.
2. Do not thread pipe too far. Valve distortion or valve malfunction may result from excess pipe in valve.
3. Apply a moderate amount of good quality pipe dope to the pipe only (see Fig. 3). If pipe dope lodges on the valve seat, it will prevent proper closure. If using LP gas, use pipe dope resistant to action of LP gas.
4. Install the valve with gas flow in the direction indicated by the arrow on the valve body. Gas must be in the same direction as indicated by the arrow.
5. Move the powerhead to the desired position and then tighten the hexagonal nut located on the top of the valve.

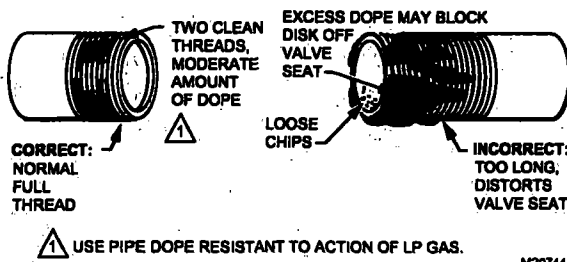


Fig. 3. Preparing the pipe threads.

## Gas and Air Applications

Test for leaks by painting pipe joints with a soapy solution. Excessive bubbles indicate a leak.

## WIRING

### ⚠ WARNING

**Electrical Shock Hazard.**  
Can cause serious injury or death.  
Disconnect power supply before wiring to prevent electrical shock or equipment damage. More than one disconnect can be involved.

All wiring must conform to local codes and ordinances.

Leadwires on these devices are long enough to reach the junction box on most burner installation. The powerhead on all models rotates 360 degrees, permitting the electrical service to be brought to it from any convenient direction.

See Fig. 4 and 5 for typical wiring hookups for V4048C and V8048C, respectively.

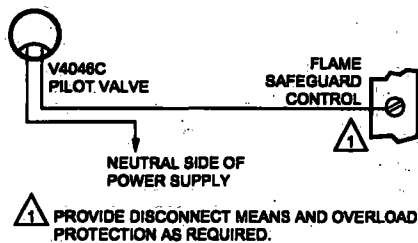


Fig. 4. Typical hookup of V4048C. See Flame Safeguard wiring diagram to determine correct terminal for pilot valve connection.

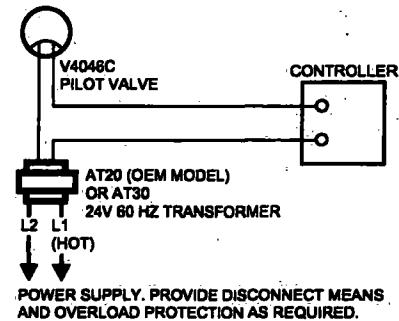


Fig. 5. Typical hookup of V8048C.

## CHECKOUT AND SERVICE

### Checkout

Put the system in operation and observe through at least one cycle to be sure valve functions as described.

**NOTE:** Valve clicks audibly when it opens and when it closes. Listen for clicks to make sure valve is opening and closing properly.

### Service

#### IMPORTANT

*Do not assume that the valve needs replacement until all other sources of trouble have been eliminated.*

**If the valve will not open when the thermostat and limit control are calling for heat:**

1. Make sure that the pilot is burning properly, the Pilotstat® Control (if used) is holding in, and the limit control contacts are closed.
2. Make sure that normal gas pressure is available at the valve.
3. Make sure that the bleed line is unobstructed.
4. Check the power supply at the valve. If no voltage is indicated, check the power source (transformer or line source) and circuit controls. If proper voltage is present at the valve, but the valve does not pull in, replace the valve coil.

**If the valve will not close with one or more of the control contacts open:**

1. Make sure that the gas flow is in the direction of the arrow on the valve body.
2. Check for a short in the wiring circuit.

## Maintenance

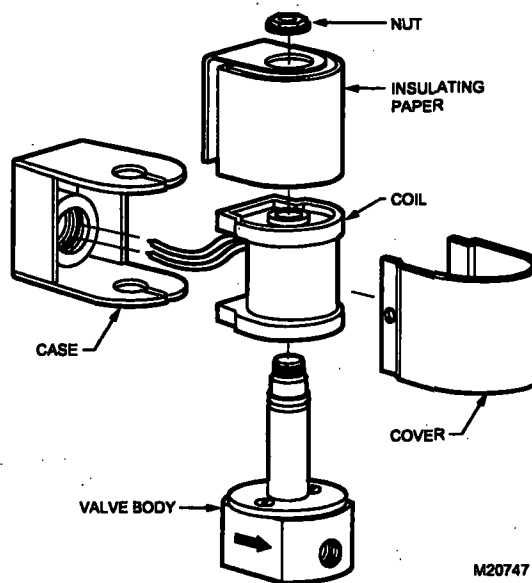
### WARNING

**Electrical Shock Hazard.**  
Can cause serious injury or death.  
Disconnect the power supply before replacing the solenoid coil. More than one disconnect can be involved.

The V4046C and V8046C Magnetic Valves are built to give long and reliable service without attention. If necessary, the solenoid coil is replaced as follows (see Fig. 6):

1. Disconnect the power supply before replacing the solenoid coil.
2. Remove the nut on top of the valve by turning it counterclockwise.
3. Lift the powerhead assembly off the spindle.
4. Disconnect and remove the solenoid coil.
5. Connect the replacement coil and reassemble.

**NOTE:** The valve need not be removed from the pipe installation to change the solenoid coil.



**Fig. 6. Removing the solenoid coil.**



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**Automation and Control Solutions**

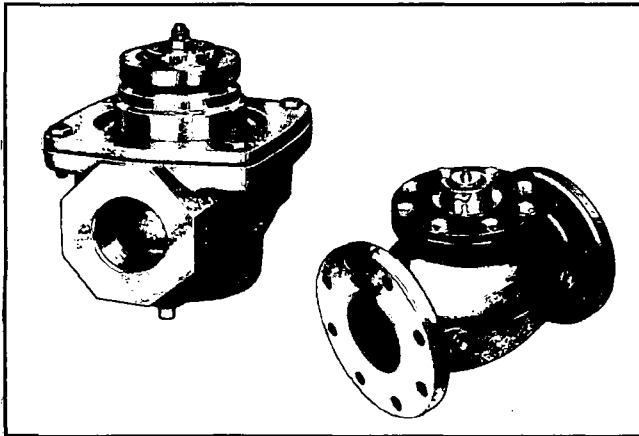
**Honeywell**  
1985 Douglas Drive North  
Golden Valley, MN 55422

**Honeywell Limited-Honeywell Limitée**  
35 Dynamic Drive  
Scarborough, Ontario  
M1V 4Z9



## V5055A-F Industrial Gas Valves

### PRODUCT DATA



### APPLICATION

The V5055 Gas Valves are used with the V4055, V4062, and V9055 Fluid Power Actuators to control gas flow to commercial and industrial burners.

While it is possible to combine any V5055 gas valve with any V4055, V4062, V9055 fluid actuator, a limited range of combinations apply to the applications most often used. See Table 1.

### FEATURES

- Used with natural or liquefied petroleum (LP) gases.
- V5055 normally closed valves are rated for final shutoff service (safety shutoff).
- V5055A,C,D,E,F Valves are for On-Off service.
- V5055B Valve has a characterized guide and in combination with the V4055, V4062, and V9055 Fluid Power Actuators, provides slow-opening, hi-lo-off, and modulating functions respectively.
- V5055C,E Valves have a double seal and are used with V4055D,E Actuators to provide proof-of-closure switch and valve seal overtravel interlock.
- V5055D,E Valves are for high pressure applications (see Table 2).
- Seven valve sizes from 3/4 to 3 inches have NPT threaded connections. Models are available with BSP-PL threads. V5055A,B,C Valves are available in a 4 inch size and have flange connections.
- Most models have 1/4 inch upstream and downstream tap and plug. BSP-PL thread models have 1/4 inch upstream tap and plug.
- Yellow SHUT indicator attached to the valve stem provides an indication of the valve closed position.
- Unpainted, die-cast aluminum body.

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## SPECIFICATIONS

Table 1. Usual Combinations of Fluid Power Actuators and V5055 Industrial Gas Valves.

Fluid Power Actuators/ Industrial Gas Valves			Standard pressure <sup>a</sup>			High Pressure <sup>a</sup>	
			V5055A, F <sup>b</sup>	V5055B	V5055C	V5055D	V5055E
Type	Model	Pressure Rating <sup>a</sup>	On-Off	Characterized Guide <sup>c</sup>	VSOI <sup>d</sup>	On-Off	VSOI <sup>d</sup>
V4055 On-Off	A, G <sup>e</sup>	Standard	.	.		.	
	B	High	. <sup>f</sup>	. <sup>f</sup>		.	
	D <sup>c</sup> , F <sup>d e</sup>	Standard			.		.
	E <sup>d</sup>	High			. <sup>f</sup>		.
V4062 High-Low-Off	A	Standard		.	.		
	B	High		. <sup>f</sup>	. <sup>f</sup>		.
	D <sup>d</sup>	Standard			.		
V9055 Modulating	A	Standard		.			
	D <sup>d</sup>	Standard			.		

<sup>a</sup> Refer to Table 2 for actual pressure ratings of the various combinations of valves and actuators.

<sup>b</sup> V5055F models meet EN161 leakage requirements.

<sup>c</sup> Characterized guide provides a more linear relationship between the stem travel and gas flow. Check Honeywell form 70-8311 to verify that flow curve characteristics match application requirements.

<sup>d</sup> Valve Seal Overtravel Interlock. Valve has two shutoff seals, actuator has proof-of-closure switch.

<sup>e</sup> V4055F, G models include switch for manual control.

<sup>f</sup> These combinations have higher pressure ratings; see Table 2.

## 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 Honeywell Automation and Control Products Sales Office (check white pages of your phone directory).
2. Honeywell Customer Care  
1885 Douglas Drive North  
Minneapolis, Minnesota 55422-4386

In Canada—Honeywell Limited/Honeywell Limitée, 35 Dynamic Drive, Toronto, 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 2. V5055 Pressure Ratings

Model	Pipe Size	STANDARD PRESSURE ACTUATORS V4055A, D, F, G V4062A, D V9055A, D				HIGH PRESSURE ACTUATORS V4055B, E V4062B			
		M.O.P.D. <sup>a</sup>		Max. Rated Pressure <sup>b</sup>		M.O.P.D. <sup>a</sup>		Max. Rated Pressure <sup>b</sup>	
STANDARD PRESSURE VALVES V5055A, B, C, F	3/4" to 1-1/2"	5 PSI	340 mbar	15 PSI	1.0 Bar	15 PSI	1030 mbar	15 PSI	1.0 Bar
	2" to 3"	5 PSI	340 mbar	15 PSI	1.0 Bar	15 PSI	1030 mbar	15 PSI	1.0 Bar
	4" flanged	3 PSI	207 mbar	15 PSI	1.0 Bar	5 PSI	340 mbar	15 PSI	1.0 Bar
HIGH PRESSURE VALVES V5055D, E	3/4" to 1-1/2"	5 PSI	340 mbar	75 PSI	5.0 Bar	25 PSI	1720 mbar	75 PSI	5.0 Bar
	2" to 3"	5 PSI	340 mbar	45 PSI	3.0 Bar	15 PSI	1030 mbar	45 PSI	3.0 Bar

<sup>a</sup> Max Operating Pressure Differential (UL) or Max Operating Pressure (CSA); maximum allowable pressure drop from inlet to outlet for proper operation.

<sup>b</sup> Max rated pressure (UL) or Max Close-off Pressure (CSA); maximum pressure that the valve can be exposed to without leakage or damage to the valve.

Models: See Table 3.

Table 3. Industrial Gas Valve Models.

Model Number	Features
V5055A	Industrial Gas Valve for On-Off service.
V5055B	Industrial Gas Valve with characterized guide for slow opening, HI-LO-OFF, or modulating service.
V5055C	Same as V5055A but incorporates a double seal. Used with the V4055D Actuator to a provide proof-of-closure switch and a valve seal overtravel interlock.
V5055D	Same as V5055A but for high pressure applications.
V5055E	Same as V5055C but for high pressure applications.
V5055F	Same as V5055E but meets the intent of EN161 leakage requirements.

**Type of Gas:** Natural or liquefied petroleum (LP) only.

**Pipe Size:** 3/4, 1, 1-1/4, 1-1/2, 2, 2-1/2, 3, and 4 in. (only V5055A,B,C available in 4 in. size).

**Pipe Threads:** NPT or BSP-PL Threads (equivalent to ISO R7 and DIN 2999). Available on inlet and outlet of 3/4 to 3 inch valves. Four inch valves have flange connections.

**Pressure Ratings:** See Table 2.

**Valve Capacities:** See Table 4.

**Upstream Tapping and Plug:** 1/4 in. NPT or BSP-PL is standard.

#### Downstream Tapping and Plug:

1/4 in. NPT on most domestic models.

1/8 in. NPT on V5055C1182.

#### Ambient Operating Temperature Rating:

-40°F to 150°F (-40°C to 66°C); -40°F to 125°F (-40°C to 52°C) when used with V9055.

Table 4. Valve Rated Capacity at 1 in. (2.5 mbar) pressure drop; based on gas with specific gravity of 0.64.

Valve Size (in.)	CSA Rated Capacity	
	cf/h	cu m/hr
3/4	665	18.8
1	960	27.2
1-1/4	1406	39.8
1-1/2	1717	48.6
2	3620	102.5
2-1/2	4250	120.3
3	5230	148.1
4 (V5055A)	10200	288.8
4 (V5055B,C)	9180	259.9

**Material:** Die-cast aluminum.

**Mounting:** Mounts directly in the gas supply line.

**Dimensions:** See Fig. 2 and 3.

#### Weight:

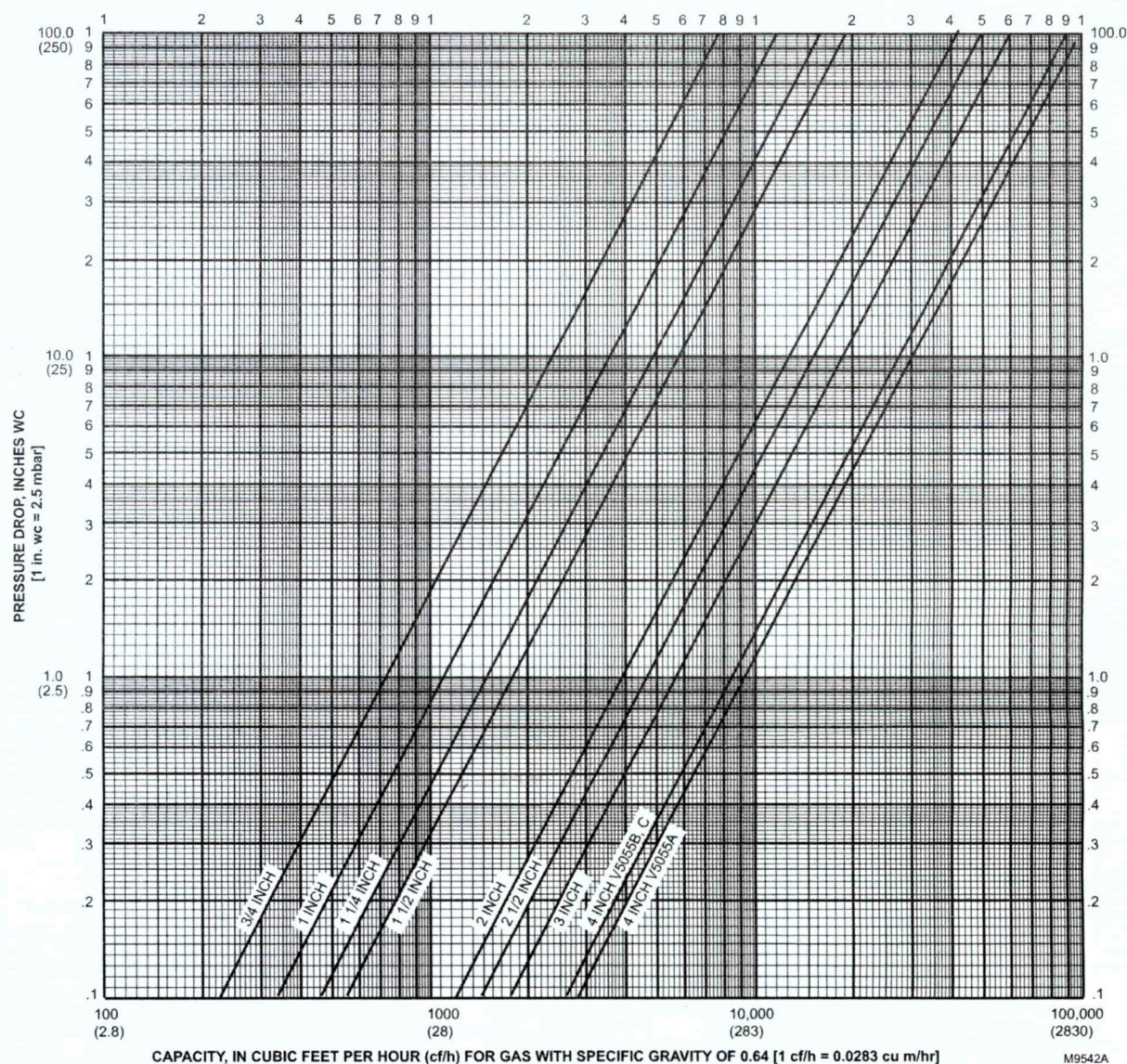
3/4, 1, 1-1/4, 1-1/2, in. valve: 4 lb. (1.8 kg).

2 in. valve: 8 lb. (3.6 kg).

2-1/2, 3 in. valve: 11 lb. (5.0 kg).

4 in. valve: 28 lb. (12.7 kg).



**Replacement Parts:**

Replacement Seal Assembly: Includes valve seal, bonnet seal, and tube of lubricant.

133393A: for 3/4, 1, 1-1/4, and 1-1/2 in. valves

133392A: for 2, 2-1/2, and 3 in. valves.

137253A: for 4 in. valves.

**Replacement Bonnet Assembly:** Includes complete bonnet assembly, plus the required replacement seal assembly. See Table 5.

**Table 5. Replacement Bonnet Assemblies.**

Valve Model	Valve Size (in.)	Replacement Bonnet Assembly
V5055A (On-Off)	3/4, 1, 1-1/4, 1-1/2	133398AA
	2, 2-1/2, 3	133417AA
	4	136911AA

**Table 5. Replacement Bonnet Assemblies. (Continued)**

Valve Model	Valve Size (in.)	Replacement Bonnet Assembly
V5055B (Characterized guide)	3/4, 1, 1-1/4, 1-1/2	133398BA
	2, 2-1/2, 3	133417BA
	4	136911BA
V5055C (Valve-closed indicator)	3/4, 1, 1-1/4, 1-1/2	133398CA
	2, 2-1/2, 3	133417CA
	4	136911CA
V5055D (High pressure On-Off)	3/4, 1, 1-1/4, 1-1/2	136308AA
	2, 2-1/2, 3	136307AA
V5055E (Valve Closed Indicator)	3/4, 1, 1-1/4, 1-1/2	136308BA
	2, 2-1/2, 3	136307BA

**Approvals:**

The following combinations of V5055 Valves (3/4 through 4 in.) and V4055, V4062 and V9055 Fluid Power Actuators are approved by these agencies:

Underwriters Laboratories Inc. Listed: (File No. MH1639, Guide No. YIOZ):

V4055A,B,D,E/V5055A,B,C,D,E,F

V4062/V5055A,B,C,E,F

V9055/V5055A,B,C,E,F

Swiss Re (Formerly GeGap/IRI) Acceptable:

V4055A,B,D,E/V5055A,B,C,D,E,F

V4062/V5055A,B,C,E,F

V9055/V5055A,B,C,E,F

Factory Mutual Approved (Report No. ID9AZ.AF).

CSA File No. 158158, Class 3371 for USA and Canada:

V4055A/V5055A,B

V4055E/V5055E

V4055B/V5055D

V4062/V5055B,C

V4055D/V5055C

V9055/V5055B,C

NOTE: CSA does not certify models equipped with BSP threads.

British Gas Corporation and Dutch Gas Institute Approved:

V4055 or V4062 with V5055A1145, A1152, A1160,

A1178, B1168, B1184, B1192, B1200, B1218.

Australian Gas Association Approved:

V5055B1267, B1275, and B1291.

DIN-DVGW Approved (Germany):

V5055A1145, A1152, A1160, A1178, B1168, B1184, B1192, B1200, and B1218.

## 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 Btu/h (Btus per hour) or in cf/h (cubic foot per hour).
2. Call the gas utility for information on (a) the specific gravity (sp gr) and (b) Btu per cubic foot (Btu/cu ft) for type of gas used.

3. Find the capacity in cf/h. If the capacity is listed in Btu/h, convert to cf/h by the following formula:

$$\text{Capacity in cf/h} = \frac{\text{Btu/h (from burner nameplate)}}{\text{Btu/cu ft (from gas utility)}}$$

4. For gases with specific gravities other than 0.64, multiply the burner cf/h by the proper conversion factor. See Table 6.

**Table 6. Gas Conversion Factors.**

Type of Gas	sp gr (average)	Multiply cf/h by:
Manufactured	0.60	0.968
Mixed	0.70	1.046
Propane	1.53	1.546
Butane	1.98	1.759

5. Use the corrected burner capacity in cf/h when determining the gas valve size in Fig. 1.
6. Determine the available pressure drop across the valve and draw a horizontal line at this pressure in Fig. 1.
7. Draw a vertical line in Fig. 1 at the capacity (cf/h) previously determined. Use the corrected capacity for a gas with a specific gravity other than 0.64.
8. Use the valve size at the intersection of the horizontal and vertical lines. If the intersection is between valve sizes, use the next higher size to the right.

## TO SIZE TWO IDENTICAL VALVES PIPED IN SERIES

1. Find the cf/h for the type of gas used.
2. Consider both valves as one unit. Determine the total maximum pressure drop across the unit.
3. Find the pressure drop across the first valve by assuming it to be 45 percent of the total pressure drop.
4. Find the valve size from Fig. 1.
5. The second valve will be the same size as the first valve.

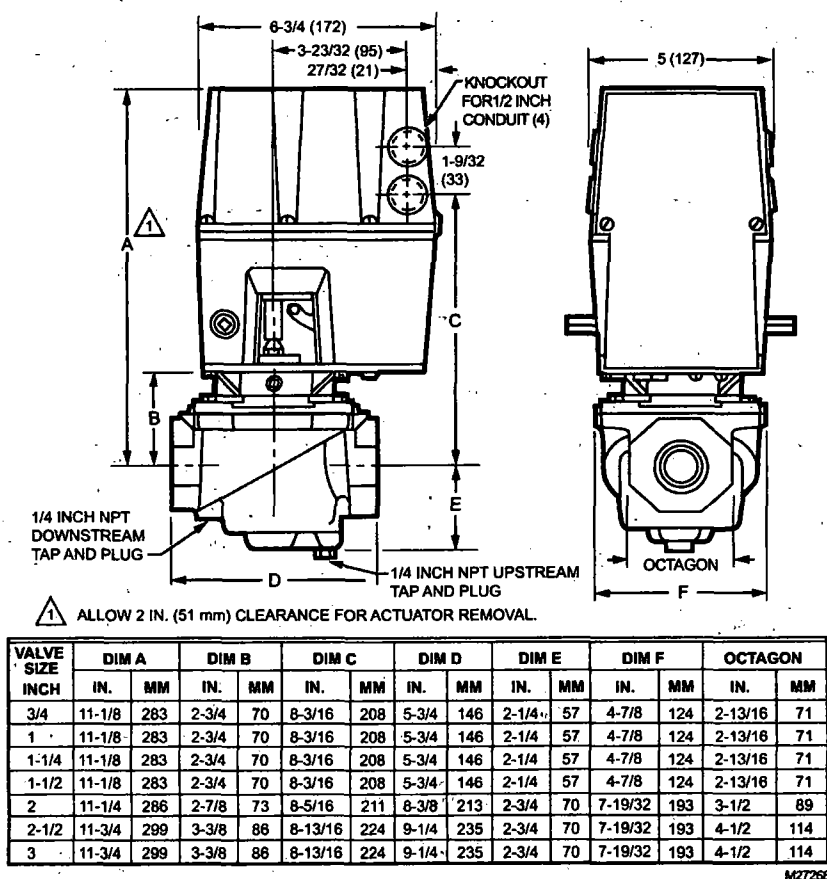


Fig. 2. Approximate dimensions of the 3/4 through 3 in. V5055 Valves, with valve actuator, in in. (mm).



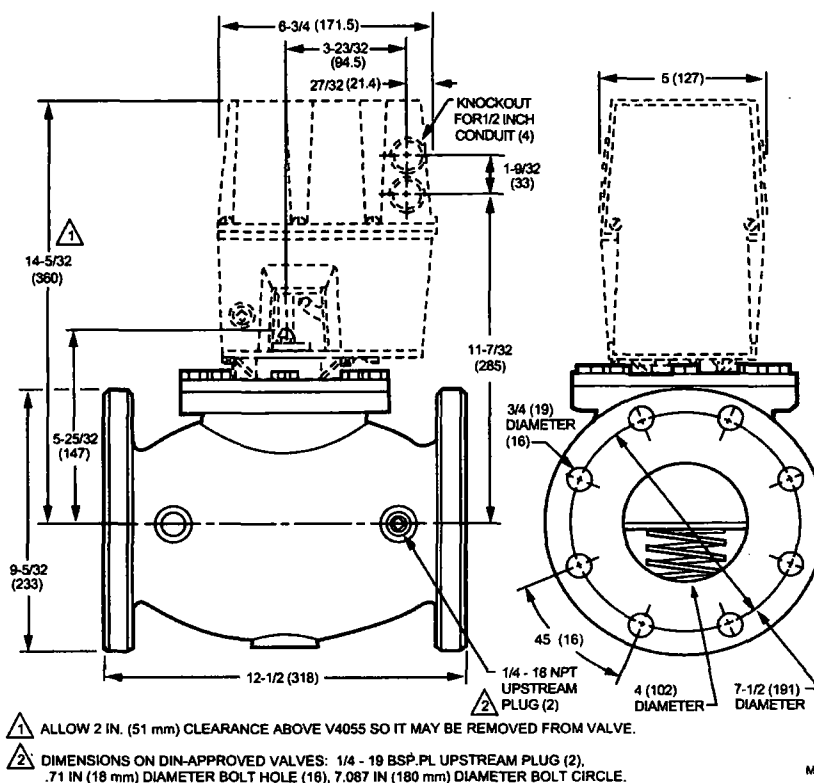


Fig. 3. Approximate dimensions of the 4 in. V5055 Valves, with valve actuator, in in. (mm).

## INSTALLATION

### IMPORTANT:

The V5055 Valve is designed to provide control of gaseous fuel (natural and LP gas) flow in applications in which there is minimal exposure to water. V5055 Valves used in maritime, beverage, food processing, outdoor and other installations in which occasional exposure to water is experienced may be subject to valve stem and spring corrosion. The presence of corrosion decreases the operating life of the valve. V5055 Valves used in such installations should be inspected at least annually and should have the valve bonnets replaced if corrosion is noted.

A V4055 Valve Actuator with a NEMA 4 rating is also recommended for such installations. The water-tight design of the NEMA 4 rated V4055 Actuator prevents water from entering the V4055 valve stem and spring chamber through the actuator. Under certain conditions, some water may be retained by the external upper portion of the valve body. The retained water is effectively excluded from the valve stem and spring chamber by a functional seal that is incorporated into the NEMA 4 rated actuator.

### 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 operations as provided in these instructions.



## ⚠ WARNING

**Electrical Shock Hazard and Explosion Hazard.**  
Can cause serious injury, death or property damage.

1. Turn off gas supply before starting installation.
2. Disconnect power supply for valve actuator before beginning installation to prevent electrical shock and equipment damage.
3. Be sure the valve is installed so the arrow on the valve points in the direction of gas flow.  
(Gas pressure helps to close the valve.)

## Location

Install the valve in the gas supply line downstream from the pressure regulator. The valve and actuator may be mounted in any position that allows sufficient clearance for installation and for repair or replacement.

1. The valve position indicators should be easily visible with the valve and actuator in the final position.
2. The final position of the valve and actuator must allow for damper linkage, if used.

### IMPORTANT:

*Allow room for turning the valve body (actuator not attached) onto the gas piping. Swing dimensions, measured from the center of the pipe are:*

3/4 through 1-1/2 in. valves: 4 in. (101.6 mm).  
2 through 3 in. valves: 5 in. (127.0 mm).  
4 in. valves: 7 in. (177.8 mm).

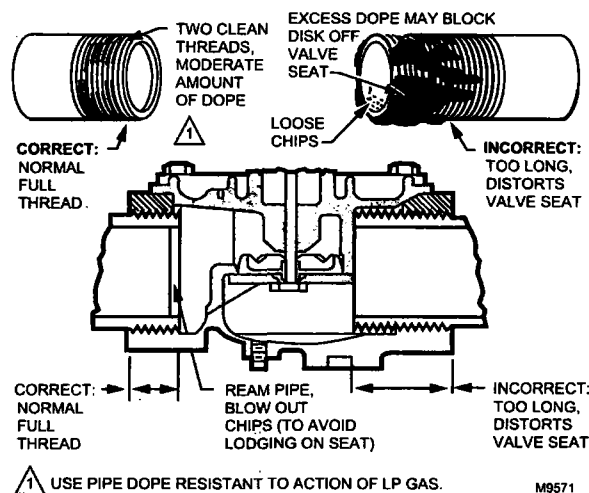
## Mounting (Figs. 4 through 6)

## ⚠ WARNING

**Explosion Hazard.**  
Can cause serious injury, death or property damage.

If flow is not in the direction of the arrow on the valve body, the valve may not shut off.

1. Use new, properly reamed, pipe, free from chips.
2. Do not thread pipe too far (Fig. 4). Valve distortion or malfunction may result from excess pipe in the valve.



**Fig. 4. Preparing the pipes.**

3. Remove the protective caps from the ends of the valve. Do not attach the valve actuator until the valve body installation is complete.
4. Apply good quality pipe dope resistant to action of LP gas, putting a moderate amount on the male threads only. Use dope sparingly; if pipe dope lodges on the valve seat, it will prevent proper closure.
5. Install valve with the gas flow in the direction indicated by the arrow on the casting.
6. Apply a parallel jaw wrench only to the flat next to the pipe being inserted (Fig. 5). A wrench applied to the valve body itself, or to the end farthest from the pipe being inserted, may distort the casting, causing a malfunction. Do not use the valve for a lever.
7. Be sure the gas flow is in the same direction as the arrow on the bottom of the valve body.
8. Use two threaded companion flanges, two gaskets (included with valve), and 16 bolts (with washers and nuts) for mounting a 4 in. -V5055 Valve. Mount a threaded flange and gasket on each end of the valve as shown in Fig. 6. Then screw the pipes into the threaded flanges. Apply dope sparingly, and use wrenches and vises properly as shown in Fig. 4 and 5.
9. *Make sure the power supply is disconnected from the valve actuator.* Then mount the actuator on the valve body and complete the electrical and linkage connections following the instructions packed with the actuator.

## OPERATION AND CHECKOUT

### Operation

A V5055 Industrial Gas Valve is operated by a V4055, V4062, or V9055 Fluid Power Gas Valve Actuator. The valve opens when the actuator is energized, and closes when power is removed. When closed, the valve seals off against the rated close-off pressure with no power applied. For further information, refer to the instructions for the actuator.

## Checkout

### WARNING

#### Explosion Hazard.

Can cause serious injury, death or property damage.

Do not allow fuel to accumulate in the combustion chamber. If fuel is allowed to enter the chamber, for longer than a few seconds without igniting, an explosive mixture could result.

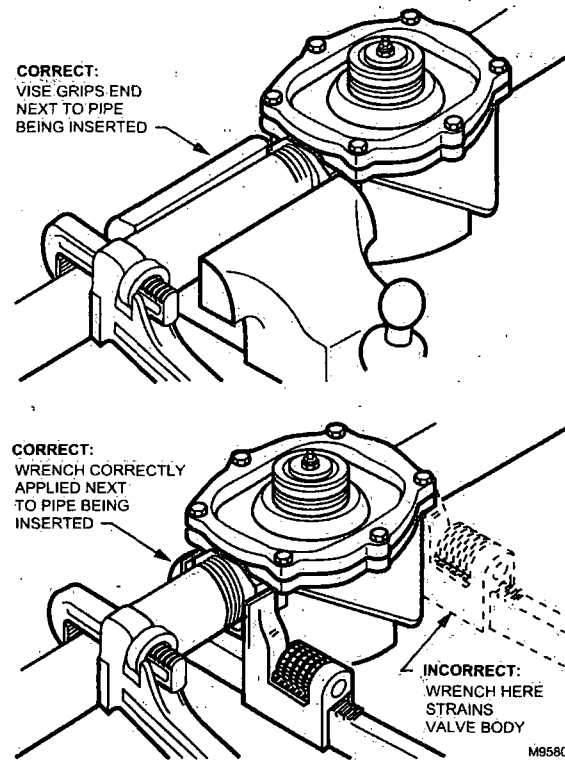


Fig. 5. Installing a 3/4 through 3 in. V5055 Valve.

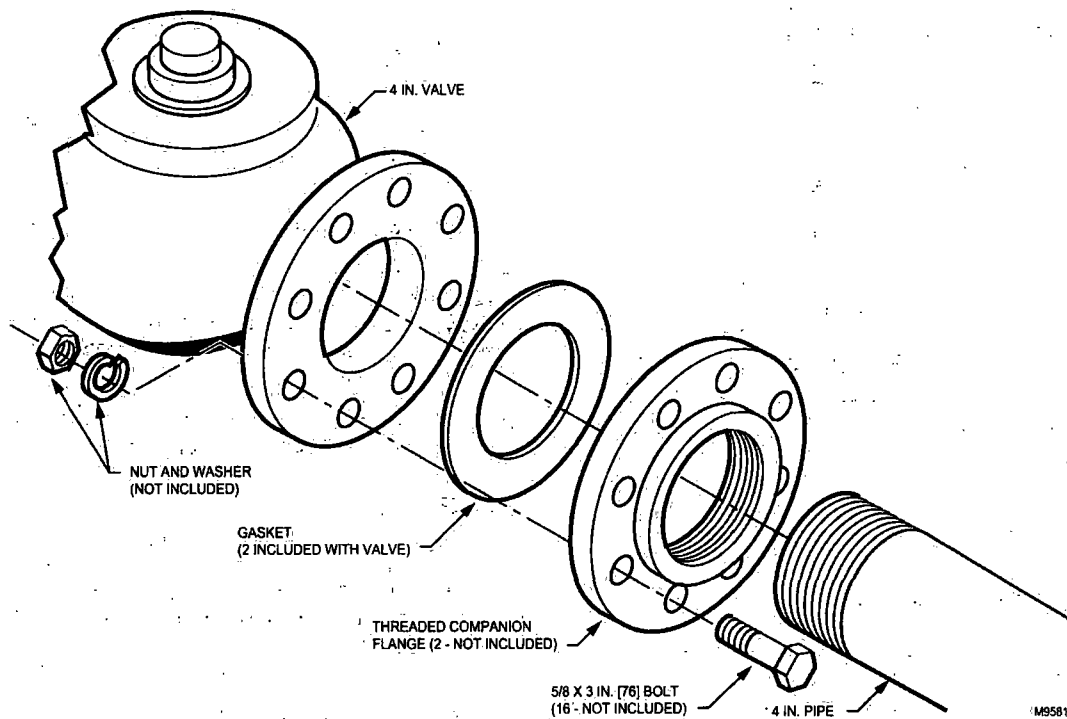


Fig. 6. Installing a 4 in. V5055 Valve.



## CAUTION

### Equipment Damage Hazard.

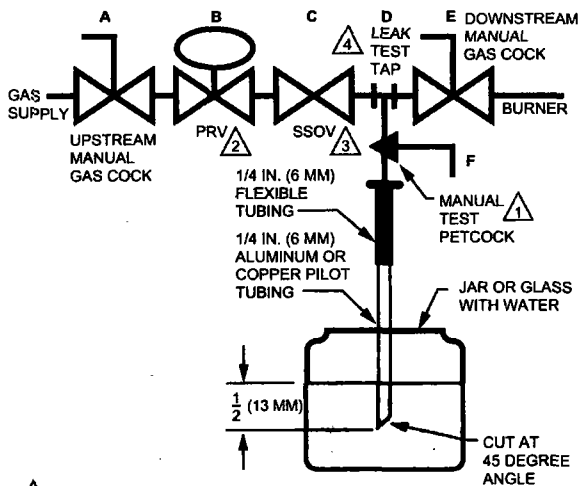
Operation without proper checkout can damage the equipment.

1. Do not put the system into service until you have satisfactorily completed the following Valve Leak Test, all applicable tests described in the Checkout section of the Instructions for the flame safeguard control, and any other tests required by the burner manufacturer.
2. All tests must be performed by a trained, experienced flame safeguard control technician.
3. Close all manual fuel shutoff valves as soon as trouble occurs.

After the installation is complete, cycle the valve several times with the manual fuel shutoff cock closed. Make sure the valve and actuator function properly. Also perform the Valve Leak Test that follows before putting the valve into service.

### Valve Leak Test (Fig. 7)

This is a test for checking the closure tightness of a gas safety shutoff valve. It should be performed by qualified personnel during the initial startup of a burner system, or whenever the valve or valve bonnet is replaced (see Service Information section). It is recommended that this test also be included in the scheduled inspection and maintenance procedures. For a periodic inspection test, follow steps 1, 3, 4, 5, 8, 9, 10, 12, 13, 16, and 17.



① CAN ALSO BE A PERMANENT PETCOCK.

② PRV = PRESSURE REGULATING VALVE.

③ SSOV = SAFETY SHUTOFF VALVE.

④ USE ONLY ONE OF THE DOWNSTREAM TAPS ON THE SSOV.

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Fig. 7. Valve leak test.

1. De-energize the control system to assure that there is no power to the safety shutoff valve (C) shown in Fig. 7.
2. Close the upstream manual gas cock (A).
3. Make sure the manual test petcock (F) is closed in the leak test tap assembly (D).
4. Remove the leak test tap plug and connect the test apparatus to the Leak Tap (D).
5. Close the downstream manual gas cock (E).

6. Open the upstream manual gas cock (A).
7. Run the safety shutoff valve (C) to its fully open position (through the safety system); then immediately de-energize the system to close the valve.
8. Immerse a 1/4 in. tube vertically 1/2 in. (12.7 mm) into a jar of water.
9. Slowly open the test petcock (F).
10. When the rate of bubbles coming through the water stabilizes, count the number of bubbles appearing during a ten-second period. Each bubble appearing during a ten-second period represents a flow rate of approximately 0.001 cfh.

To meet U.S. requirements, leakage must not exceed the values listed in Table 5.

Table 7. Allowable Leakage for V5055 Valves.

V5055 Pipe Size (in.)	Gas specific gravity	Allowable leakage (cc/hr) <sup>a</sup>	Maximum Number of bubbles per 10 sec.	Minimum Number of Seconds for 10 bubbles
3/4" thru 1-1/2"	0.64 nat'l gas	573	14	6.7
	1.00 air	458	9	10.2
	1.57 propane	366	9	10.5
2" thru 3"	0.64 nat'l gas	940	24	4.1
	1.00 air	752	16	6.2
	1.57 propane	602	15	6.4
4"	0.64 nat'l gas	1254	33	3.1
	1.00 air	1003	21	4.6
	1.57 propane	801	21	4.8
V5055F	0.64 nat'l gas	62	-	62
	1.00 air	50	-	93
	1.57 propane	40	-	96

<sup>a</sup> Based on standard conditions, test pressures provided by ANSI Z21.21, Section 2.4.2 and a maximum of 235 cc/hr (air) per inch of seal-off diameter. Seal-off diameter is not to be confused with pipe size.

NOTE: For international leak test requirements, contact the office of the appropriate approval agency.

### After the test:

11. Close the upstream manual gas cock (A).
12. Close the test petcock (F), remove the test apparatus, and replace the leak test tap plug (D).
13. Open the upstream manual gas cock (A) and energize the safety shutoff valve (C).
14. Test with soap bubbles to assure that there is no leak at the test tap (D).
15. De-energize the safety shutoff valve (C).
16. Open the downstream manual gas cock (E).
17. Restore the system to normal operation. If two safety shutoff valves are utilized, each V5055 valve is to be checked for tightness of closure.

## SERVICE INFORMATION

### WARNING

**Explosion and Electrical Shock Hazard.**  
Can cause serious injury, death or property damage.

1. Before servicing, turn off the gas supply and disconnect all electrical power to the valve actuator.
2. Only qualified service technicians should attempt to service or repair flame safeguard controls and burner systems.
3. Do not disassemble the valve bonnet assembly; the valve seat is not replaceable.
4. Failure to properly position and seat the seals in the valve body may result in a hazardous gas leak.

### Scheduled Inspection and Maintenance

Setup and follow a schedule for periodic inspection and maintenance, including the burner, all other controls, and the valve(s) and actuator(s) for leaking oil. It is recommended that the Valve Leak Test in the Checkout section be included in this schedule. Refer to the Instructions for the primary safety control for more information.

### Valve Checkout for Oil Leakage from Actuator

1. Turn off the gas supply at the manual shutoff valve located upstream from the valve(s) being serviced.
2. Shut off all electrical power to the valve actuator(s).
3. Mark and disconnect the wires from the actuator terminals. Remove conduit and disengage the damper linkage assembly (if applicable).
4. Loosen the two set screws from the valve to lift off the actuator.
5. If the actuator is to be replaced and it did not leak hydraulic fluid, skip to Step 11.

**NOTE:** It is good practice to inspect the inside of the valve whenever the actuator is replaced. To do so, remove the bonnet assembly, inspect the valve and bonnet. If all is well, proceed to Step 7.

6. If the actuator leaked hydraulic fluid onto the valve (the fluid is red), it must be cleaned off from the valve and bonnet assembly.
  - a. Wipe off the outer valve body.
  - b. Remove the valve bonnet bolts and lift off the bonnet.

**NOTE:** V5055/V5097C and E Valves have additional internal springs that will push the bonnet up as the bolts are loosened.

- c. Inspect the inside of the valve.

#### IMPORTANT

*If fluid is present on the inside surfaces of the valve body or bonnet surfaces, the bonnet assembly or entire valve must be replaced. For part numbers, refer to "Replacement Parts:" on page 4.*

- d. If the inside surfaces are clear of hydraulic fluid, clean the bonnet assembly and be sure to remove all hydraulic fluid from the inside and outside of the actuator mounting curb. This is the "cup-like" area around the valve stem. Avoid using a cleaning solution as it may damage the rubber seals used in the valve.
7. If the valve bonnet assembly is in good condition and is not replaced, replace the bonnet seal. Do not reuse the old bonnet seal. See "Replacement Parts:" on page 4 for the seal number.
8. Coat seals with grease provided and position in valve body/bonnet assembly.
9. Carefully seat the bonnet assembly on the valve body. Be sure the seals are in their proper position. On those valves with a spring below the disc, be sure the spring is centered in the indentation on the inside of the valve body.
10. After positioning the bonnet assembly, replace the screws removed earlier.

**NOTE:** When replacing the bonnet assembly on the 4" valve, it must be drawn evenly into the valve body. Finger tighten the 8 screws. Draw the bonnet assembly into the valve by tightening, in order, screws 1, 5, 7, 3 (two turns each). Repeat until the assembly is seated. Tighten the remaining screws.

11. Remount the actuator on the bonnet assembly. Tighten the two set screws (50-60 inch pounds).
12. Replace the damper crank arm assembly.
13. Re-attach the wires removed from the actuator terminals and turn on the electrical power.
14. With the gas still off, cycle the actuator to check for proper mechanical operation.



### CAUTION

**Be sure to perform a bonnet seal and seat leak check after installation.**

Be sure to read and follow all instructions that come with the actuators, valves, seal and bonnet kits.

### Valve Bonnet Replacement - See Table 5

The entire valve bonnet may be replaced without removing the valve body from the gas line. Do not disassemble the valve bonnet assembly; the valve seat is not replaceable.

For part numbers, refer to Replacement Parts in the Specifications section. Complete instructions for replacing the bonnet assembly are included with the replacement part.

### Replacement of Seals (Fig. 8 or 9)

When removing the bonnet to inspect and clean the valve, install new seals (see Replacement Parts in Specifications section). Coat the new seals with the grease provided, and position them in the valve body as shown in Fig. 8 or 9.

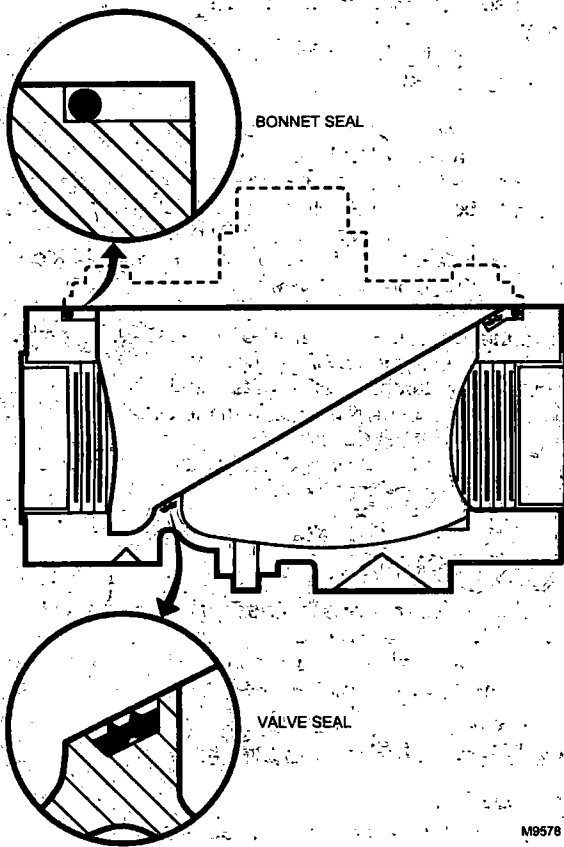
Failure to properly position and seat the seals in the valve body may result in a hazardous gas leak.

After the new bonnet assembly is installed, or the bonnet is removed for any reason, check for gas leakage around the bonnet seal. Turn on the gas at the manual valve. Paint the

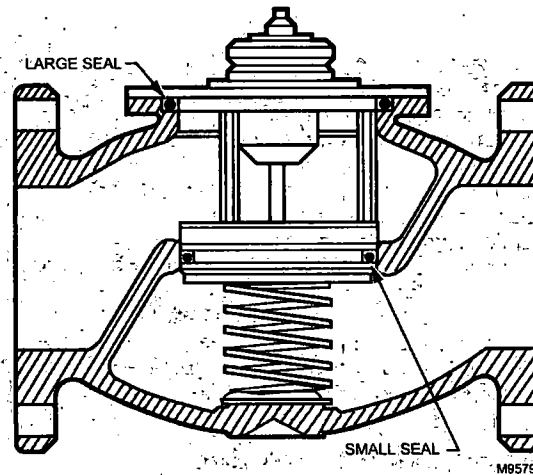
seal area with a rich soap and water solution. Bubbles indicate a gas leak. If a leak is detected, check to see that the bonnet screws are tight. If necessary, turn off the gas again and remove the bonnet to be sure the seals are properly seated.

**Table 8. Gas Valve Replacement Seals.**

Replacement Seal Assy #	Valve Size (in in.)
133393A	3/4, 1, 1-1/4, 1-1/2
133392A	2, 2-1/2, 3
137253A	4



**Fig. 8. Proper positions of valve and bonnet seals in 3/4 through 3 in. valves.**



**Fig. 9. Proper positions of valve and bonnet seals in 4 in. valves.**

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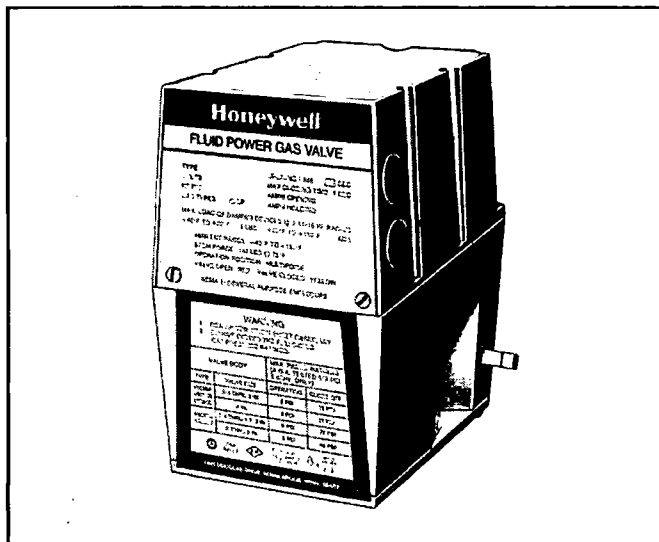
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**Honeywell**

## V4055A,B,D,E On-Off Fluid Power Gas Valve Actuator

### PRODUCT DATA



### APPLICATION

The V4055 Gas Valve Actuator, in combination with a VE5000<sup>a</sup>, V5055 or V5097 Gas Valve, controls the gas supply to commercial and industrial burners.

When replacing a V4034 with a V4055, the V5034 gas valve must also be replaced with a V5055 or V5097 gas valve.

### FEATURES

- The V4055 Actuator, when used with the VE5000<sup>a</sup>, V5097 or V5055 Valve, is rated for final safety shutoff service.

- The V4055 Actuator can be used with the characterized guide model of the V5055 or V5097 Gas Valve to enhance lightoff smoothness.
- The standard model has an opening time of 26 seconds at 60 Hz or 32 seconds at 50 Hz. A fast-opening model is available with timings of 13 seconds at 60 Hz or 16 seconds at 50 Hz.
- Maximum closing time is one second, which meets code, standard and insurer requirements.
- Models available with damper shaft, with or without spring return; shaft extends out both sides and rides in Teflon-like Delrin bushings; used with standard 7616BR Damper Crank Arm.
- Red OPEN indicator attached to actuator stem shows when valve is even slightly open; yellow SHUT indicator on valve stem shows only when gas valve is fully closed.
- Models available with adjustable max flow limit switch.
- Ambient temperature rating is -40°F to +150°F (-40°C to +66°C) for 60 Hz models and -10°F to +158°F (-23°C to +70°C) for 50 Hz and 50/60 Hz models.
- Valve and actuator combinations can be mounted in any position, with the exception of the 220 to 240 Vac, 50/60 Hz models, which are mounted vertically.
- Models available with factory-installed single pole double throw (spdt) field-adjustable Auxiliary Switch. Field-addable Auxiliary Switch kits are also available.
- Standard enclosure meets NEMA 1 (IP30) requirements; models available with NEMA 4 (IP54) weatherproof enclosure.
- V4055D and high pressure V4055E with Proof-of-Closure Switch and V5055/V5097C or E with valve seal overtravel interlock (double seal) to meet specific code, standard and insurer requirements.

<sup>a</sup> VE5000 is a European manufactured and approved valve for European use only.

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## SPECIFICATIONS

### Models:

V4055A Actuator, with V5055, V5097 or VE5000 Gas Valves, provides on-off control of fuel. With proper adapter (see Accessories), it replaces the V4034 Actuator on a V5034 Gas Valve.

V4055B Actuator is a high pressure version of V4055A.

V4055D Actuator is identical to V4055A, except has a Proof-of-Closure Switch. Used with V5055C/V5097C (double seal) for valve seal overtravel interlock.

V4055E Actuator is identical to V4055B, except has a Proof-of-Closure Switch. Used with V5055E/V5097E (double seal) for valve seal overtravel interlock.

NEMA 4 weatherproof models available.

**Nominal Opening Time:** See Table 1.

**Table 1. Nominal Opening Time (seconds).**

Model	50 Hz	60 Hz
Standard	32	26
Fast-opening	16	13

**Maximum Closing Time:** One second when de-energized.

### Ambient Operating Temperature Ratings:

60 Hz Models: -40°F to +150°F (-40°C to +66°C).

50 Hz, 50/60 Hz Models: -10°F to +158°F (-23°C to +70°C).

**Mounting:** V4055 Actuator attaches directly to V5055/V5097 Valve with two sets of screws positioned 90 degrees apart. Combination is multipoise.

NOTE: 220 to 240 Vac, 50/60 Hz models are vertical mount only.

**Pressure Ratings:** See Table 2.

**Table 2. Pressure Ratings of Valve-Actuator Combinations.**

Model	Pipe Size	STANDARD PRESSURE ACTUATORS V4055A, D, F, G				HIGH PRESSURE ACTUATORS V4055B, E			
		M.O.P.D. <sup>a</sup>		Max. Rated Pressure <sup>b</sup>		M.O.P.D. <sup>a</sup>		Max. Rated Pressure <sup>b</sup>	
STANDARD PRESSURE VALVES V5055A, B, C, F, V5097A, B, C	3/4" to 1-1/2" <sup>c</sup>	5 PSI	340 mbar	15 PSI	1.0 Bar	15 PSI	1030 mbar	15 PSI	1.0 Bar
	2" to 3" <sup>d</sup>	5 PSI	340 mbar	15 PSI	1.0 Bar	15 PSI	1030 mbar	15 PSI	1.0 Bar
	4" flanged <sup>e</sup>	3 PSI	207 mbar	15 PSI	1.0 Bar	5 PSI	340 mbar	15 PSI	1.0 Bar
HIGH PRESSURE VALVES V5055D, E, V5097D, E	3/4" to 1-1/2" <sup>c</sup>	5 PSI	340 mbar	75 PSI	5.0 Bar	25 PSI	1720 mbar	75 PSI	5.0 Bar
	2" to 3" <sup>d</sup>	5 PSI	340 mbar	45 PSI	3.0 Bar	15 PSI	1030 mbar	45 PSI	3.0 Bar

<sup>a</sup> Max Operating Pressure Differential (UL) or Max Operating Pressure (CSA): maximum allowable pressure drop from inlet to outlet for proper operation.

<sup>b</sup> Max rated pressure (UL) or Max Close-off Pressure (CSA): maximum pressure that the valve can be exposed to without leakage or damage to the valve.

<sup>c</sup> Applies for small-body V5097 valves 3/4" up to 2" pipe size.

<sup>d</sup> Applies for large-body V5097 valves 2" up to 3" pipe size.

<sup>e</sup> V5055A, B, C only.

**Electrical Ratings:** See Tables 3 and 4.

## 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 Honeywell Automation and Control Products Sales Office (check white pages of your phone directory).
2. Honeywell Customer Care  
1885 Douglas Drive North  
Minneapolis, Minnesota 55422-4386

In Canada—Honeywell Limited/Honeywell Limitée, 35 Dynamic Drive, Toronto, 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 3. V4055A,D Electrical Ratings.

Voltage and Frequency	Opening (Standard)				Opening (Fast)				Holding		
	Inrush	(W)	(A)	(VA)	Inrush	(W)	(A)	(VA)	(W)	(A)	(VA)
100/50-60 <sup>a</sup>	—	43.0	0.91	91	—	58.0	1.30	130	10.4	0.16	16
100/50-60 <sup>b</sup>	—	33.0	0.6	67	—	43.0	0.91	91	8.4	0.14	14
120/60	3.9	50.0	0.94	115	5.4	71.0	1.33	160	9.5	0.12	14
200/50-60 <sup>a</sup>	—	68.0	0.79	158	—	88.0	1.10	220	10.6	0.09	18
200/50-60 <sup>b</sup>	—	48.0	0.52	104	—	63.0	0.72	144	9.0	0.07	14
220/50	1.6	55.5	0.55	121	3.0	76.0	0.80	176	9.0	0.06	14
240/50	—	81.5	0.79	190	—	95.0	1.00	240	9.1	0.06	14
240/60	2.6	51.0	0.45	115	4.0	71.5	0.68	160	9.2	0.06	14
220-240/50-60 <sup>c</sup>	—	—	—	—	—	70.3	0.59	136	7.2	0.07	16
220-240/50-60 <sup>d</sup>	—	—	—	—	—	58.6	0.46	106	5.9	0.06	14

<sup>a</sup> 50 Hz power supply.<sup>b</sup> 60 Hz power supply.<sup>c</sup> 230 Vac, 50 Hz power supply.<sup>d</sup> 230 Vac, 60 Hz power supply.

Table 4. V4055B,E Electrical Ratings.

Voltage and Frequency	Opening (Standard)				Opening (Fast)				Holding		
	Inrush	(W)	(A)	(VA)	Inrush	(W)	(A)	(VA)	(W)	(A)	(VA)
120/60	—	60	0.94	115	—	60.0	0.94	115	9.5	0.16	19
220-240/50-60 <sup>a</sup>	—	—	—	—	—	68.9	0.58	133	6.7	0.08	18
220-240/50-60 <sup>b</sup>	—	—	—	—	—	58.2	0.46	106	5.3	0.06	14

<sup>a</sup> 230 Vac, 50 Hz power supply.<sup>b</sup> 230 Vac, 60 Hz power supply.

**Auxiliary Switch and Proof-of-Closure Switch Ratings:**  
See Table 5.

**Table 5. Auxiliary Switch and Proof-of-Closure  
Switch Ratings (1/2 hp [0.37kW]<sup>a</sup>).**

Load	120V	240V
Full Load	9.8A	4.9A
Locked Rotor	58.8A	29.4A

<sup>a</sup>Maximum total connected power to both switches (if used) is 1800 VA.**Mounting Dimensions:** See Fig. 1 and Table 7.

**Damper Shaft:** Shaft is 3/8 in. (9.5 mm) square, for use with 7616BR Damper Crank Arm (ordered separately) and with or without damper shaft return spring.

**Maximum Damper Shaft Rotation:** 52 angular degrees.

**Maximum Force:** 2-11/16 in. (68.3 mm) radius for 7616BR Damper Crank Arm ordered separately (see Accessories section).

**NOTE:** Damper shaft drives damper crank arm in one direction only; optional return spring is available on damper shaft to turn damper crank arm in opposite direction. See Table 6.

**Table 6. Actuator Torque (With and  
Without Return Spring).**

V4055 Model	-40°F to +20°F (-40°C to -7°C)		20°F to 150°F (-7°C to +66°C)	
	lb	N	lb	N
With return spring	5	22.2	10	44.5
Without return spring	5	22.2	20	89.0

**Approvals:**

Underwriters Laboratories Inc. Listed: File No. MH1639, Guide No. YIOZ.

Factory Mutual: Listed.

Canadian Standards Association certified: General Listed file numbers 158158 Class 3371.

For U.S.A. and Canada: certified 60 Hz models only.

Swiss Re (Formerly GeGap/IRI) Acceptable.

Some V4055 Actuators are approved as Class A valves in accordance with EN161:

When used with V5055 Valves: Pin: CE-0063AR1359.

When used with VE5000 Series Valves: Pin: CE-0063AP3075.



## V4055A,B,D,E ON-OFF FLUID POWER GAS VALVE ACTUATOR

### Accessories:

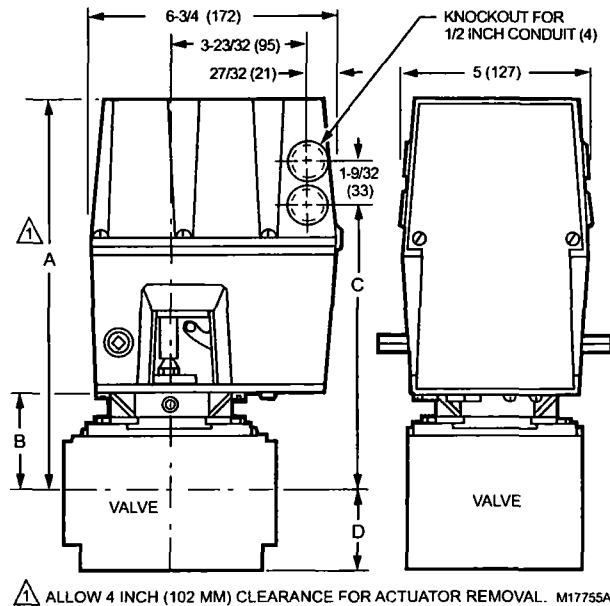
133568 Auxiliary Switch Bag Assembly (not for models with maximum flow limit switch).

133569 Valve-Closed Indication Switch Bag Assembly.

7616BR Damper Crank Arm (damper arm and clip).

**Available Models:** V4055 with NEMA 4 enclosure (weatherproof).

**NOTE:** Check local codes for acceptance of adding the switch and using the valve seal overtravel V5055C or V5055E valves.



**Fig. 1. Approximate mounting dimensions of V4055 Actuators in in. (mm).**

**Table 7. Approximate Mounting Dimensions of V4055 Actuators with V5055 and V5097 Valves.**

Valve Size <sup>a</sup> (in.)		V5055								V5097							
		Dim. A		Dim. B		Dim. C		Dim. D		Dim. A		Dim. B		Dim. C		Dim. D	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
Small Body	3/4	11-1/8	283	2-3/4	70	8-3/16	208	5-3/4	146	11-1/8	283	2-3/4	70	8-3/16	208	2-1/2	64
	1	11-1/8	283	2-3/4	70	8-3/16	208	5-3/4	146	11-1/8	283	2-3/4	70	8-3/16	208	2-1/2	64
	1-1/4	11-1/8	283	2-3/4	70	8-3/16	208	5-3/4	146	11-1/8	283	2-3/4	70	8-3/16	208	2-1/2	64
	1-1/2	11-1/8	283	2-3/4	70	8-3/16	208	5-3/4	146	11-1/8	283	2-3/4	70	8-3/16	208	2-1/2	64
	2	11-1/8	286	2-7/8	73	8-5/16	211	8-3/8	213	11-3/4	298	3-3/8	86	8-3/8	213	4	102
Large Body	2	11-3/4	298	3-3/8	86	8-13/16	224	9-1/4	235	11-3/4	298	3-3/8	86	8-3/8	213	4	102
	2-1/2	11-3/4	298	3-3/8	86	8-13/16	224	9-1/4	235	11-3/4	298	3-3/8	86	8-3/8	213	4	102
	3	11-3/4	298	3-3/8	86	8-13/16	224	9-1/4	235	11-3/4	298	3-3/8	86	8-3/8	213	4	102
	4	14-1/8	359	5-13/16	148	11-7/32	285	12-1/2	318	—	—	—	—	—	—	—	—

<sup>a</sup> Valve size using accessory pipe adapter fitting.

## 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.

## ! WARNING

**Electrical Shock Hazard.**

**Can cause serious injury or death.**

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

**IMPORTANT**

1. All wiring must comply with all applicable electrical codes, ordinances, and regulations. All wiring must be NEC Class 1.
2. Voltage and frequency of the power supply connected to this control must agree with those marked on the device.
3. Loads connected to the Auxiliary Switch and/or Proof-of-Closure Switch, if used, must not exceed the ratings given in the Specifications section.

**Install Valve**

The actuator is mounted directly on the valve bonnet after the valve is installed in the gas supply line. Refer to the instructions packed with the gas valve for installation details. When installing the gas valve, make sure:

1. Sufficient clearance is left to install and service the actuator.
2. Ambient temperatures at the valve location do not exceed actuator ratings. See Specifications section.
3. Position of the valve permits hookup to the damper if one is controlled.

**Install Accessory Switches (If Needed)**

An spdt switch can be installed to operate an auxiliary load up to 1/2 hp (0.37 kW). See Table 5. The switch can be adjusted to operate at any point in the valve stroke.

A Proof-of-Closure Switch can also be installed with a V5055/V5097C or E Valve (with double seal) on any V4055 Actuator to provide a 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.

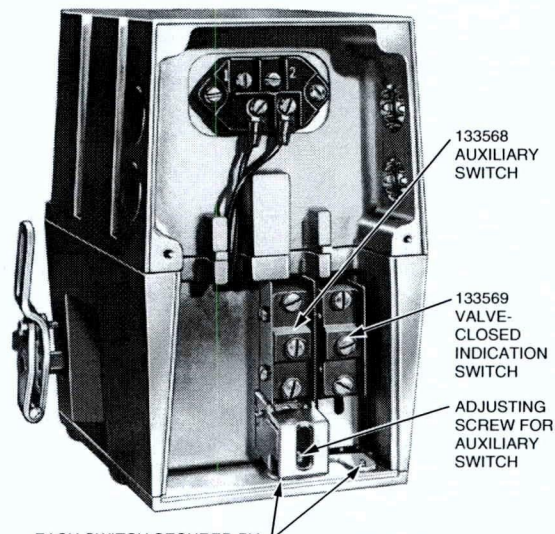
**NOTE:** Mark the actuator or valve to indicate any changes made.

To install the switches:

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. 2. Fasten with two screws through the actuator base.
4. Insert the Proof-of-Closure Switch in the position shown in Fig. 2. The switch mounts against the side of the actuator housing. The mounting holes are spaced to assure mounting the switch in the correct position. Fasten with two screws through the actuator base. (The Proof-of-Closure Switch is not adjustable.)
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 Auxiliary Switch.

**Mount Actuator on Valve**

1. Check the final position of the valve body to be sure that the actuator is in the proper position when mounted on the valve. This is especially important when the actuator is used to drive a damper.
2. If two smaller sized valves are mounted very closely together, as in an Industrial Risk Insurers approved type of valve train, it may be necessary to mount the actuators off center to provide adequate clearance.



EACH SWITCH SECURED BY TWO SCREWS FROM UNDERSIDE OF BASE. IF ONLY ONE SWITCH IS USED, INSTALL BARRIER IN OPEN POSITION.

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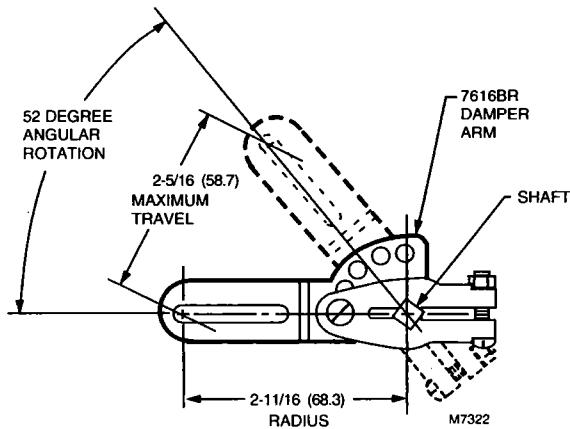
**Fig. 2. V4055 Actuator with cover removed.**

3. Slip the bottom collar of the actuator over the valve bonnet assembly. Rotate the actuator to the desired position and use a 5/32 in. Allen wrench to securely tighten the two setscrews to 50 to 60 lb-in. (5.7 to 6.8 N•m).
4. Connect the damper linkage, if used. Refer to the instructions packed with the damper arm.

**Mount and Adjust 7616BR Damper Crank Arm (If Used)****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.*

Follow installation and adjustment directions included with damper crank arm. Maximum pushrod travel is 2-5/16 in. (59 mm) through a stroke of 52 degrees. See Fig. 3.



**Fig. 3. 7616BR Damper Crank Arm can be attached to actuator shaft to drive a damper when valve is open.**

## WIRING

### ⚠ WARNING

#### Electrical Shock Hazard.

**Can cause serious injury or death.**

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

Wiring must comply with all applicable electrical codes, ordinances and regulations. Wiring to the actuator must be NEC Class 1.

Connect the power supply to terminals 1 and 2 on the V4055 terminal strip. Refer to Fig. 4 for Auxiliary Switch connections and Fig. 5 for Max Flow Limit Switch connections. For typical system hookups, refer to Fig. 6 and to instructions packed with the device used to control the valve.

When all wiring connections are complete, replace the actuator faceplate.

### ⚠ CAUTION

#### Operation Hazard.

**Improper wiring can cause improper and dangerous operation.**

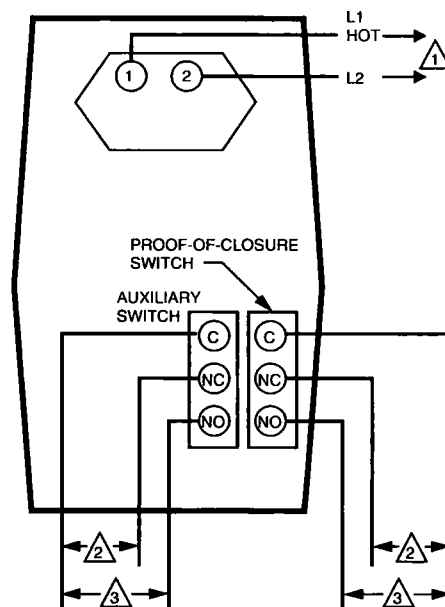
Label all wires prior to disconnection when servicing valves. Wiring errors can cause improper and dangerous operation.

NOTE: Pipe sealant is required on the conduit threads of actuators with NEMA 4 enclosures.

## Adjust 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 (see Fig. 2) clockwise ↻ to cause the switch to operate earlier in the stroke or counter-clockwise ↻ to cause the switch to operate later in the

stroke.



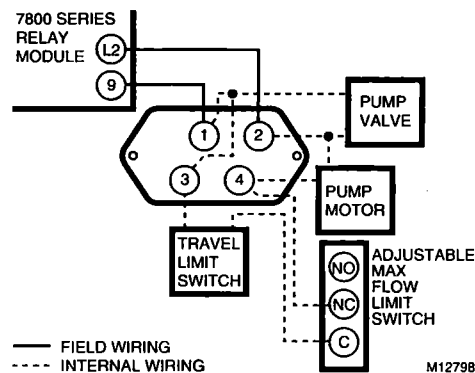
1 POWER SUPPLY. PROVIDE OVERLOAD PROTECTION AND DISCONNECT MEANS AS REQUIRED.

2 SWITCH BETWEEN THESE TWO LEADS IS CLOSED WHEN VALVE IS SHUT (DE-ENERGIZED).

3 SWITCH BETWEEN THESE TWO LEADS IS OPEN WHEN VALVE IS SHUT (DE-ENERGIZED).

M7334

**Fig. 4. External connections to the V4055 Actuator.**



**Fig. 5. Connecting the Max Flow Limit Switch to the actuator.**

NOTE: The Proof-of-Closure Switch is not adjustable.

## Adjust Max Flow Limit Switch (If Used)

The Max Flow Limit Switch is adjustable throughout the stroke of the actuator. With the switch installed in the actuator, turn the adjusting screw clockwise ↻ to cause the switch to operate earlier in the stroke or counter-clockwise ↻ to cause the switch to operate later in the stroke.

## CHECKOUT AND SERVICE



### CAUTION

**Equipment Damage Hazard.**

**Unskilled technicians can cause equipment damage.**

Only a trained, experienced, flame safeguard technician should check out and service this control.

### Checkout

After the installation is complete, cycle the valve several times with the manual fuel shutoff cock closed before testing the system in actual operation.

### Service

The actuator is not field repairable except for replacing the Auxiliary Switch, Max Flow Limit Switch or Proof-of-Closure Switch. See Installation section for procedure. Do not disassemble the valve actuator.

If the actuator fails to operate properly, replace it.

1. Turn off the gas supply at the manual shutoff valve located upstream from the valve(s) being serviced.
2. Shut off all electrical power to the valve actuator(s).
3. Mark and disconnect the wires from the actuator terminals. Remove conduit and disengage the damper linkage assembly (if applicable).
4. Loosen the two set screws from the valve to lift off the actuator.
5. If the actuator is to be replaced and it did not leak hydraulic fluid, skip to Step 11.

**NOTE:** It is good practice to inspect the inside of the valve whenever the actuator is replaced. To do so, remove the bonnet assembly, inspect the valve and bonnet. If all is well, proceed to Step 7.

6. If the actuator leaked hydraulic fluid onto the valve (the fluid is red), it must be cleaned off from the valve and bonnet assembly.
  - a. Wipe off the outer valve body.
  - b. Remove the valve bonnet bolts and lift off the bonnet.

**NOTE:** V5055/V5097C and E Valves have additional internal springs that will push the bonnet up as the bolts are loosened.

- c. Inspect the inside of the valve.

### IMPORTANT

*If fluid is present on the inside surfaces of the valve body or bonnet surfaces, the bonnet assembly or entire valve must be replaced. See Table 8 below for the bonnet assembly part number.*

- d. If the inside surfaces are clear of hydraulic fluid, clean the bonnet assembly and be sure to remove all hydraulic fluid from the inside and outside of the actuator mounting curb. This is the "cup-like" area around the valve stem. Avoid using a cleaning solution as it may damage the rubber seals used in the valve.

7. If the valve bonnet assembly is in good condition and is not replaced, replace the bonnet seal. Do not reuse the old bonnet seal. See Table 9 below for the seal number.
8. Coat seals with grease provided and position in valve body/bonnet assembly.
9. Carefully seat the bonnet assembly on the valve body. Be sure the seals are in their proper position. On those valves with a spring below the disc, be sure the spring is centered in the indentation on the inside of the valve body.
10. After positioning the bonnet assembly, replace the screws removed earlier.

**NOTE:** When replacing the bonnet assembly on the 4-inch valve, draw it evenly into the valve body. Finger-tighten the eight bolts. Draw the bonnet assembly into the valve by tightening, in order, bolts 1, 5, 7 and 3 (two turns each). Repeat until the bonnet assembly is seated. Tighten the remaining bolts. Torque the bolts as follows:

Valve Size	Torque
3/4 in. (19 mm) to 1-1/2 in. (38 mm)	55 in.-lb.
2 in. (51 mm) to 4 in. (102 mm)	75 in.-lb.

11. Remount the actuator on the bonnet assembly. Tighten the two set screws (50-60 inch pounds).
12. Replace the damper crank arm assembly.
13. Re-attach the wires removed from the actuator terminals and turn on the electrical power.
14. With the gas still off, cycle the actuator to check for proper mechanical operation.



### CAUTION

**Be sure to perform a bonnet seal and seat leak check after installation.**

Be sure to read and follow all instructions that come with the actuators, valves, seal and bonnet kits.

**Table 8. Replacement Bonnets for V5055/V5097 Gas Valves.**

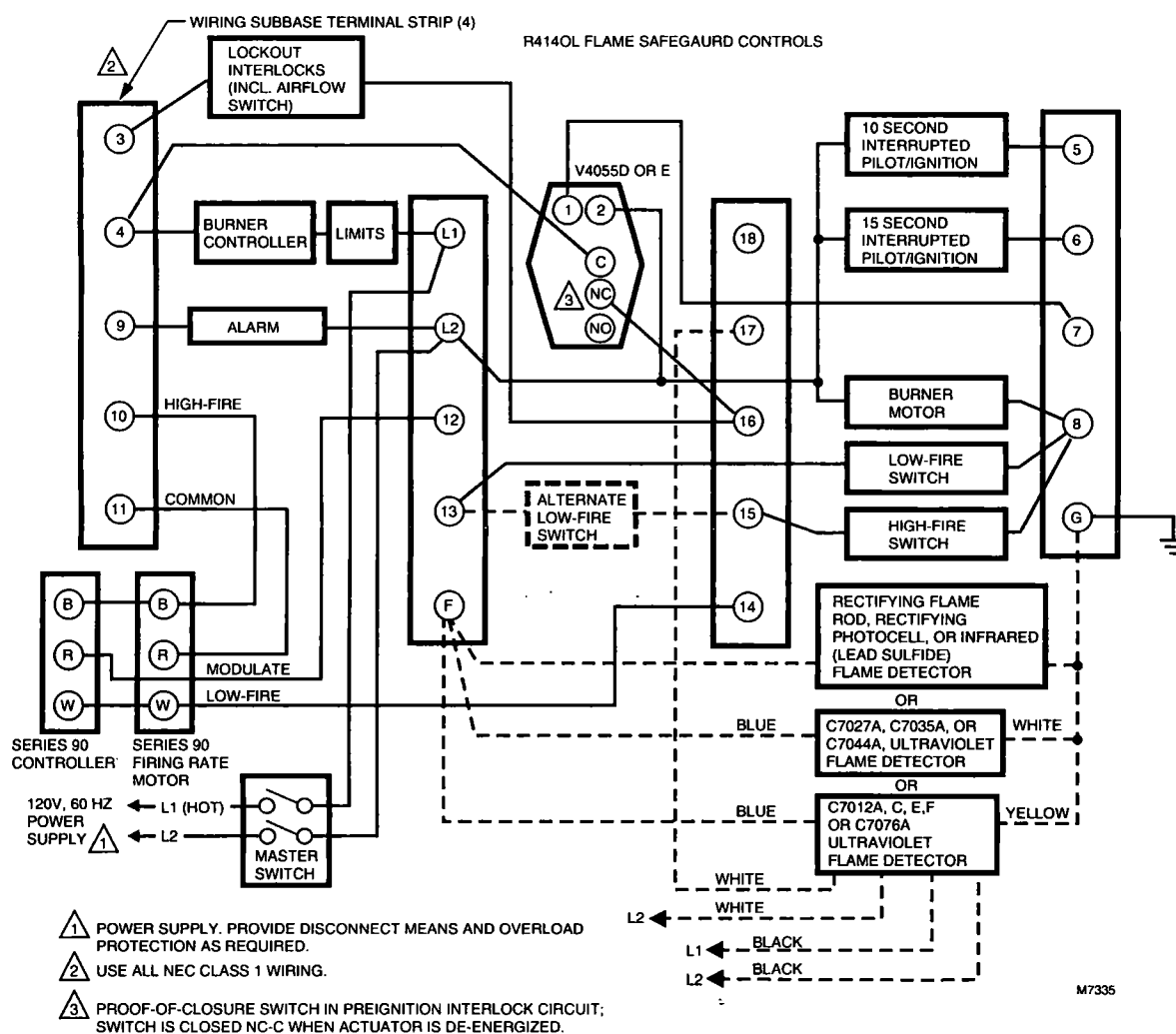
Replacement Bonnet	Valve		Valve Size (in in.)
133398AA	V5055A	V5097A	3/4, 1, 1-1/4, 1-1/2
133417AA			2, 2-1/2, 3
136911AA	(On-Off)		4
133398BA	V5055B	V5097B	3/4, 1, 1-1/4, 1-1/2
133417BA			2, 2-1/2, 3
136911BA	(Characterized Guide)		4
133398CA	V5055C	V5097C	3/4, 1, 1-1/4, 1-1/2
133417CA			2, 2-1/2, 3
136911CA	(Proof of Closure)		4
136308AA	V5055D	V5097D	3/4, 1, 1-1/4, 1-1/2
136307AA			2, 2-1/2, 3
136308BA	V5055E	V5097E	3/4, 1, 1-1/4, 1-1/2
136307BA			2, 2-1/2, 3

## V4055A,B,D,E ON-OFF FLUID POWER GAS VALVE ACTUATOR

Each replacement assembly contains the bonnet assembly, two rubber seals, and a tube of grease. It must be used only on the type of valve indicated above.

**Table 9. Gas Valve Replacement Seals.**

<b>Replacement Seal Assy #</b>	<b>Valve Size (in in.)</b>
133393A	3/4, 1, 1-1/4, 1-1/2
133392A	2, 2-1/2, 3
137253A	4



**Fig. 6. Typical application of a V4055D/V5055C/V5097D or V4055E/V5055E/V5097E combination to meet Factory Mutual or Underwriters Laboratories Inc. approved requirements for Proof-of-Closure Switch (valve seal overtravel interlock).**

## Automation and Control Solutions

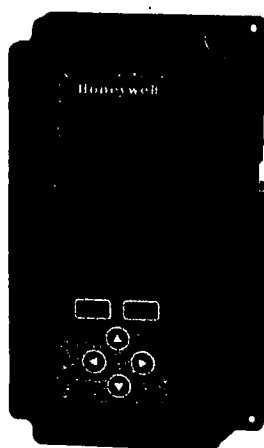
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# Honeywell

## T775A/B/M Series 2000 Electronic Stand-Alone Controllers



### PRODUCT DESCRIPTION

The T775 electronic stand-alone controllers are the next generation of commercial and agricultural controls capable of remote sensing of temperature and providing switched and/or proportional outputs to various types of loads.

Five models have analog (modulating) outputs for actuator and motor control, and NEMA-4 weatherproof enclosures are available for wet environments.

#### IMPORTANT

*Each T775A/B/M controller is an operating control, not a limit or safety control. If used in applications requiring safety or limit controls, a separate safety or limit control device is required.*

Table 1. T775A/B/M Controller Configurations.

Controller Model <sup>a</sup>	Description	Replaces	SPDT Relay Outputs	Analog (Mod) Outputs <sup>b</sup>	Floating Outputs <sup>c</sup>	Sensor Inputs	Nbr of Sensors Included	Enclosure
T775A2009	Standard	T775A1001	1	None	None	1	1	NEMA 1
T775B2016	Standard	N/A	2	None	1	2	1	NEMA 4X
T775B2024	Standard	T775C1009 T775D1008	4	None	2	2	1	NEMA 4X
T775B2032	Standard	T775A1019 T775B1000	2	None	1	2	1	NEMA 1
T775B2040	Standard	T775A1027 T775A1035 T775B1018 T775B1026 T775B1042	4	None	2	2	1	NEMA 1
T775M2006	Modulating	N/A	None	2	N/A	2	1	NEMA 1
T775M2014	Modulating	T775G1005 T775G1013 T775G1021 T775G1039	4	2	N/A	2 <sup>d</sup>	1	NEMA 4X
T775M2022	Modulating	N/A	2	2	N/A	2 <sup>d</sup>	1	NEMA 4X
T775M2030	Modulating	T775E1114 T775F1022 T775F1055 T775F1089	4	2	N/A	2 <sup>d</sup>	1	NEMA 1
T775M2048	Modulating	T775E1015 T775E1023 T775E1056 T775E1064 T775E1098	2	2	N/A	2 <sup>d</sup>	1	NEMA 1

<sup>a</sup> All models include a digital input for use with the disable or setback option.

<sup>b</sup> The modulating (analog) outputs are 4-20 mA, 0-10 Vdc, 2-10 Vdc, or Series 90 selectable.

<sup>c</sup> Each floating output eliminates two SPDT relays.

<sup>d</sup> These models can support a high/low modulating limit at Sensor B for temperature control at Sensor A.



## Temperature Sensors<sup>a</sup>

The controller accepts 1,097 Ohms PTC at 77°F (25°C):

- 50021579-001 – Standard sensor (included with all models except NEMA 4X models)
- T775-SENS-STRAP– Strap on sensor with wiring box
- T775-SENS-WR – Water resistant with 5 foot leads (included with NEMA 4X models)
- T775-SENS-WT – Watertight with 6 foot lead
- T775-SENS-OAT – Outdoor air temperature sensor
- C7031B2005 – 6 inch duct mount with wiring box
- C7031D2003 – 5 inch immersion sensor with wiring box (use immersion well; P/N 50001774-001)
- C7031J2009 – 12 foot duct averaging sensor with wiring box
- C7046D1008 – 8 inch duct probe with mounting flange
- C7100D1001 – 12 inch fast response, duct averaging sensor with flange
- C7130B1009 – Room mount sensor

## Accessories

- 107324A – Bulb Holder, duct insertion
- 107408 – Heat Conductive Compound, 4 ounce
- 50001774-001 – Immersion Well, stainless steel 304, 1/2 in. threading.

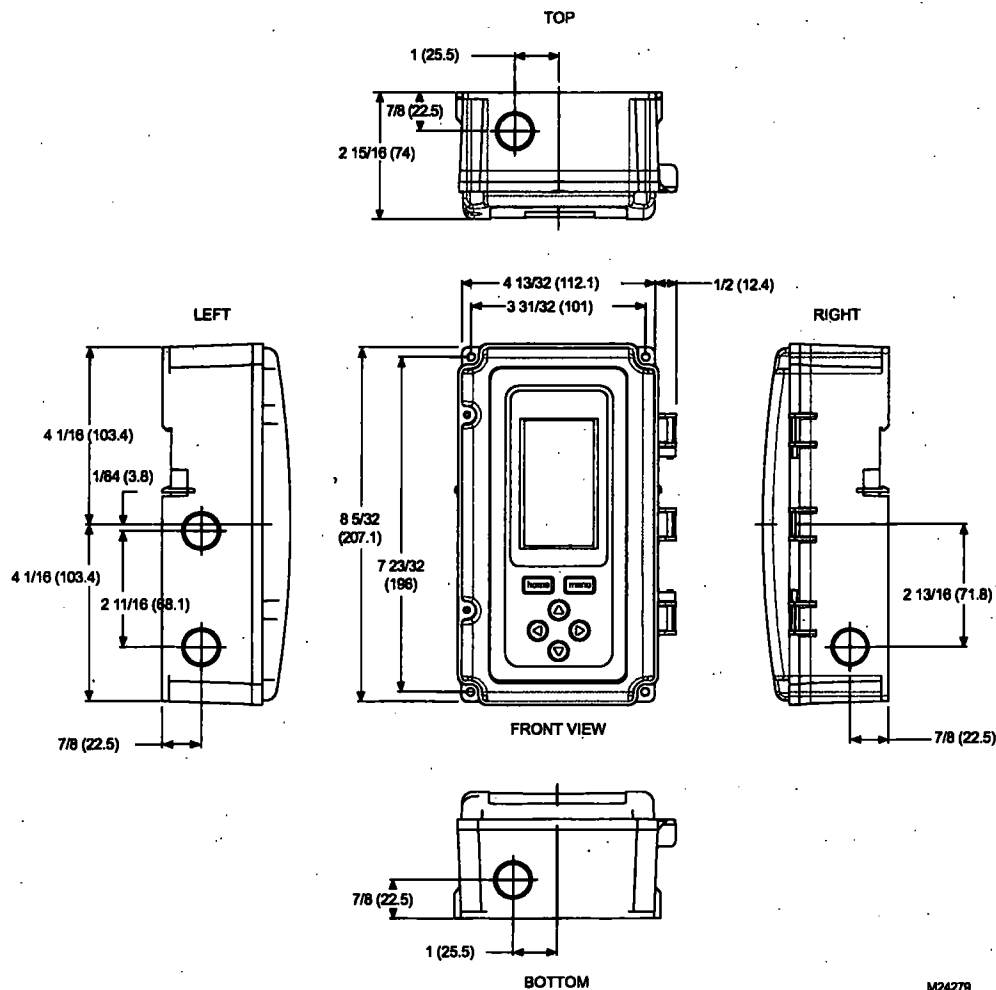
## Product Changes

Below are the changes to T775A/B/M models starting with Series 3 (March 2009). Series 3 can be identified by the sideways 3 after the part number on the device label.

1. Modulating high and low limit now both function in either the heat or the cool mode.
2. MIN ON added.
3. SYNC added.
4. Differential and throttling range increased to 300°F.
5. Setpoint and Enable options added to the DI options.
6. HIDE option added to MOD1 and MOD2 (to hide them on the home screen).

<sup>a</sup> See form 62-0265 - Temperature Sensors for the T775 Series 2000 Stand-alone Controller.

## Controller Dimensions



M24279

Fig. 1. T775A/B/M Dimensions in inches (mm).



## BEFORE INSTALLATION

Review the "SPECIFICATIONS" on page 36 before installing the controller.

### When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check ratings given in instructions and on the product to ensure 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.

## INSTALLATION AND SETUP

The following installation procedures are typically performed in the order listed:

1. Mounting — See "MOUNTING" below.
2. Wiring — See "WIRING" on this page.
3. Checkout — See page 10.
4. Programming — See page 13.
5. Scheduling (optional) — See page 31.

Additional topics are:

- Temperature sensor calibration begins on page 10.
- Interface overview begins on page 11.
- Setup (for advanced options) begins on page 17.
- Summary menu begins on page 35.
- Troubleshooting begins on page 35.

## MOUNTING

This section describes the mounting procedures for the controller and temperature sensor(s).

### Controller Mounting

#### IMPORTANT

*Avoid mounting in areas where acid fumes or other deteriorating vapors can attack the metal parts of the controller circuit board, or in areas where escaping gas or other explosive vapors are present.*

#### IMPORTANT

*The controller must be mounted in a position that allows clearance for wiring, servicing, and removal.*

Use a screwdriver to pry out only the knockouts that you will use.

If mounting on DIN rail, be sure to remove the knockouts before mounting. See "Controller Wiring" on page 5 and Fig. 7 on page 6 for recommended knockout usage and locations. If you do not use an opened knockout be sure to cover it.

Mount the controller on any convenient interior location using the four mounting holes provided on the back of the enclosure using #6 or #8 screws (screws are not provided and must be obtained separately). Use controller dimensions in Fig. 1 on page 2 as a guide.

The controller may be mounted in any orientation. However, mounting in the orientation shown in Fig. 1 on page 2 permits proper viewing of the LCD display and use of the keypad.

### NEMA 4 Enclosure Mounting

For models with NEMA 4 enclosures, ensure that waterproof wire/conduit fittings are used at the knockouts for all wiring attachments. Refer to Fig. 7 on page 6 for knockout locations.

#### IMPORTANT

*For NEMA 4 enclosures, be sure to cover and seal all unused open knockouts.*

### Temperature Sensor(s) Mounting and Location

Temperature sensors may be located up to 1,000 feet (304 m) from the T775A/B/M controller. Refer to Table 3 on page 10 for calibration guidelines.

The sensors may be mounted on a wall or panel for sensing space temperature, strapped to a pipe or inserted in an immersion well (see Fig. 2) for hot or cold water sensing, or taped to a standard cap or bulb holder for duct air sensing. To prevent moisture or condensation entering the sensor through the lead wire holes, mount the sensor with the lead wires exiting the bottom of the sensor.

#### NOTES:

1. The included sensor is not designed for very wet applications. For immersion applications, an immersion well is used.
2. Heat conductive compound must be used in immersion wells.
3. Refer to the list of temperature sensors on page 2 for this type of installation.

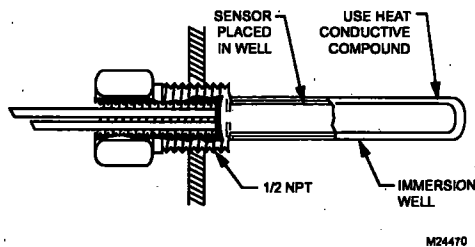


Fig. 2. Sensor Inserted in Immersion Well.

NOTE: Multiple sensors may be parallel-series wired to sense average temperatures in large spaces. Refer to Fig. 3 on page 4.

## WIRING

All wiring must comply with applicable electrical codes and ordinances, or as specified on installation wiring diagrams. Controller wiring is terminated to the screw terminal blocks located inside the device.

The remainder of this section describes the temperature sensor wiring and the T775A/B/M controller wiring.



## Wiring Connections Access

To access the wiring connections, remove the two screws on the left side of the enclosure and gently swing open the top. Be careful to not stress the ribbon cables that connect the keypad and LCD display to the controller circuit board.

## Temperature Sensor Wiring



### CAUTION

**Electrical Shock Hazard.**

**Can short equipment circuitry.**

Make sure that metal tube of sensor does not short against T terminals in wall-mounted case.

### IMPORTANT

Poor wiring practices can cause erratic readings from the sensor. Avoid the following to ensure proper operation:

- Do not route the temperature sensor wiring with building power wiring.
- Do not locate the temperature sensor wiring next to control contactors.
- Do not locate the temperature sensor wiring near electrical motors.
- Do not locate the temperature sensor wiring near welding equipment.
- Make sure good mechanical connections are made to both the sensor and the controller.
- Do not mount the sensor with the lead wire end pointing up in an area where condensation can occur.

If any of the above conditions cannot be avoided, use shielded cable.

**NOTE:** Each T775 controller must be wired to its own sensor(s). However, a benefit of the T775 controller's accuracy is that there is no more than a 2° F (-7° C) differential between any two T775 controllers.

## Multiple Parallel Sensors

Multiple sensors can be parallel-series wired to sense average temperatures in large spaces. To maintain control accuracy, the number of sensors to be parallel-series wired must be of the  $n^2$  power (for example, 4, 9, 16, etc.). Refer to Fig. 3.

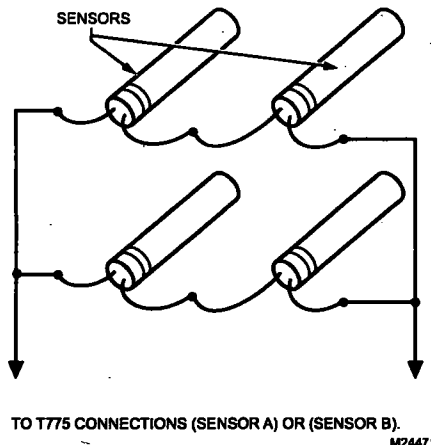
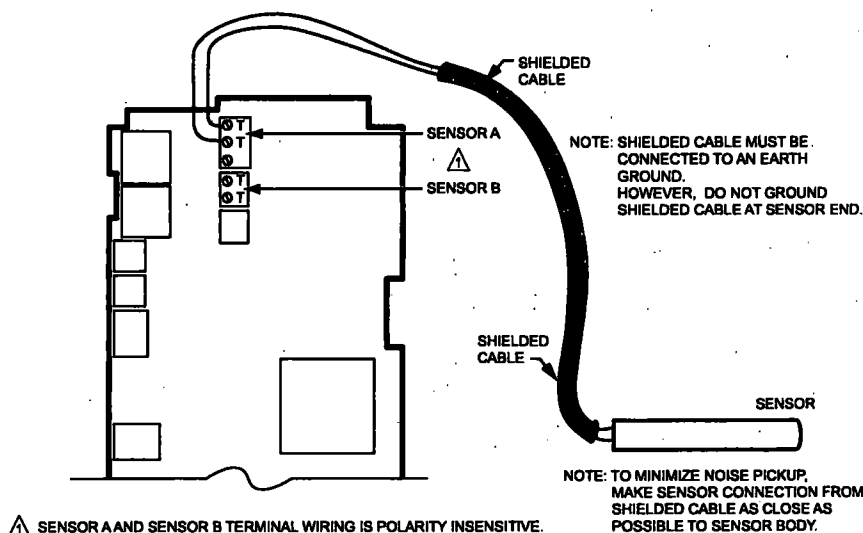


Fig. 3. Parallel-Series Wiring of Sensors.

## Temperature Sensor Wire Type and Size

Temperature sensors use standard AWG 18/2 unshielded wire. For cable runs greater than 25 feet or where electrical interference may be a problem, shielded cable is recommended (See Fig. 4).

Refer to "Temperature Sensor Calibration" on page 10 for wire size selection where cable runs are longer than 25 feet.



⚠ SENSOR A AND SENSOR B TERMINAL WIRING IS POLARITY INSENSITIVE.

M24472

Fig. 4. Sensor Wiring — Showing Shielded Cable Connection to Sensor A.

## Controller Wiring

### **! WARNING**

#### **Electrical Shock Hazard.**

Can cause severe injury, death or property damage.

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

### **! CAUTION**

Do not use 24 Vac power to power any external loads if 120 Vac or 240 Vac is used to power the T775A/B/M controller.

### **! CAUTION**

#### **A separate earth ground is required.**

Equipment damage can result if the earth ground is not connected. See Fig. 5 and Table 2 on page 6.

### **! CAUTION**

#### **Equipment Damage Hazard.**

Electrostatic discharge can short equipment circuitry.

Ensure that you are properly grounded before handling the unit.

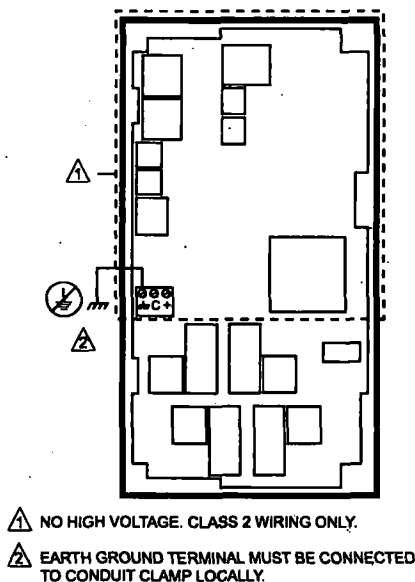


Fig. 5. Earth Ground.

### **IMPORTANT**

Poor wiring practices can cause erratic readings from the sensor. To ensure proper operation, ensure that good mechanical connections are made to both the sensor and the controller.

### **IMPORTANT**

When wiring the input power, only one source of power can be applied to the T775A/B/M controller (24 Vac or 120 Vac or 240 Vac).

See Fig. 7 on page 6 for locating the appropriate power input, remote sensors input, low voltage, contact closure, and load output terminals.

Access to the terminals can be gained through standard conduit knockouts (A through E in Fig. 7 on page 6) located around the perimeter of the enclosure:

- Knockouts A and B should be used only for sensor and low-voltage wiring.
- Knockouts C, D, and E can be used to gain access to the load relay output terminals and 120/240 Vac power wiring.

## Controller Wiring Method

Wire the sensors and outputs, then wire the power connection.

Each terminal can accommodate the following gauges of wire:

- Single wire – from 14 AWG to 22 AWG solid or stranded
- Multiple wires – up to two 22 AWG stranded

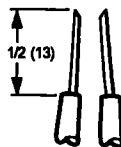
For 24, 120, or 240 Vac power connections:

- Single wire – from 14 to 18 AWG solid or stranded

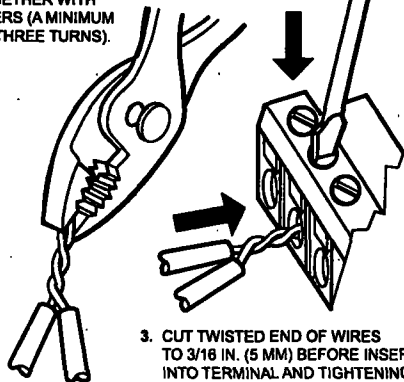
Prepare wiring for the terminal blocks, as follows:

1. Strip 1/2 in. (13 mm) insulation from the conductor.
2. Cut a single wire to 3/16 in. (5 mm). Insert the wire in the required terminal location and tighten the screw.
3. If two or more wires are being inserted into one terminal location, twist the wires together a minimum of three turns before inserting them to ensure proper electrical contact.
4. Cut the twisted end of the wires to 3/16 in. (5 mm) before inserting them into the terminal and tightening the screw.
5. Pull on each wire in all terminals to check for good mechanical connection.

1. STRIP 1/2 IN. (13 MM) FROM WIRES TO BE ATTACHED AT ONE TERMINAL.



2. TWIST WIRES TOGETHER WITH PLIERS (A MINIMUM OF THREE TURNS).



3. CUT TWISTED END OF WIRES TO 3/16 IN. (5 MM) BEFORE INSERTING INTO TERMINAL AND TIGHTENING SCREW. THEN PULL ON EACH WIRE IN ALL TERMINALS TO CHECK FOR GOOD MECHANICAL CONNECTION.

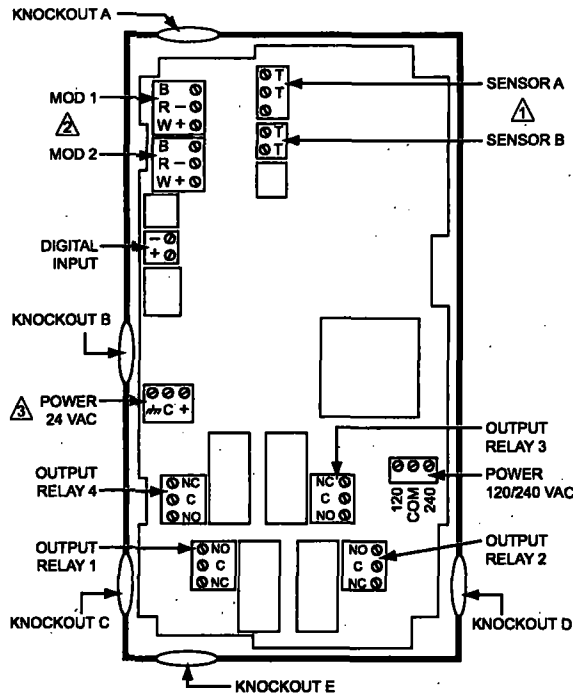
M24473

Fig. 6. Attaching Two or More Wires at Terminal Blocks.

### Controller Wiring Details

The wiring connection terminals are shown in Fig. 7 and are described in Table 2.

See Fig. 8 – 20 beginning on page 6 for typical T775A/B/ M wiring applications.



- SENSORS A AND B USE THE TWO TT CONNECTIONS AND ARE POLARITY INSENSITIVE.
- FOR MOD 1 AND MOD 2 CURRENT (mA) OR VOLTAGE (VDC) OUTPUT, USE SIGNAL (+) & COMMON (-).  
FOR MOD 1 AND MOD 2 SERIES 90 OUTPUT, USE W, R, & B.
- A SEPARATE EARTH GROUND IS REQUIRED FOR ANY POWER SOURCE (24, 120, OR 240 VAC).

Fig. 7. T775A/B/M Terminal and Feature Locations.

NOTE: Refer to Table 1 on page 1 for the specific configuration of sensors and outputs supported by the model you are installing.

NOTE: For NEMA 4 enclosures, use waterproof fittings for wiring/conduit connections at knockouts.

Table 2. Description of Wiring Terminal Connections.

Connection	Terminal Label	Description
<b>Sensors</b>		
Sensor A	T.T	Temperature Sensor; polarity insensitive
Sensor B		
<b>Outputs</b>		
Relay 1	NO	120-240 Vac Relay Output
Relay 2	COM	
Relay 3	NC	
Mod 1	+ - (Vdc or mA)	Modulating Output
Mod 2	W R B (Series 90) <sup>a</sup>	

Table 2. Description of Wiring Terminal Connections. (Continued)

Connection	Terminal Label	Description
<b>Input</b>		
DI	+ -	Digital Input (dry contact)
<b>24 Vac Power</b>		
24V +	+	24 Vac Hot
Common	C	24 Vac Common
Ground	///	Earth Ground <sup>b</sup>
<b>120 or 240 Vac Power</b>		
120 Vac	120	120 Vac Power
Common	COM	Common
240 Vac	240	240 Vac Power

- <sup>a</sup> For Series 90 connections, you must insert a 340 Ohm resistor across terminals R and W. Refer to Fig. 17 on page 8. The resistor is included with the controller.
- <sup>b</sup> A separate earth ground is required for all installations regardless of the power source (24, 120, or 240 Vac). Refer to Fig. 5 on page 5.

### WIRING APPLICATIONS (EXAMPLES)

Fig. 8 – 20 illustrate typical controller wiring for various applications.

NOTE: The electronic Series 90 output provided with modulating T775 models can not drive electro-mechanical slidewire devices like older Series 3 modulating meters (prior to Series 6), V9055s, and S984s.

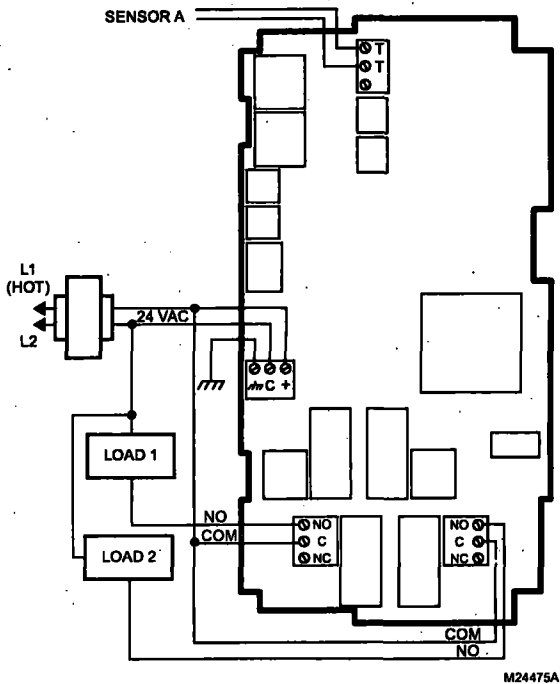
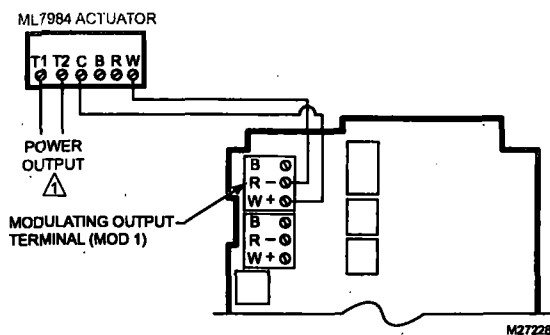
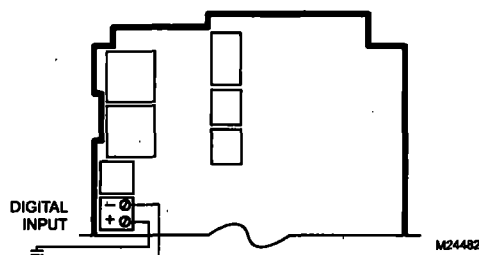


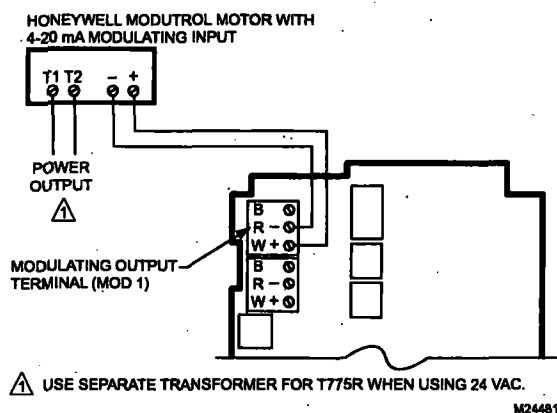
Fig. 8. Wiring for Two-Stage Control – 24 Vac Input and 24 Vac Load.



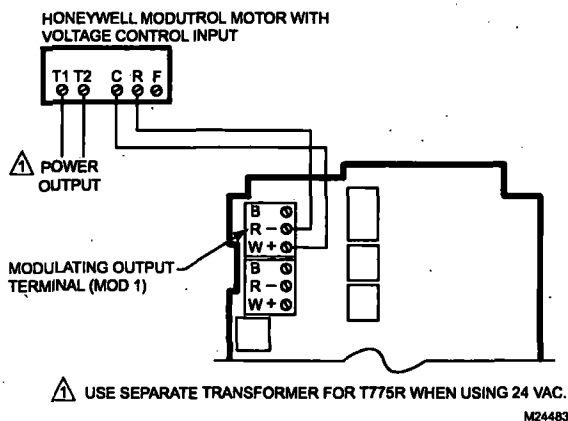
**Fig. 13. Wiring for ML7984 Valve Actuator (Using 4 to 20 mA Signal).**



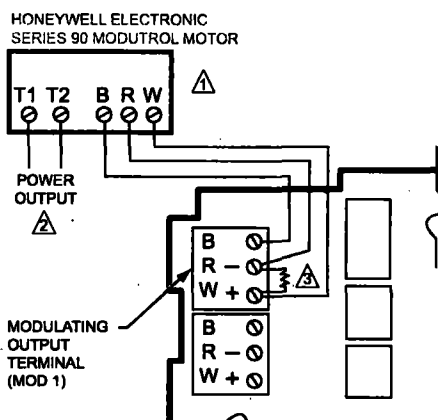
**Fig. 14. Wiring for Digital Input (Dry Contact).**



**Fig. 15. Wiring for Mod Motor or Direct Coupled Actuator with 4 to 20 mA Control Input.**



**Fig. 16. Wiring for Mod Motor or Direct Coupled Actuator with 0 to 10 Vdc Control Input.**



⚠ TO VERIFY OUTPUT, TEST OPEN CIRCUIT VOLTAGE BETWEEN THE MOD 1 TERMINALS W AND R.

- MINIMUM (DRIVE CLOSED) SIGNAL LESS THAN 0.17 VDC

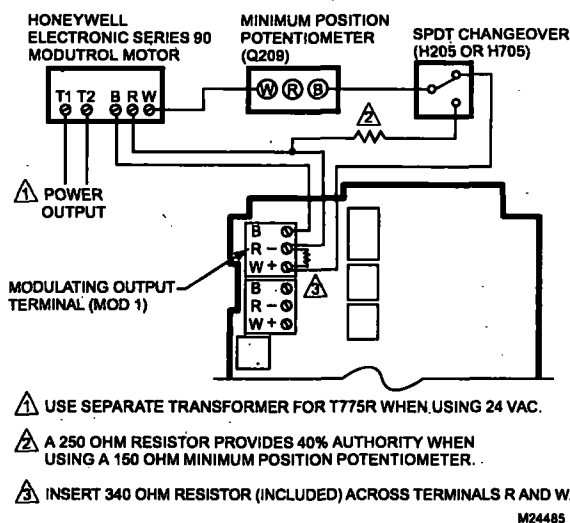
- MAXIMUM (DRIVE OPEN) SIGNAL IS GREATER THAN 1.7 VDC

⚠ USE SEPARATE TRANSFORMER FOR T775R WHEN USING 24 VAC.

⚠ INSERT 340 OHM RESISTOR (INCLUDED) ACROSS TERMINALS R AND W.

M24484

**Fig. 17. Wiring for Series 90 Modutrol Motor Control.**



⚠ USE SEPARATE TRANSFORMER FOR T775R WHEN USING 24 VAC.

⚠ A 250 OHM RESISTOR PROVIDES 40% AUTHORITY WHEN USING A 150 OHM MINIMUM POSITION POTENTIOMETER.

⚠ INSERT 340 OHM RESISTOR (INCLUDED) ACROSS TERMINALS R AND W.

M24485

**Fig. 18. Wiring for Changeover Relay and Minimum Position Potentiometer Used with Series 90 Modutrol Motors.**

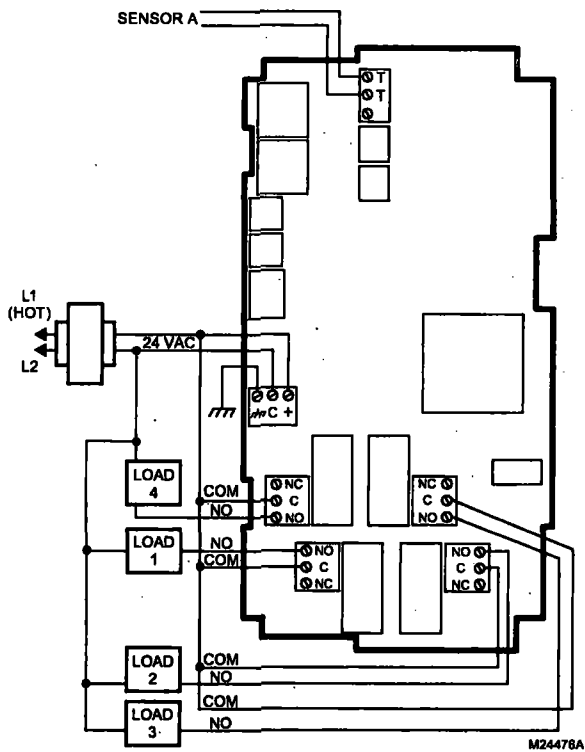


Fig. 9. Wiring for Four-Stage Control – 24 Vac Input and 24 Vac Load.

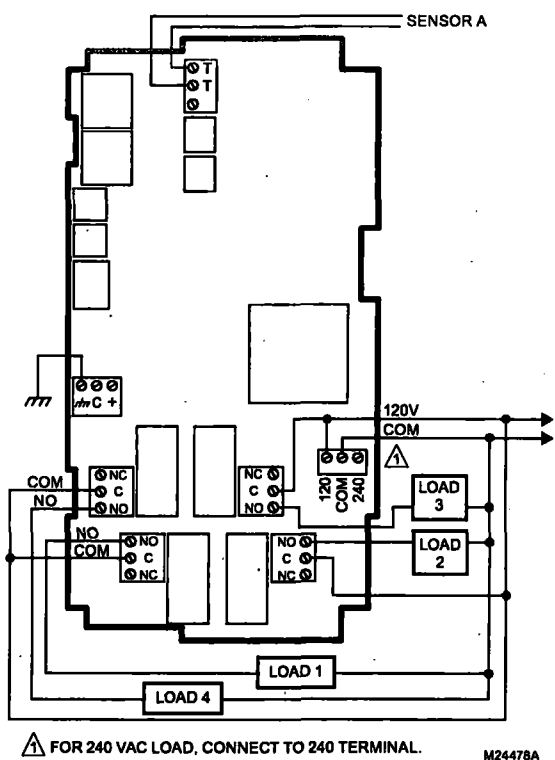


Fig. 11. Wiring for Four-Stage Control with 120 or 240 Vac (120 Vac Input and 120 Vac Load Shown).

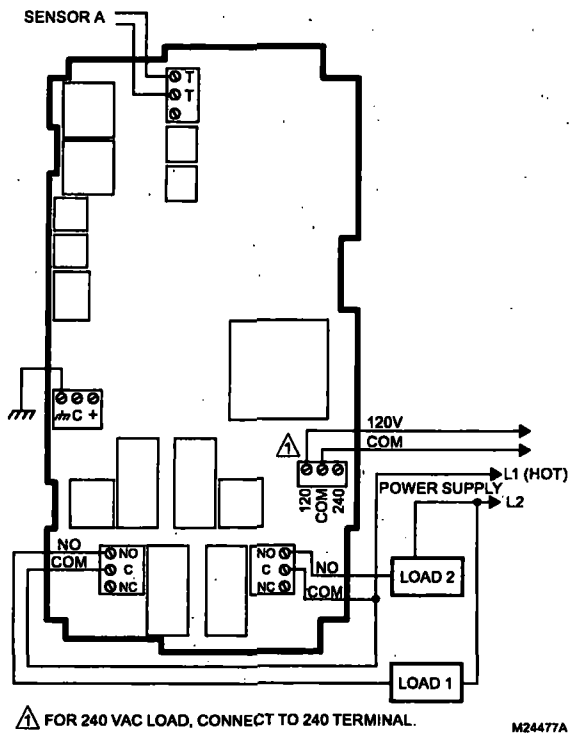


Fig. 10. Wiring for Two-Stage Control with 120 or 240 Vac (120 Vac Input and 120 Vac Load Shown).

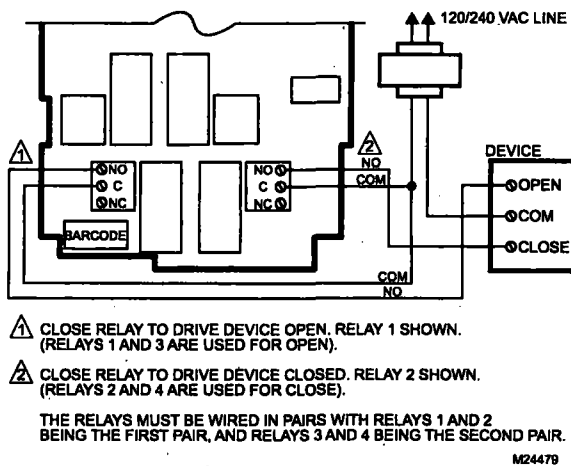


Fig. 12. Wiring for Floating Output (Relay 1 and Relay 2 Pair Shown).

## CHECKOUT

Inspect all wiring connections at the controller terminals, and verify compliance with the installation wiring diagrams.

### ! WARNING

#### Electrical Shock Hazard.

Can cause severe injury, death or property damage.

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

If any wiring changes are required, first be sure to remove power from the controller *before* starting work. Pay particular attention to verifying the power connection (24, 120, or 240 Vac).

After the controller is installed and wired, apply power.

## Power Loss

The date and time settings are retained for 24 hours after a power outage. After a power loss of more than 24 hours, the date and time settings may need to be reentered. All other settings are stored permanently.

## Temperature Sensor Calibration

As wire length increases, resistance increases and thus the temperature reading increases. If necessary, calibrate the sensor input by reducing the value by the amount shown in the Table 3. For example, a wire run with 18 gauge wire of 1,000 feet, requires a calibration offset of -6.0° F (-21° C).

### IMPORTANT

If the calibration value in the table exceeds the controller's calibration limits of  $\pm 10^{\circ}\text{F}$  ( $\pm 6^{\circ}\text{C}$ ), you must use a heavier gauge wire.

For example, with a wire run of 1,000 feet you must use 20 AWG wire or heavier in order to calibrate for wire loss within the limits of the controller.

See "2.2.2.2. CALIBRATE (the sensor)" on page 18 for the instructions to enter the calibration value.

Table 3. Temperature Sensor Calibration for Resistance Loss Due to Wire Length.

AWG Rating	mΩ/ft	Temperature Offset in °F (Foot) <sup>a</sup>		
		200 ft	500 ft	1,000 ft
14	2.5	0.46	1.14	2.28
16	4.0	0.72	1.82	3.64
18	6.4	1.16	2.90	5.82
20	10.2	1.86	4.64	9.28
22	16.1	2.92	7.32	14.64

AWG Rating	mΩ/m	Temperature Offset in °C (Meter) <sup>a</sup>		
		100 m	200 m	300 m
14	8.3	0.44	0.86	1.30
16	13.2	0.68	1.38	2.06
18	21.0	1.10	2.18	3.28
20	33.5	1.74	3.48	5.22
22	52.8	2.74	5.48	8.22

<sup>a</sup> This is the distance from the controller to the sensor (already accounts for round trip distance).

Fig. 21 shows how sensor resistance varies with temperature for a sensor having a positive temperature coefficient (PTC) of 2.1 Ohms per degree F (3.85 Ohms per degree C).

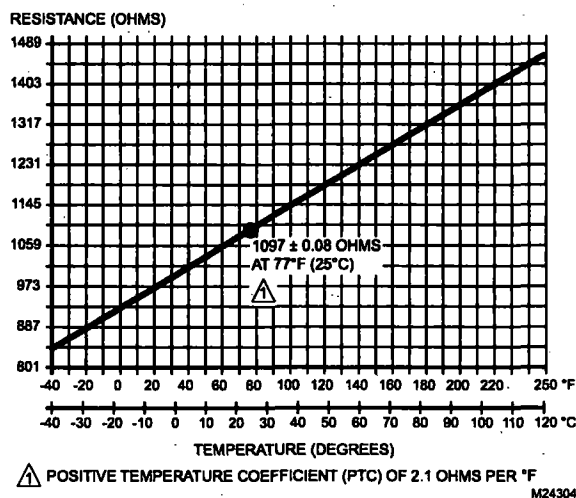
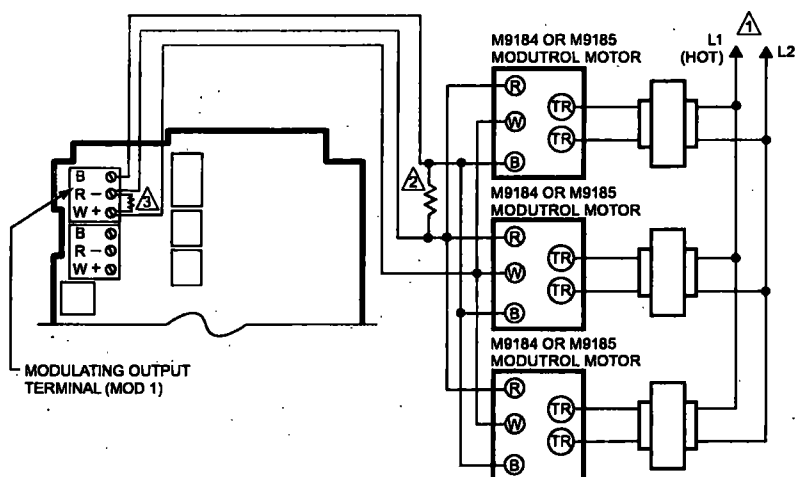


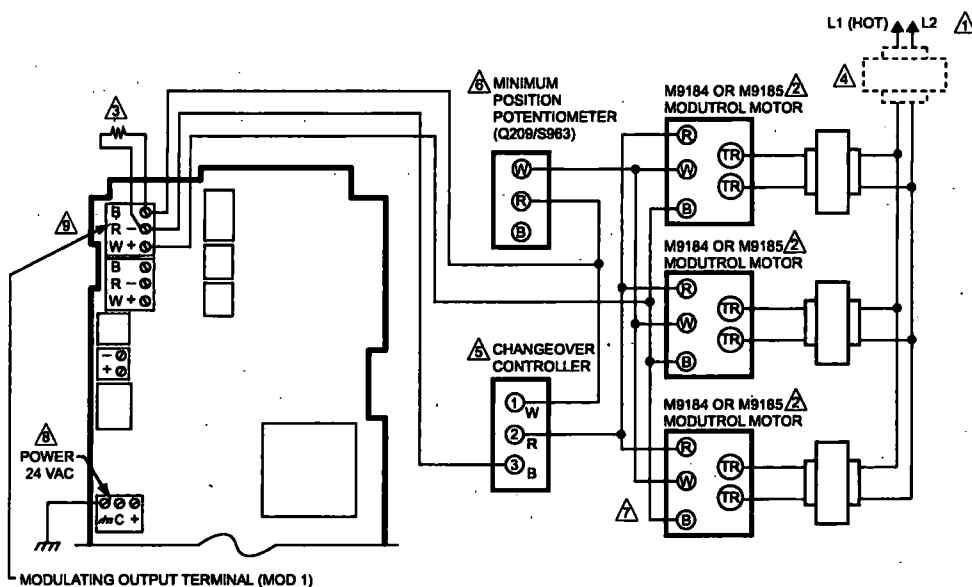
Fig. 21. Sensor Resistance vs. Temperature.



- 1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- 2 USE A 1300 OHM RESISTOR FOR TWO MOTORS, 910 OHM RESISTOR FOR THREE MOTORS. THE 407EAU RESISTOR KIT, WHICH IS SHIPPED WITH THE M9184 AND M9185 MOTORS, INCLUDES BOTH RESISTORS.
- 3 INSERT 340 OHM RESISTOR (INCLUDED) ACROSS TERMINALS R AND W.

M24486

Fig. 19. Wiring for Three Series 90 Modutrol Motors.



- 1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- 2 UP TO SIX SIMILAR MOTORS CAN BE CONNECTED IN UNISON.
- 3 USE RESISTOR BETWEEN R AND B ON THE MOD 1 TERMINAL: 1300 OHMS FOR TWO MOTORS; 910 OHMS FOR THREE MOTORS (407EAU KIT).
- 4 IF COMMON TRANSFORMER IS USED, ALL MOTORS MUST BE IN PHASE. CONNECT THE SAME TRANSFORMER LEAD TO T1 ON EACH MOTOR, CONNECT THE OTHER TRANSFORMER LEAD TO T2 ON EACH MOTOR.
- 5 USE TEMPERATURE CONTROLLER SUCH AS H205 OR H705, OR T875A FOR CHANGEOVER CONTROL.
- 6 AUTHORITY OF MINIMUM POSITION POTENTIOMETER, IF USED, INCREASES WITH THE NUMBER OF MOTORS IN PARALLEL. WITH ONE MOTOR, 50% STROKE; WITH TWO MOTORS, 100% STROKE; WITH THREE MOTORS, 100% STROKE WITH 1/3 OF FULL POTENTIOMETER ROTATION.
- 7 REVERSING THE B AND W TERMINALS ON ONE OR MORE MOTORS WILL NOT AFFECT CONTROL PERFORMANCE ON THE OTHER MOTORS. THE SYSTEM CAN BE CONFIGURED TO HAVE SOME MOTORS BE REVERSE ACTING AND OTHER MOTORS BE DIRECT ACTING.
- 8 USE SEPARATE TRANSFORMER FOR T775 WHEN POWERING FROM 24 VAC.
- 9 THE SYSTEM IS SHOWN CONNECTED FOR COOLING. FOR HEATING, REVERSE THE W AND B LEADS OF THE MODULATING OUTPUT ON THE T775 CONTROLLER.

M24487

Fig. 20. Wiring for Unison Control of M9184 or M9185 Modutrol IV Motor Using One Minimum Position Potentiometer for All Motors.

## INTERFACE OVERVIEW

The T775A/B/M controllers use an LCD panel and 5-button keypad to provide status information and permit user input of the programming, setup, and scheduling parameters.

The following figure describes the display areas of the LCD and the keypad.

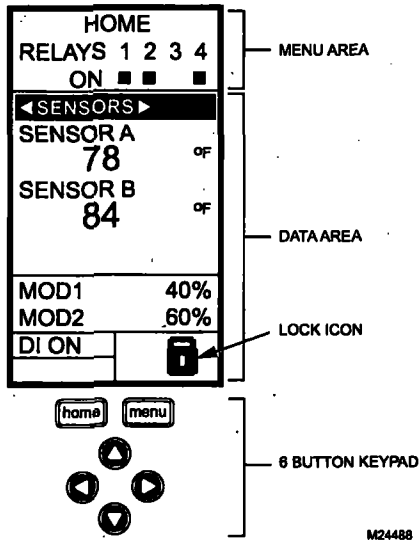


Fig. 22. LCD Display - Home Screen And Keypad.

**Menu Area** – On the home screen, the LCD displays the configured relays and whether they are active. In Program, Setup or Schedule mode, the LCD displays the current menu selection and its order within the menu hierarchy.

**Data Area** – On the home screen, the LCD displays the sensors and outputs status. In Setup or Program mode, the LCD displays menu choices, parameter selections, and data values.

**Lock Icon** – The icon indicates the MENU button is locked and prevents access to the Setup and Program menus.

**NOTE:** Pressing and holding the HOME and MENU buttons simultaneously for five seconds locks/unlocks the MENU button.

**6-Button Keypad** – The keypad is used to access the menus and enter values (See "Using the LCD Panel Interface").

## Using the LCD Panel Interface

The 6-button keypad is used to move through the menus and enter or change parameter values.

### Home Button

Pressing the HOME button at any time exits the current Programming or Setup display screen and returns to the home screen as shown in Fig. 22 and Fig. 23.

### Menu Button

- Pressing the MENU button always displays the Program menu. If you are in Setup mode, you exit setup and return to the Program menu.
- Pressing and holding the MENU button for five seconds leaves the current screen and displays the Setup menu.

### Left and Right Arrow Buttons (◀ and ▶)

Use these buttons to move backward (◀) and forward (▶) through the Program and Setup menus.

### Up and Down Arrow Buttons (▲ and ▼)

Use these buttons to move your selection up and down through a menu or list.

- When the desired item is highlighted, you press the ▶ arrow button to display that item's content.
- When a value is displayed (e.g. 70° F), the up and down arrows increase and decrease the value.

**NOTE:** Once you select an item from a list or enter a value, pressing the ◀ or ▶ or HOME button accepts your selection or value and stores it in the controller's memory.

## Home Screen

In the normal run state, the LCD home screen displays the current sensed temperatures, the modulating outputs status, the active status of the output relays, and error and status codes.

Active relays are indicated by the small black square (■) just below the relay number. Fig. 23 shows the home screen with relays 1, 2, and 4 energized.

Pressing the ◀ and ▶ buttons from the home screen cycles through each modulating output that is paired with the sensor it controls and the active output relays.

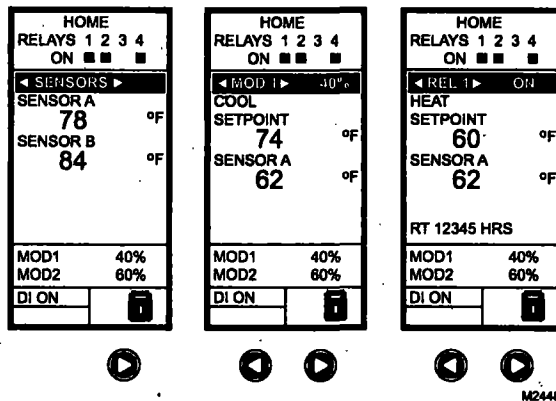


Fig. 23. LCD Display - Home Screen Displaying Sensors, Active Relays, and Mod Outputs.

**NOTE:** The modulating output home screen and the relay home screen do not dynamically update the active relay status, sensor values, and modulating output percentages. The information is a snapshot taken when you press the ◀ or ▶ button to display the screen.

### IMPORTANT

After four minutes of inactivity (no buttons pressed), the LCD display reverts to the home screen display.



## Accessing the Menus

Menus are used for programming, scheduling, viewing the summary settings, and setup of advanced options.

### Programming, Scheduling, and Summary Menus

To access these menus from the home screen, press the **MENU** button (See Fig. 24).

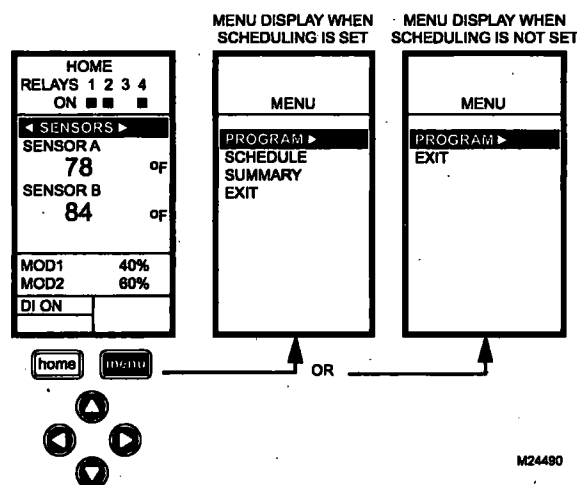


Fig. 24. Menus.

Depending on whether scheduling is enabled or not, the LCD displays one of two menus as shown in Fig. 24. Scheduling is enabled from the Setup menu's Output settings (See "2.3.3.1. USE SCHED" on page 25).

### Setup Menu

To access the Setup menu, press and hold the **MENU** button for five seconds (Refer to Fig. 25).

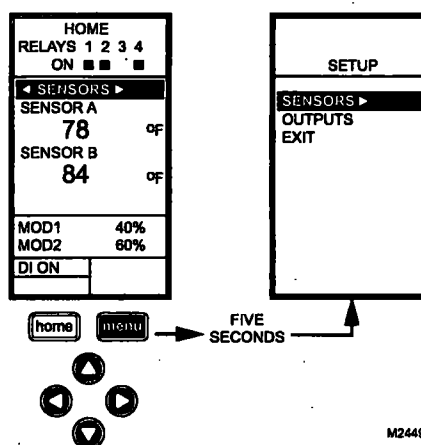


Fig. 25. Setup Menu.

### Using the Menus

When you are working with the menus, use the:

- **Left arrow button (◀)** to scroll backward through the menus
- **Right arrow button (▶)** to select the highlighted menu item and display its content
- **Up and Down arrow buttons (▲ and ▼)** to scroll up and down through a list of items or to increase or decrease the value of a displayed parameter

**NOTE:** If you press the **HOME** button or there is no keypad activity for four minutes, you exit Program mode and return to the home screen.

If you press the **MENU** button, you exit and return to the menu.

# 1. PROGRAMMING

The controller must be programmed before being placed into service.

## IMPORTANT

*During programming, the controller is live at all times. For example, the contacts may open and close when adjusting the setpoint.*

The Programming process uses a hierarchical menu structure that is easy to use. You press the ◀ and ▶ arrow buttons to move forward and backward through the menus.

## NOTES:

1. The controller interface is intuitive. You may find that you do not need the following procedure instructions to program the controller. You may want to use this procedure simply as a reference to locate the particular option or parameter of interest.
2. The menus can display only those relays that are defined in Setup (See "2.3.2. NBR OF RELAYS" on page 24). For example, if you configure only two relays, then only two relays display on the appropriate menus.
3. If you press the HOME button or there is no keypad activity for four minutes, you exit Program mode and return to the home screen.
4. If you press the MENU button, you exit Program mode and return to the menu.

## Setpoint and Differential

The following describes the relationship between setpoint and differential for heating and cooling. These settings are programmed for each output relay.

## Heating Mode Setpoint and Differential

In heating mode, the differential is below the setpoint. The relay de-energizes when the temperature rises to the setpoint. As the temperature drops to the setpoint minus the differential, the relay energizes.

## Cooling Mode Setpoint and Differential

In cooling mode, the differential is above the setpoint. The relay de-energizes when the temperature falls to the setpoint. As the temperature rises to the setpoint plus the differential, the relay energizes.

## Setpoint High Limit

You can set a single irreversible setpoint high limit maximum value, which is applied to all outputs.

Adjust the setpoint (at any output) to the desired maximum setpoint. Then, simultaneously press the home, ◀, and ▶ buttons and continue to press all three buttons for five seconds to set the setpoint high limit maximum to this value.

**NOTE:** You must press all three buttons at exactly the same time for this action to occur.

## IMPORTANT

1. This action sets the maximum setpoint value of all outputs to the setpoint high limit maximum.
2. Setting the high limit setpoint maximum is **irreversible**. If you perform the action inadvertently gently and this setpoint adversely affects the control of your system, you must replace the controller.

## Programming the T775A/B/M Controller

To program the controller, perform the following procedures in the order listed:

1. Enter Program mode — see "1.1. Entering Program Mode"
2. Program the Outputs — see "1.2. Program Menu for Outputs"

When programming is complete, you may continue with "3. SCHEDULING" on page 31 or, for advanced options, continue with "2. SETUP (ADVANCED OPTIONS)" on page 17.

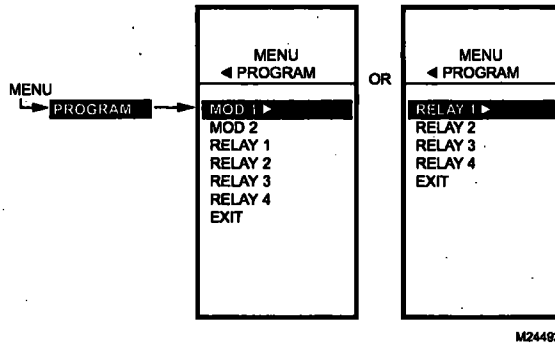


Fig. 26. Program Menu.

### 1.1. Entering Program Mode

Press the MENU button, then select PROGRAM and press the ► button to view the Program menu.

Fig. 26 shows the Program menus for controllers with and without Modulating Outputs.

NOTE: Modulating outputs are not available on the T775A and T775B controller models.

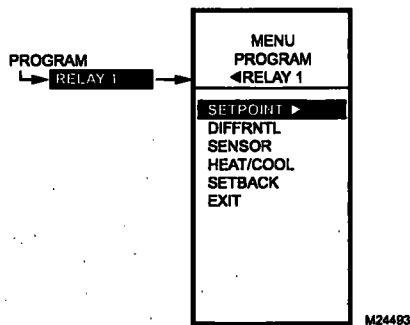


Fig. 27. Program Menu Outputs.

### 1.2. Program Menu for Outputs

Press the MENU button, select PROGRAM, then select RELAY 1 (or MOD 1) to view the parameters. Fig. 27 shows RELAY 1.

NOTE: For MOD 1 and 2, THROT RNG replaces DIFFRNTL.

NOTE: The Setback parameter displays only if scheduling is enabled (See Fig. 55 on page 24) or the DI Option is set to Setback. (See Fig. 58 on page 26).

Continue with "1.2.1. SETPOINT".

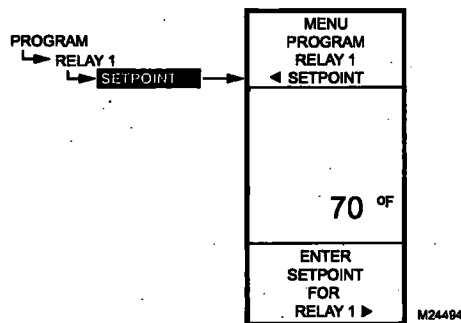


Fig. 28. Program - Setpoint.

#### 1.2.1. SETPOINT

1. From the menu, use the ▲ and ▼ buttons to highlight SETPOINT.
2. Press the ► button to display the setpoint value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired setpoint temperature.  
Default: 70° F (21° C)  
Range: -40° to 248° F (-40° to 120° C)
4. Press the ► button to accept the setpoint temperature and display the next option.

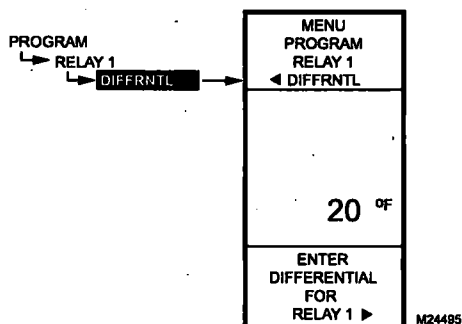


Fig. 29. Program - Differential or Throttling Range.

### 1.2.2. DIFFERENTIAL or THROTTLING RANGE

Differential is used for Relay outputs and Throttling Range is used for Modulating outputs.

1. From the menu, use the ▲ and ▼ buttons to highlight THROT RNG or DIFFERNTL.
2. Press the ► button to display the throttling range value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired value.  
Default: 20° F (-7° C)  
Range: 1° to 300° F (1° to 149° C).
4. Press the ► button to accept the value and display the next option.

In heating mode, the Differential is below the setpoint. The relay de-energizes when the temperature rises to the setpoint. As the temperature drops to the setpoint minus the Differential, the relay energizes.

In cooling mode, the Differential is above the setpoint. The relay de-energizes when the temperature falls to the setpoint. As the temperature rises to the setpoint plus the Differential, the relay energizes.

The Throttling Range brackets the setpoint setting, e.g., if the setpoint is 72°F (22° C) and the throttling range is 10° F (-12° C), then the effective throttling temperature range is 67° to 77° F (19° to 25° C). This applies to both modulating outputs and floating outputs.

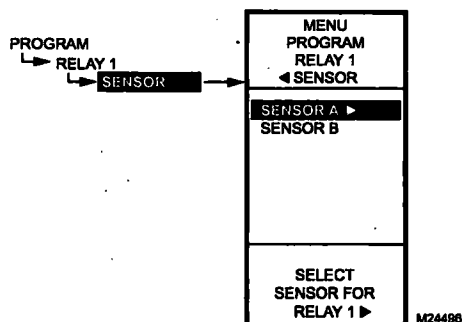


Fig. 30. Program - Sensor.

### 1.2.3. SENSOR

1. From the menu, use the ▲ and ▼ buttons to highlight SENSOR.
2. Press the ► button to display the sensor selections.
3. Use the ▲ and ▼ buttons to select Sensor A or B.
4. Press the ► button to accept the highlighted sensor and display the next option.

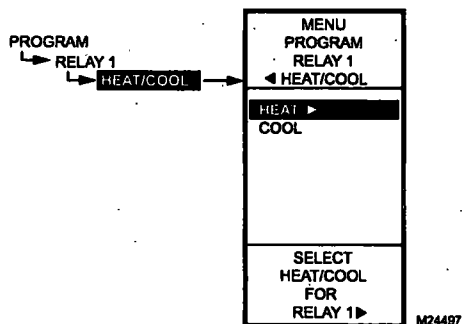


Fig. 31. Program - Heat/Cool.

### 1.2.4. HEAT/COOL

1. From the menu, use the ▲ and ▼ buttons to highlight HEAT/COOL.  
Default: HEAT
2. Press the ► button to display the heat and cool selections.
3. Use the ▲ and ▼ buttons to select Heat or Cool.
4. Press the ► button to accept the highlighted selection and display the next option.

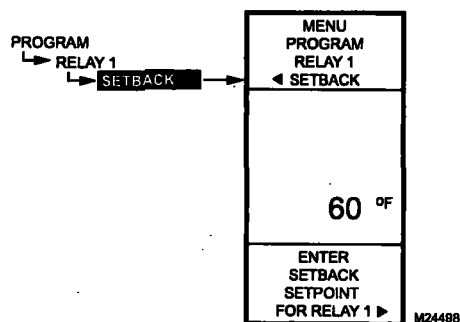


Fig. 32. Program - Setback.

### 1.2.5. SETBACK

The Setback temperature option displays if scheduling is enabled (See Fig. 55 on page 24) or the DI Option is set to Setback. (See Fig. 58 on page 26).

This is the desired setpoint temperature that you want to use during setback mode for this output. For example, if your setpoint is 70° F (21° C) and you want the temperature to drop 10° F during setback mode, enter 60° F (16° C) as the setpoint for this output.

1. From the menu, use the ▲ and ▼ buttons to highlight SETBACK.
2. Use the ▲ and ▼ buttons to increase/decrease the desired setpoint temperature.  
Default: 60° F (16° C)  
Range: -40° to 248° F (-40° to 120° C)
3. Press the ► button to accept the value and display the menu.

### 1.2.6. Program Next Output (Mod or Relay)

For the next output (Mod or Relay), select the desired output from the Program menu (Refer to Fig. 26 on page 14).

Go to "1.2.1. SETPOINT" on page 14 to program the next output.

When you finish programming the outputs, continue with "1.2.7. Exiting Program Mode" on page 16.

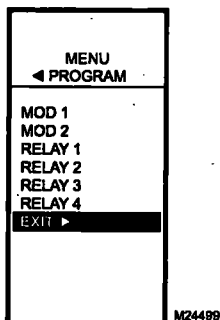


Fig. 33. Program - Exit.

### 1.2.7. Exiting Program Mode

Press the HOME button to leave programming mode and return to the home screen.

This completes the programming procedure.

## 2. SETUP (ADVANCED OPTIONS)

Setup provides the ability to change the factory default settings for the temperature sensors and outputs, to enable/disable reset control, and to enable/disable scheduling.

**NOTE:** The controller interface is intuitive. You may find that you do not need the following setup instructions for the sensors and outputs. You may want to use this procedure simply as a reference to locate the particular option or parameter of interest.

**NOTES:**

1. If you press the **HOME** button or there is no keypad activity for four minutes, you exit Setup mode and return to the home screen.
2. If you press the **MENU** button, you exit Setup mode and return to the menu.

### Setup Procedure

The Setup process uses a hierarchical menu structure that is easy to use. You press the ◀ and ▶ arrow buttons to move forward and backward through the menus.

**NOTE:** The menus can display only those relays that are defined in Setup (see "2.3.2. NBR OF RELAYS" on page 24). For example, if you configure only two relays, then only two relays display on the appropriate menus.

Once in Setup mode, you use the —

- **Left arrow button (◀)** to scroll backward through the Setup menus
- **Right arrow button (▶)** to select the highlighted menu item and display its content
- **Up and Down arrow buttons (▲ and ▼)** to scroll up and down through a list of items or to increase or decrease the value of a displayed setup parameter

To change the controller's sensors and output setup parameters, perform the following procedures in the order listed:

1. Enter Setup mode — see "2.1. Entering Setup Mode"
2. Setup Sensors — see "2.2. Setting up the Sensors"
3. Setup Outputs — see "2.3. Setting up the Outputs" on page 21
4. Exit Setup Mode — see "2.4. EXIT Setup Mode" on page 30

### 2.1. Entering Setup Mode

To enter Setup mode, press and hold the **MENU** button for five seconds to display the Setup menu. Refer to Fig. 25 on page 12.

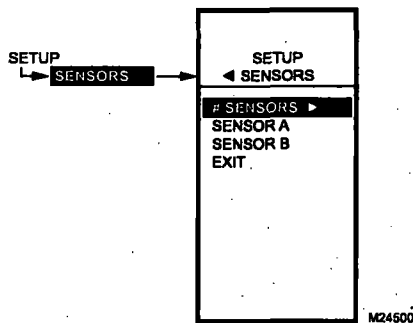


Fig. 34. Setup - Sensors Menu.

### 2.2. Setting up the Sensors

1. From the Setup menu, use the ▲ and ▼ buttons to highlight **SENSORS**.
2. Press the ▶ button to display the Sensors menu.

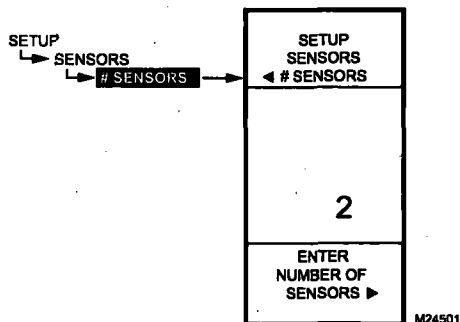


Fig. 35. Setup - Sensors - Number of Sensors.

#### 2.2.1. Number of SENSORS

The value entered here determines the number of sensors displayed on the home screen.

1. From the Sensors menu, highlight **# SENSORS** then press the ▶ button to display the number of sensors.
2. Use the ▲ and ▼ buttons to enter the number of sensors (1 or 2).  
Default: 2
3. Press the ▶ button to accept the value and display the **SENSOR A** selection.

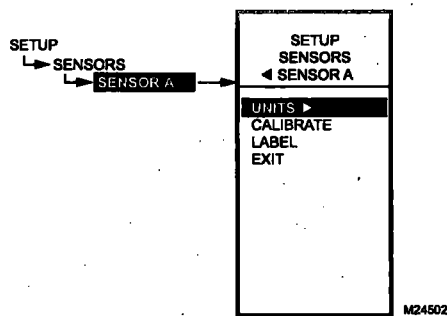


Fig. 36. Setup - Sensors - Sensor A Menu.

## 2.2.2. SENSOR A

1. From the Sensors menu, highlight SENSOR A.
2. Press the ► button to display the Sensor A selections.

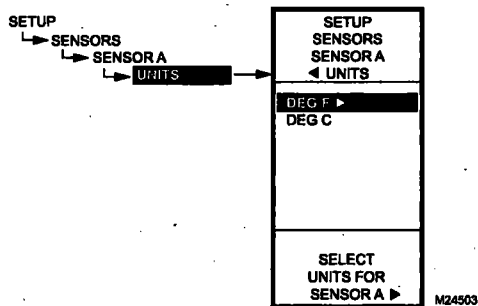


Fig. 37. Setup - Sensors - Sensor A - Units.

### 2.2.2.1. UNITS (° F or ° C)

#### IMPORTANT

*This is a global change and affects the unit values for all temperature parameters on all displays.*

*The UNITS screen displays only for Sensor A.*

1. From the Sensor A selections, use the ▲ and ▼ buttons to highlight UNITS.
2. Press the ► button to display the temperature units.
3. Use the ▲ and ▼ buttons to highlight F or C.  
Default: F (Fahrenheit)
4. Press the ► button to accept the units and return to the Sensor A selections.

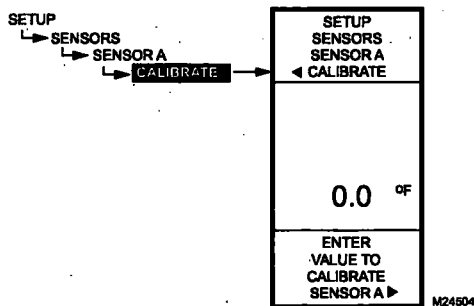


Fig. 38. Setup - Sensors - Sensor A - Calibrate.

### 2.2.2.2. CALIBRATE (the sensor)

Ensure that the wire size calibration value is within the limits. See "Temperature Sensor Calibration" on page 10.

1. From the Sensor A selections, use the ▲ and ▼ buttons to highlight CALIBRATE.
2. Press the ► button to display the calibration degree value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired calibration degrees.  
Default: 0.0  
Range: +/-10° F (+/-6° C)
4. Press the ► button to accept the value and return to the Sensor A selections.

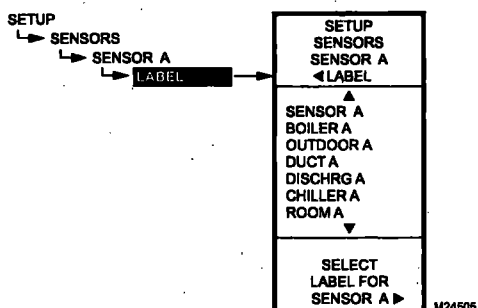


Fig. 39. Setup - Sensors - Sensor A - Label.

### 2.2.2.3. LABEL (the sensor input)

For a sensor already labeled, the display positions to and highlights that label.

1. From the Sensor A selections, use the ▲ and ▼ buttons to highlight LABEL.
2. Press the ► button to display the label list.
3. Use the ▲ and ▼ buttons to scroll through list and highlight the desired label.  
You may need to scroll up or down to view all possible labels.
4. Use the ► button to accept the highlighted label and exit the list.

NOTE: The label names in list order are: Sensor, Boiler, Outdoor, Duct, Dischrg, Chiller, Room, Supply, Return, and Animals.

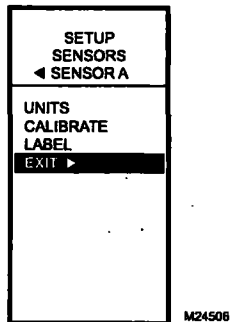


Fig. 40. Setup - Sensors - Sensor A - Exit.

**2.2.2.4. Exit Sensor A Setup**

Press the ◀ button to exit Sensor A selections and return to the Sensors menu.

or

Use the ▲ and ▼ buttons to highlight EXIT and press the ▶ button.

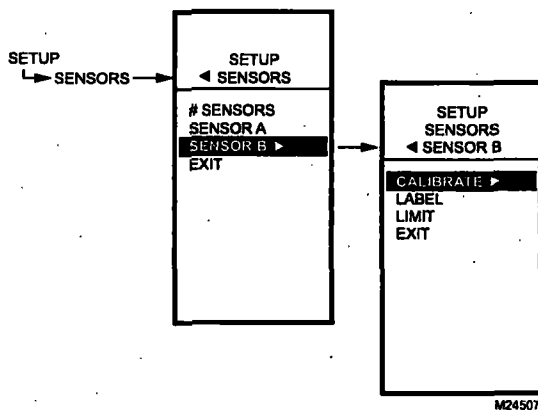


Fig. 41. Setup - Sensors - Sensor B Menu.

**2.2.3. SENSOR B**

For the T775M2030 and T775M2048 models only, which have a High/Low modulating temperature limit, the LIMIT item displays on the Sensor B menu.

1. From the Sensors menu, use the ▼ button to highlight SENSOR B.
2. Press the ▶ button to display the Sensor B menu.

**2.2.3.1. CALIBRATE**

Setting the calibration value is accomplished the same way as the Sensor A. See "2.2.2.2. CALIBRATE (the sensor)" on page 18.

**2.2.3.2. LABEL**

Setting the label is accomplished the same way as the Sensor A. See "2.2.2.3. LABEL (the sensor input)" on page 18.



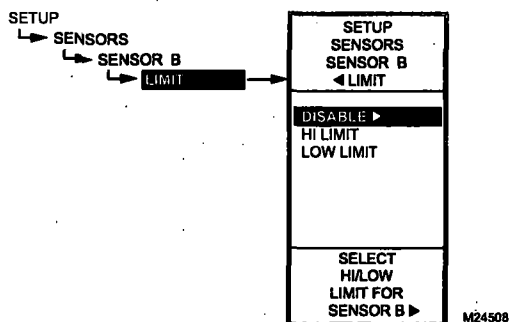


Fig. 42. Setup - Sensors - Sensor B - Limit.

**2.2.4. LIMIT (Sensor B only)**

For the T775M2030 and T775M2048 models only, the LIMIT item displays on the Sensor B menu.

NOTE: The LIMIT option acts *only* on Modulating Output 1.

1. From the Sensors menu, use the ▼ button to highlight SENSOR B.
2. Press the ► button to display the Sensor B menu.
3. Use the ▲ and ▼ buttons to select the LIMIT item.
4. Use the ► button to display the Limit selections.
5. Use the ▲ and ▼ buttons to select the desired limit, (Disable, Hi Limit, or Low Limit).  
Default: Disable
6. Press the ► button to accept the value and return to the Sensor B menu.

When you select Hi Limit or Low Limit, the Sensor B menu changes and adds the Hi/Low Limit and Throttling Range items.

If you are setting a Hi or Low Limit, continue with "2.2.4.1. HI LIMIT or LOW LIMIT (Sensor B only)".

If you selected Disable for the Limit value, continue with "2.3: Setting up the Outputs" on page 21.

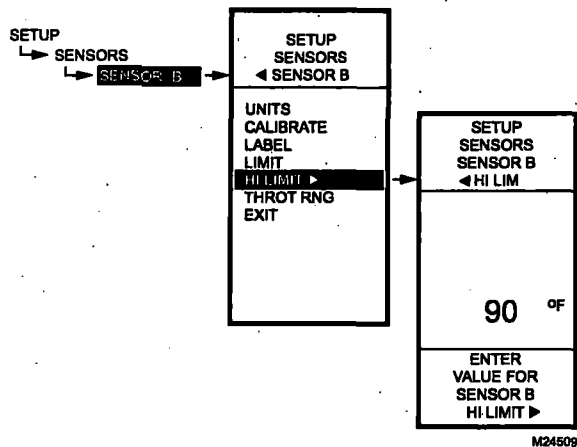


Fig. 43. Setup - Sensors - Sensor B - Hi/Low Limit (showing Hi Limit).

**2.2.4.1. HI LIMIT or LOW LIMIT (Sensor B only)**

Fig. 43 shows the High Limit, but the process is the same for setting the Low Limit.

Sensor B can be assigned a high/low limit, so that as you are controlling temperature at Sensor A, the control adjusts its modulating output to prevent exceeding the user-entered limit for Sensor B.

1. From the Sensor B menu, use the ▼ button to highlight HI LIMIT or LOW LIMIT.
2. Press the ► button display the LIMIT value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired Limit value.
4. Press the ► button to accept the value and return to the Limit menu.

The high and low limit action will work in either the heat or the cool mode as follows:

- When the low limit is used in the heat mode, the MOD1 output *increases* to prevent reaching the low limit at sensor B.
- When the high limit is used in the heat mode, the MOD1 output *decreases* to prevent reaching the hi limit at sensor B.
- When the low limit is used in the cool mode, the MOD1 output *decreases* to prevent reaching the low limit at sensor B.
- When the high limit is used in the cool mode, the MOD1 output *increases* to prevent reaching hi limit at sensor B.

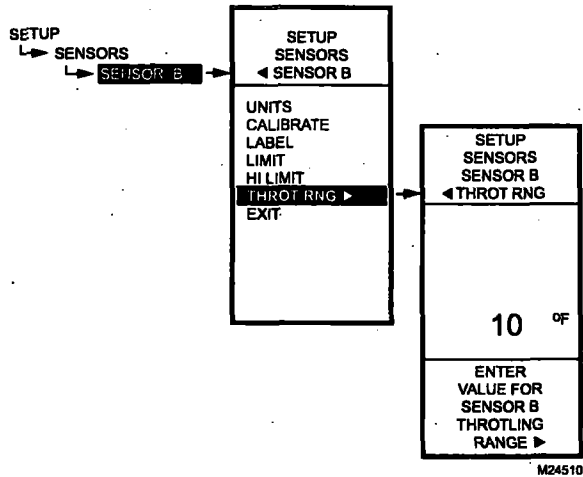


Fig. 44. Setup - Sensors - Sensor B - Throttling Range.

### 2.2.4.2. THROTTLING RANGE (Sensor B only)

The throttling range for the modulating high or low limit positions the setpoint at the end of the throttling range. For example, with a high limit at Sensor B of 200°F and a throttling range of 10°F, the modulating output controlling Sensor A begins to throttle back at 190°F (88°C), and fully closes at 200°F (93°C). Conversely, the throttling range for the low limit begins above the setpoint in the same manner.

1. From the Limit menu, use the ▼ button to highlight THROT RNG.
2. Use the ▲ and ▼ buttons to increase/decrease the desired value for the Throttling Range.  
Default = 0
3. Press the ► button to accept the value and return to the Limit menu.
4. Press the ◀ button to exit the Limit menu.
5. Press the ◀ button to exit the Sensors menu and return to the Setup menu.

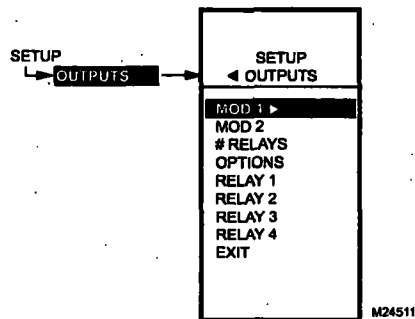


Fig. 45. Setup - Outputs Menu.

## 2.3. Setting up the Outputs

1. From the Setup menu, use the ▲ and ▼ buttons to highlight OUTPUTS.
2. Press the ► button to display the Outputs menu.

**NOTE:** The menus (e.g. the Outputs menu shown here) can display only those relays that are defined in Setup (see "2.3.2. NBR OF RELAYS" on page 24). For example, if you configure only two relays, then only two relays display on the appropriate menus.

The following procedures set up each modulating output and relay output.

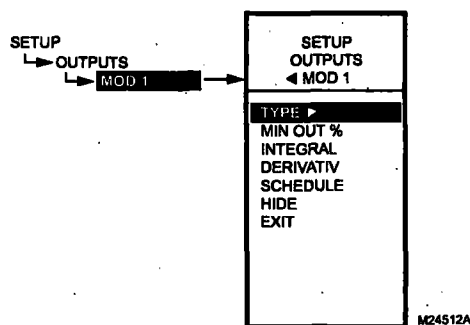


Fig. 46. Setup - Outputs - Modulating Output Menu.

### 2.3.1. Setting up the Modulating Outputs

1. From the Output menu, use the ▲ and ▼ buttons to highlight the desired modulating output (MOD 1 or MOD 2).
2. Press the ► button to display the selected MOD menu.

**NOTE:** Modulating outputs are not available on the T775A and T775B controller models. If you are setting up one of these controllers, skip to "2.3.2. NBR OF RELAYS" on page 24.

Use the remaining procedures, beginning with "2.3.1.1. TYPE (of output signal)" on page 22, to set up each modulating output. If you have two modulating outputs, repeat these procedures for each modulating output.

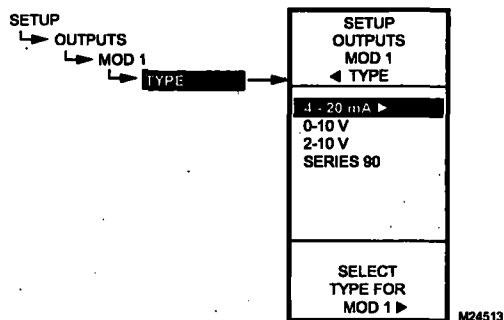


Fig. 47. Setup - Outputs - Mod Out - Type.

**2.3.1.1. TYPE (of output signal)**

1. From the Mod menu, use the ▲ and ▼ buttons to highlight TYPE.
2. Press the ► button to display the Type selections.
3. Use the ▲ and ▼ buttons to highlight the desired output type.  
Default: 4-20 mA
4. Press the ► button to accept the selected type and return to the Mod menu.

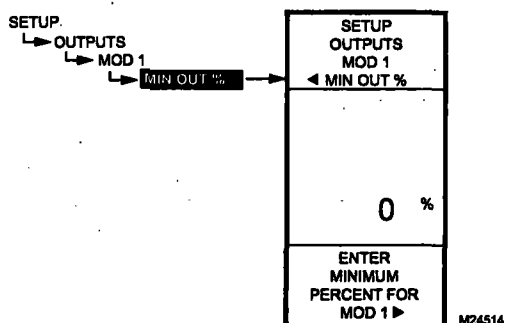


Fig. 48. Setup - Outputs - Mod Out - Minimum Output Percentage.

**2.3.1.2. MIN OUT %**

The minimum output % prevents the output from dropping below the value entered. This value can be useful to maintain minimum damper position.

Using the time clock or digital input to disable the output forces the output to 0%.

1. From the Mod menu, use the ▲ and ▼ buttons to highlight MIN OUT %.
2. Press the ► button to display the Min Out %.
3. Use the ▲ and ▼ buttons to increase/decrease the desired value from 0% to 100% in 1% increments.  
Default: 0%  
Range: 0 to 100%
4. Press the ► button to accept the percentage and return to the Mod menu.

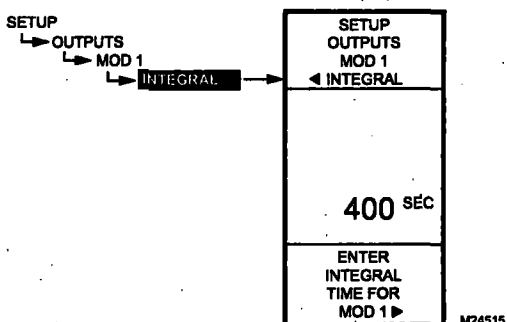


Fig. 49. Setup - Outputs - Mod Out - Integral.

**2.3.1.3. INTEGRAL**

1. From the Mod menu, use the ▲ and ▼ buttons to highlight INTEGRAL.
2. Press the ► button to display the Integral seconds.
3. Use the ▲ and ▼ buttons to increase/decrease the value from 0 to 3,600 in 10 second increments.  
Default: 400 seconds  
Range: 0 to 3,600 seconds
4. Press the ► button to accept the seconds and return to the Mod menu.

**NOTES:**

1. The Integral time is factory set for 400 seconds. This is a good middle range and should satisfy many applications. The integral time can be increased for applications where sensed response is slow, and can be decreased for applications where sensed response is fast (e.g. discharge air control).
2. As a starting point, an optimal integral time for discharge air typically ranges from 12 to 200 seconds. An optimal integral time for room control typically ranges from 60 to 2,500 seconds. The purpose of integral action is to reduce or eliminate the offset from setpoint during steady state control that is often seen in proportional only control.
3. Keep in mind that control is most sensitive to throttling range. Adjust the throttling range first before any adjustment to integral time. Adjust throttling range to be as wide as possible to start since this will provide the most stable control. Remember that the integral will eliminate the steady state error so you do not need to have a small throttling range to have accurate control. (Integral action allows for controlling to a setpoint even with a wide throttling range).

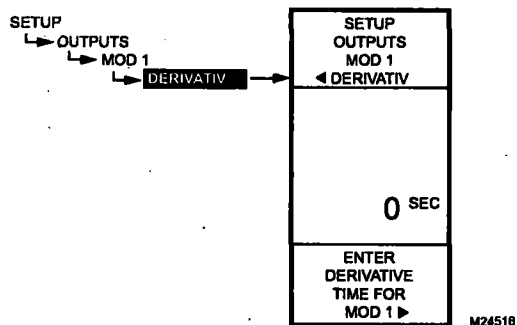


Fig. 50. Setup - Outputs - Mod Out - Derivative.

**2.3.1.4. DERIVATIVE**

The Derivative default value is factory set to zero (no derivative control). It is strongly recommended that the derivative remain at zero (0) unless you have a very good reason to adjust it. Derivative control is not needed in the vast majority of HVAC applications.

1. From the Mod menu, use the ▲ and ▼ buttons to highlight DERIVATIV.
2. Press the ► button to display the Derivative seconds.
3. Use the ▲ and ▼ buttons to increase/decrease the value.  
Default: 0 (zero)  
Range: 0 to 3,600 seconds
4. Press the ► button to accept the seconds and return to the Mod menu.

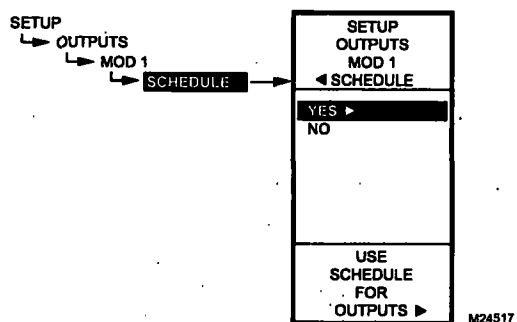


Fig. 51. Setup - Outputs - Mod Out - Schedule.

**2.3.1.5. SCHEDULE**

The Schedule option displays only if the USE SCHED parameter is set to Yes (See "2.3.3.1. USE SCHED" on page 25).

1. From the Mod menu, use the ▲ and ▼ buttons to highlight SCHEDULE.
2. Use the ▲ and ▼ buttons to highlight YES or NO.  
Default: YES
3. Press the ► button to accept the selection and return to the Mod menu.

Each output can be set up to follow or ignore the built in scheduler. To disable the scheduler for all outputs, see "2.3.3.1. USE SCHED" on page 25.

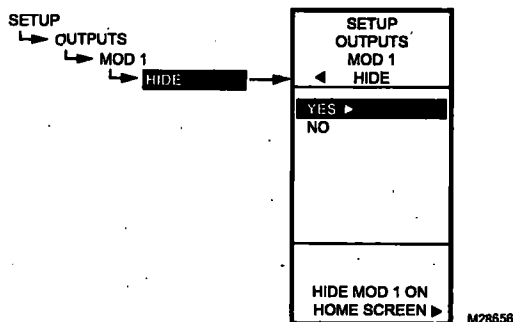


Fig. 52. Setup - Outputs - Mod 1/2 - Hide.

**2.3.1.6. HIDE**

The Hide option is used to prevent the MOD 1 and MOD 2 outputs from displaying on the Home screen.

1. From the Mod menu, use the ▲ and ▼ buttons to highlight HIDE.
2. Use the ▲ and ▼ buttons to highlight YES or NO.  
Default: YES
3. Press the ► button to accept the selection and return to the Mod menu.

**NOTE:** The MOD1 and MOD2 outputs are still active even when hidden from the Home screen.

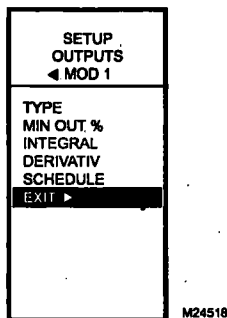


Fig. 53. Setup - Outputs - Mod Out - Exit.

**2.3.1.7. EXIT**

Press the ◀ button (or highlight EXIT and press the ▶ button) to exit the Mod menu and return to the Outputs menu.

If you have a second modulating output to configure, go to "2.3.1. Setting up the Modulating Outputs" on page 21.

If you are finished setting up the modulating outputs, continue with "2.3.2. NBR OF RELAYS".

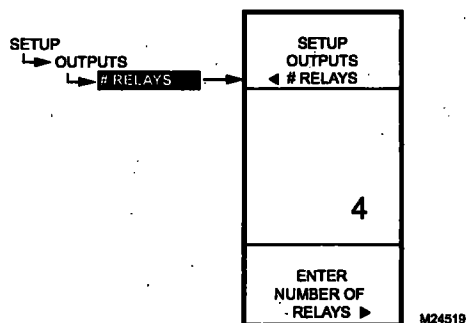


Fig. 54. Setup - Outputs - Number of Relays.

**2.3.2. NBR OF RELAYS**

1. From the Outputs menu, use the ▲ and ▼ buttons to highlight # RELAYS.
2. Press the ▶ button to display the number of relays.
3. Use the ▲ and ▼ buttons to display the number from 1 to 4 depending on the model. (See notes below.)
4. Press the ▶ button to accept the value and display the Outputs menu.

**NOTES:**

1. The T775A/B/M models have the following outputs available:  
 T775A20191 relay output  
 T775B2016up to 2 relay outputs  
 T775B2024up to 4 relay outputs  
 T775B2032up to 2 relay outputs  
 T775B2040up to 4 relay outputs  
 T775M2006no relay outputs  
 T775M2014up to 4 relay outputs
2. The number of relay outputs entered here determines how many relays display on the home screen.

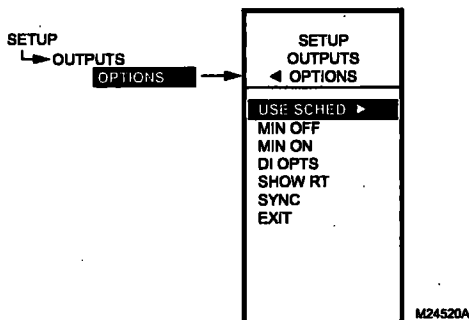


Fig. 55. Setup - Outputs - Options Menu.

**2.3.3. OPTIONS**

1. From the Outputs menu, use the ▲ and ▼ buttons to highlight OPTIONS.
2. Press the ▶ button to display the Options menu.

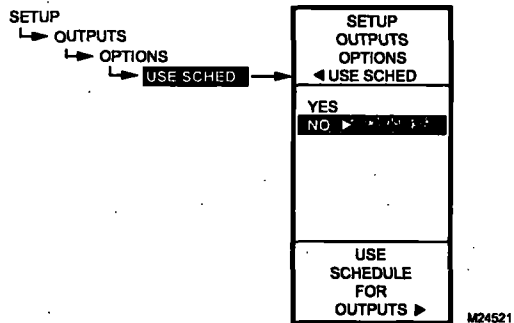


Fig. 56. Setup - Outputs - Options - Schedule.

### 2.3.3.1. USE SCHED

1. Press the ► button to display the schedule selections.
2. Use the ▲ and ▼ buttons to highlight YES or NO.  
Default: NO
3. Press the ► button to accept the value and display the MIN OFF option.

Selecting NO disables scheduling for all outputs.

Selecting YES enables scheduling for all outputs. When YES is selected, all individual outputs default to follow the schedule. However, each individual output can be removed from scheduling as desired.

With Scheduling enabled, when you return to Program mode, the new option for Scheduling displays. You can press the home key and then the menu key to view the Schedule options in the menu.

See "2.3.1.5. SCHEDULE" on page 23.

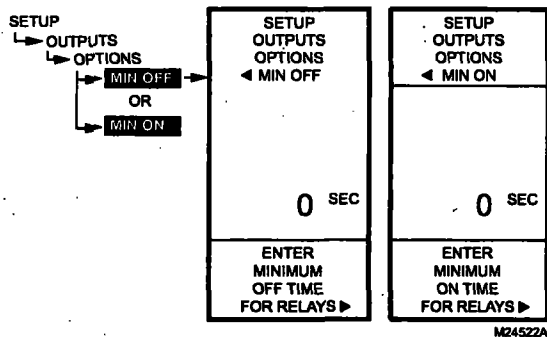


Fig. 57. Setup - Outputs - Options - Min Off/On Time.

### 2.3.3.2. MIN OFF or MIN ON

This is the minimum number of seconds of "off time" or "on time" for all relays.

1. Press the ► button to display the Min Off/On value.
2. Use the ▲ and ▼ buttons to increase/decrease the desired number of seconds from 0 to 990 seconds in 10 second increments.  
Default: 0 (zero)  
Range: 0 to 990 seconds
3. Press the ► button to accept the seconds and display the DI OPTIONS.

#### NOTES:

1. The minimum OFF or ON time applies to all relay outputs.
2. When minimum OFF or ON time is active, relays waiting to be energized display a flashing square underneath the relay number on the home screen.
3. If the minimum OFF time is not equal to zero (0), the minimum OFF time activates at power-up. To manually override, press the ◀ button at any time.

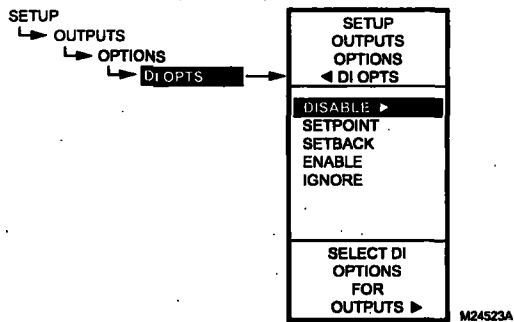


Fig. 58. Setup - Outputs - Options - DI Options.

**2.3.3.3. DI OPTIONS** (digital input options)

The DI Option you select applies to all outputs. This option overrides any Setpoint/Setback values entered in the Schedule.

1. Press the ► button to display the DI Option selections.
2. Use the ▲ and ▼ buttons to highlight DISABLE, SETBACK, or IGNORE.  
Default: DISABLE
3. Press the ► button to accept the value and display the SHOW RT option.

When the digital input (DI) closes, all outputs follow the DI option value (Disable, Setback, or Ignore):

- **DISABLE** disables the outputs; relays return to de-energized state and Mod outputs return to 0% output.
- **SETPOINT** forces the control to the setpoint temperature.
- **SETBACK** enables a setback temperature value to be programmed for each output and forces the control to the setback temperature.  
— To program the Setback temperature, see Fig. 32 on page 16.
- **ENABLE** energizes all relays and MOD outputs to 100%. Use this option carefully.
- **IGNORE** causes the digital input to have no effect on the Relay or Mod outputs.

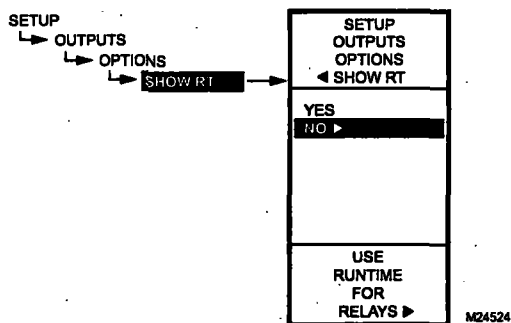


Fig. 59. Setup - Outputs - Options - Show Runtime.

**2.3.3.4. SHOW RT** (show run time hours)

1. Press the ► button to display the Show RT values.
2. Use the ▲ and ▼ buttons to select YES or NO.  
Default: YES
3. Press the ► button to accept the value and return to the Options menu.

Selecting YES shows the RT (run time) hours for each relay on the home screen displays.

**NOTE:** Run times can be reset to zero for each individual relay. You must do this for each relay that you want to reset to zero. See "2.3.4.3. RESET RT (run time hours)" on page 29.

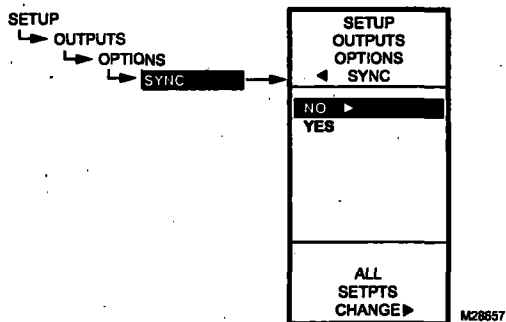


Fig. 60. Setup - Outputs - Options - Sync.

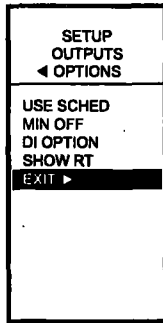
**2.3.3.5. SYNC** (synchronize setpoint changes)

1. Press the ► button to display the Sync values.
2. Use the ▲ and ▼ buttons to select YES or NO.  
Default: NO
3. Press the ► button to accept the value and return to the Options menu.

Depending on the model, selecting YES causes all setpoints for all relays and MODs to sync to any change to:

- Relay 1 for models without MOD outputs
- MOD1 for models with MOD outputs

For example, assume the MOD1 setpoint is 110°F, MOD2 is 115°F, and Relay 1 is 120°F. With SYNC=YES, when the MOD1 setpoint is adjusted to 112°F (increase 2°F), then MOD2 and all other relay setpoints increase by 2°F. Thus the MOD2 setpoint is now 117°F and the relay 1 setpoint is 122°F.



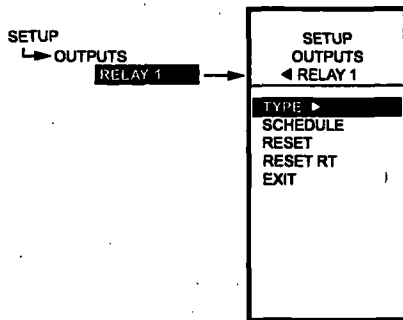
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Fig. 61. Setup - Outputs - Options - Exit.

### 2.3.3.6. Exit Options Setup

Press the ◀ button (or highlight EXIT and press the ▶ button) to exit and return to the Outputs menu.

Continue with "2.3.4. Setting up the Relays"



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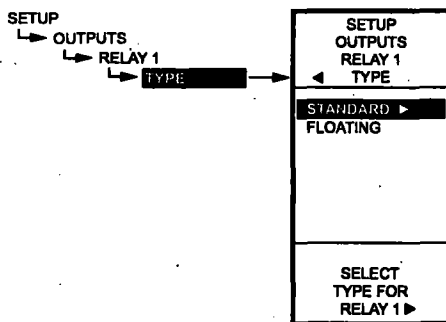
Fig. 62. Setup - Outputs - Relay Menu.

### 2.3.4. Setting up the Relays

1. From the Outputs menu, use the ▲ and ▼ buttons to highlight the desired relay (1-4 depending on model).
2. Press the ▶ button to display the selected relay menu.

The TYPE selection shown in Fig. 62 displays only for Relay 1 and Relay 3.

Continue with the remainder of section 3.4 to setup the relay outputs.



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Fig. 63. Setup - Outputs - Relay - Type.

#### 2.3.4.1. TYPE (standard or floating).

The Floating option is only available on the T775B2016, T775B2024, T775B2032, and T775B2040 models.

For these models, this selection displays only for Relay 1 and/or Relay 3.

1. Press the ▶ button to display the Type values.
2. Use the ▲ and ▼ buttons to select STANDARD OR FLOATING.  
Default: STANDARD (not floating)
3. Press the ▶ button to accept the value and return to the Relay menu.

If you select FLOATING, the relays are paired (1-2 or 3-4) and are setup together. Continue with "2.3.4.1.1. Floating Relay Menu".

If you select STANDARD, go to "2.3.4.2. SCHEDULE" on page 29.



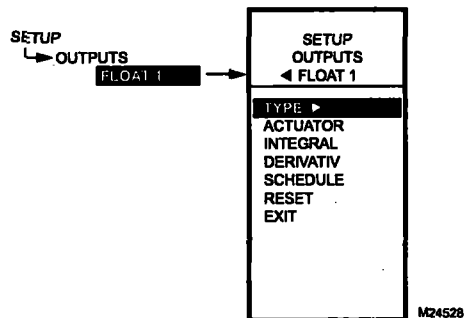


Fig. 64. Setup - Outputs - Floating Relay - Menu.

### 2.3.4.1.1. Floating Relay Menu

The Floating option is only available on the T775B2016, T775B2024, T775B2032, and T775B2040 models.

When Relay 1 or Relay 3 is setup as floating, relays are paired and the Float 1 or Float 2 menu displays with the selections shown in Fig. 64.

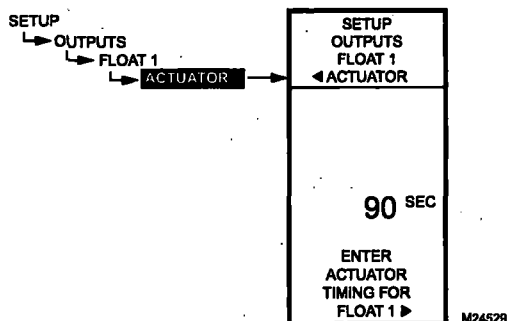


Fig. 65. Setup - Outputs - Floating Relay - Actuator.

#### 2.3.4.1.1.1. ACTUATOR (floating relay only)

The Actuator option displays only on the T775B2016, T775B2024, T775B2032, and T775B2040 models when the Type option = Floating.

1. From the menu, use the ▲ and ▼ buttons to highlight ACTUATOR.
2. Press the ► button to display the actuator value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired number of seconds.  
Default: 90 seconds  
Range: 0 to 3,600 seconds)
4. Press the ► button to accept the value and display the INTEGRAL option.

The actuator run time is defined as the time needed to move the actuator from the fully closed to fully open position and visa versa.

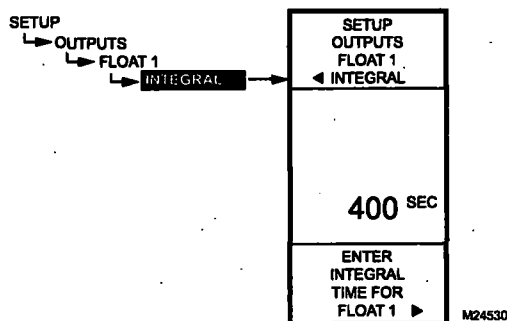


Fig. 66. Setup - Outputs - Floating Relay - Integral.

#### 2.3.4.1.1.2. INTEGRAL (modulating/floating relay only)

The Actuator option displays only on the T775B2016, T775B2024, T775B2032, and T775B2040 models when the Type option = Floating.

1. From the menu, use the ▲ and ▼ buttons to highlight INTEGRAL.
2. Press the ► button to display the actuator value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired number of seconds.  
Default: 400 seconds  
Range: 0 to 3,600 seconds)
4. Press the ► button to accept the value and display the DERIVATIV option.

See Integral NOTES on page 22 for additional information about setting the Integral time.

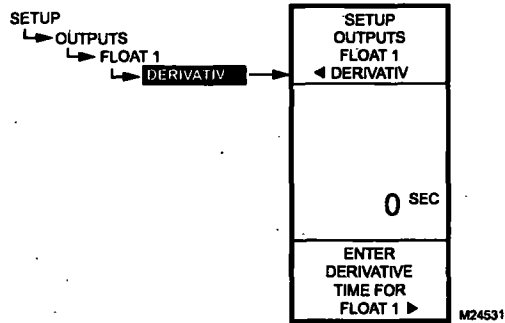


Fig. 67. Setup - Outputs - Floating Relay - Derivative.

**2.3.4.1.1.3. DERIVATIVE** (modulating/floating relay only)

The Derivative option displays only on the T775B2016, T775B2024, T775B2032, and T775B2040 models when the Type option = Floating.

1. From the menu, use the ▲ and ▼ buttons to highlight DERIVATIV.
2. Press the ► button to display the actuator value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired number of seconds.  
Default: 0 seconds  
Range: 0 to 3,600 seconds)
4. Press the ► button to accept the value and display the SCHEDULE option.

Continue with "2.3.4.2. SCHEDULE" for the remaining relay selections.

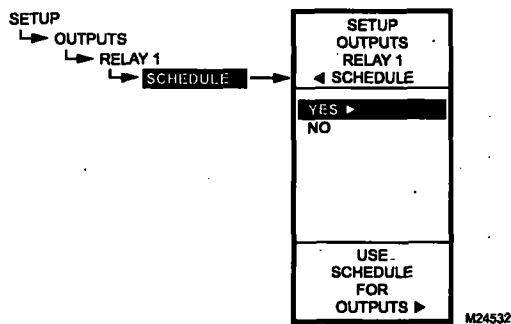


Fig. 68. Setup - Outputs - Relay - Schedule.

**2.3.4.2. SCHEDULE**

This selection displays only if "Use Sched = YES" is selected during the Output Options setup (see "2.3.3.1. USE SCHED" on page 25). When selected, individual outputs default to follow the schedule.

1. Press the ► button to display the Schedule values.
2. Use the ▲ and ▼ buttons to select YES or NO.  
Default: YES
3. Press the ► button to accept the value and return to the Relay menu.

An individual output can be selected to be controlled or not controlled by the schedule.

If NO is selected, the Setback selection does not appear in the Program menu for this output.

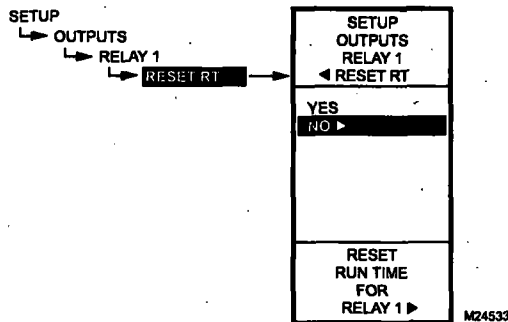


Fig. 69. Setup - Outputs - Relay - Reset Runtime.

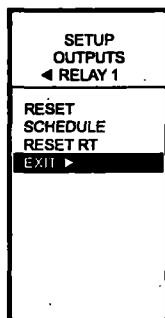
**2.3.4.3. RESET RT** (run time hours)

This selection displays only if "Show RT = YES" is selected during Output Options setup (see "2.3.3.4. SHOW RT (show run time hours)" on page 26).

1. From the Relay menu, press the ► button to display the Reset RT values.
2. Use the ▲ and ▼ buttons to select YES or NO.  
Default: NO
3. Press the ► button to accept the value and return to the Relay menu.

Selecting YES immediately resets the output run time hours to zero for this output. When you subsequently return to this screen, the RESET RT defaults to NO.

**NOTE:** Run times can be reset to zero for each individual relay. You must do this for each relay that you want to reset to zero.



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## 2.4. EXIT Setup Mode

Press the ◀ button to exit the selected relay set up and return to the Outputs menu.

To setup the next relay output go to "2.3.4. Setting up the Relays" on page 27.

If you are finished setting up the relay outputs, press the HOME button to exit Setup mode and return to the home screen display.

This completes the Setup procedure.

Fig. 70. Setup - Outputs - Relay - Exit.

### 3. SCHEDULING

Scheduling provides the ability to set daily temperature settings for up to two events per day. Typically, these are the daytime (setpoint) and the nighttime (setback) settings.

#### IMPORTANT

To enable Scheduling, you must first enter Setup mode (press and hold the **MENU** button for 5 seconds), select **OUTPUTS**, select **OPTIONS**, select **USE SCHED**, and then select **YES**. (See "2.3.3.1. USE SCHED" on page 25).

#### IMPORTANT

To properly account for Daylight Saving time, be sure to set the Date **before** setting the Time. See "3.2.2. SET DATE" on page 32.

**NOTE:** Each output is independently configurable to follow the schedule or not. For modulating outputs, See "2.3.1.5. SCHEDULE" on page 23. For relay outputs, see "2.3.4.2. SCHEDULE" on page 29.

**NOTE:** The controller interface is intuitive. You may find that you do not need the following scheduling instructions. You may want to use this procedure simply as a reference to locate the particular option or parameter of interest.

#### NOTES:

1. If you press the **HOME** button or there is no keypad activity for four minutes, you exit Scheduling mode and return to the home screen.
2. If you press the **MENU** button, you exit Scheduling mode and return to the menu.

To create or change a schedule, you use the —

- **Left arrow button (◀)** to scroll backward through the Schedule menus
- **Right arrow button (▶)** to select the highlighted menu item and display its content
- **Up and Down arrow buttons (▲ and ▼)** to scroll up and down through a list of items or to increase or decrease the value of a displayed schedule parameter

### Creating a Schedule

To create a schedule, perform the following in the order listed:

1. Enable Scheduling in Setup mode - See "2.3.3.1. USE SCHED" on page 25
2. Enter Schedule mode — See "3.1. Entering Schedule Mode"
3. Set the Schedule Options — See "3.2. OPTIONS"
4. Set Individual Schedules — begin with "3.3. Setting Individual Schedules" on page 33
5. Exit Schedule Mode — See "3.4. Exiting Scheduling Mode" on page 34

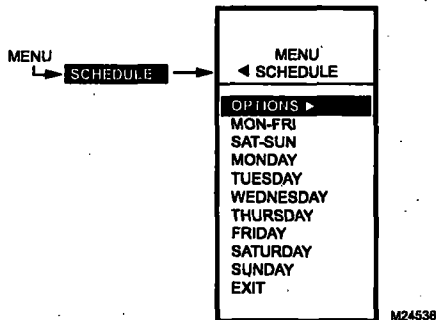


Fig. 71. Schedule - Menu.

#### 3.1. Entering Schedule Mode

Press the **MENU** button, then select **SCHEDULE** and press the **▶** button to view the Schedule menu.

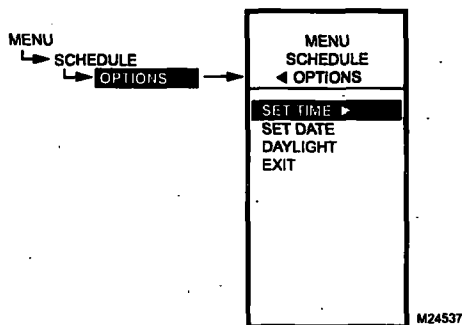


Fig. 72. Schedule - Options Menu.

#### 3.2. OPTIONS

1. From the Schedule menu, use the **▲** and **▼** buttons to highlight **OPTIONS**.
2. Press the **▶** button to display the Options menu.

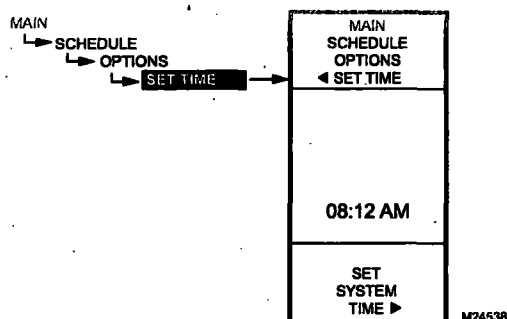


Fig. 73. Schedule - Options - System Time.

### 3.2.1. SET TIME

Setting the system time is required to enable the controller to follow daylight saving time.

**IMPORTANT**

*Set the Date **before** setting the Time. See "3.2.2. SET DATE".*

1. From the Options menu, use the ▲ and ▼ buttons to highlight SET TIME.
2. Press the ► button to display the current system time setting.
3. Use the ► button to cycle between the hour, minute, and AM/PM values.
4. Use the ▲ and ▼ buttons to increase/decrease the desired value for the hour, minute, and AM/PM.
5. Press the ◀ button to accept the Time and return to the Options menu.

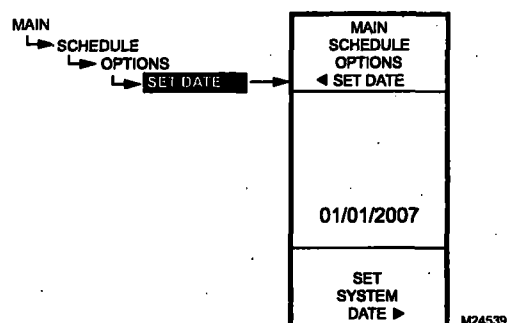


Fig. 74. Schedule - Options - System Date.

### 3.2.2. SET DATE

Setting the system date is required to enable the controller to follow daylight saving time.

**IMPORTANT**

*To properly account for Daylight Saving time, be sure to set the Date **before** setting the Time.*

1. From the Options menu, use the ▲ and ▼ buttons to highlight SET DATE.
2. Press the ► button to display the current system date setting.
3. Use the ► button to cycle between the month, day, and year values.
4. Use the ▲ and ▼ buttons to increase/decrease the desired value for the month, day, and year.
5. Press the ◀ button to accept the Date and return to the Options menu.

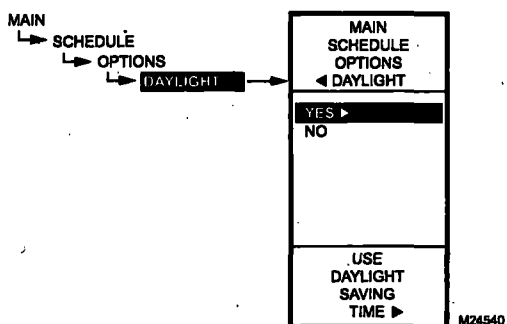


Fig. 75. Schedule - Options - Daylight Saving Time.

### 3.2.3. DAYLIGHT (daylight saving time)

1. From the Options menu, use the ▲ and ▼ buttons to highlight DAYLIGHT.
2. Press the ► button to display the current system setting for daylight saving time.
3. Use the ▲ and ▼ buttons to select YES or NO.  
Default: YES
4. Press the ► button to accept the value and return to the Options menu.
5. From the Options menu, use the Use the ▲ and ▼ buttons to highlight EXIT.
6. Press the ► button to return to the Schedule menu.

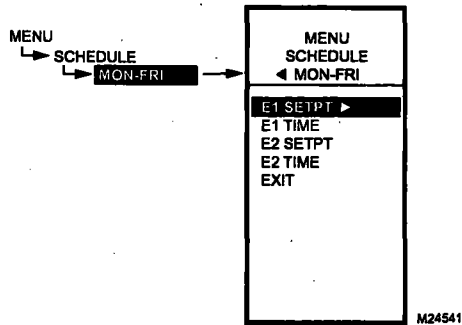


Fig. 76. Schedule Event Menu (Showing MON-FRI).

### 3.3. Setting Individual Schedules

As shown in the Schedule menu (Fig. 71 on page 31), schedules can be set for the following time periods:

- Monday through Friday
- Saturday and Sunday
- Individual days of the week

1. From the Schedule menu, use the ▲ and ▼ buttons to highlight the desired time period.
2. Press the ► button to display the Schedule menu for the selected time period.

For each selected time period, the schedule event (E1 and E2) parameters are exactly the same as shown in Fig. 76.

#### SCHEDULING EXAMPLE

Setting the schedule is independent of the temperature settings for the relay outputs. The following illustrates a weekly schedule for daytime (setpoint) and night time (setback) use and shows the factory default settings:

Table 4. Mon-Fri Schedule Defaults

DAY	EVENT	SETPT ACTION	TIME
Mon-Fri	Event 1 (E1)	Setpoint	6:00 AM <sup>a</sup>
Mon-Fri	Event 2 (E2)	Setback	6:00 PM <sup>b</sup>
Sat-Sun	Not used; remains in Setback from Mon-Fri E2 settings		

<sup>a</sup> Setpoint time span is 6:00 AM until 5:59 PM because setback starts at 6:00 PM.

<sup>b</sup> Setback time span is 6:00PM until 5:59 AM because setpoint starts at 6:00 AM.

To set a schedule, continue with "3.3.1. E1 SETPT (setpoint for event 1)".

The following figures show the MON-FRI menu, but the menu selections are the same for any time period.

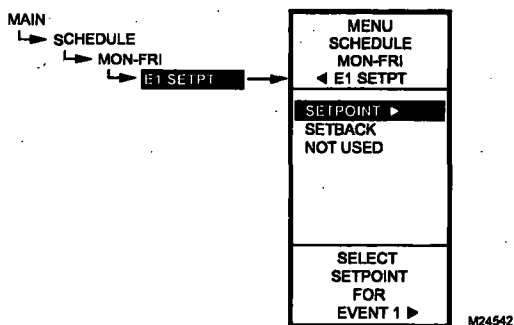


Fig. 77. Schedule - Event 1 Setpoint.

#### 3.3.1. E1 SETPT (setpoint for event 1)

1. From the selected time period menu, use the ▲ and ▼ buttons to highlight E1 SETPT.
2. Press the ► button to display the setpoint options.
3. Use the ▲ and ▼ buttons to highlight the desired option.
4. Press the ► button to accept the value and return to the selected time period menu.

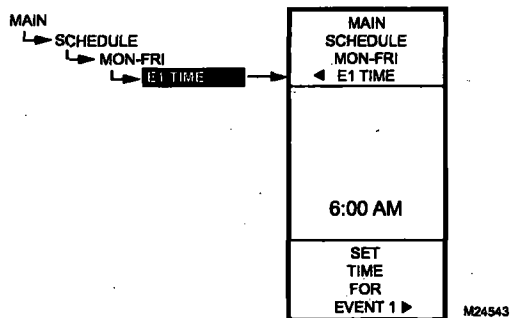


Fig. 78. Schedule - Event 1 Time.

**3.3.2. E1 TIME** (time for event 1)

1. From the selected time period menu, use the ▲ and ▼ buttons to highlight E1 TIME.
2. Press the ► button to display the current time setting for event 1.
3. Use the ► button to cycle between the hour, minute, and AM/PM values.
4. Use the ▲ and ▼ buttons to increase/decrease the desired value for the hour, minute, and AM/PM.
5. Press the ◀ button to accept the time and return to the selected time period menu.

**3.3.3. E2 SETPOINT** (setpoint for event 2)

Creating the setpoint for event 2 is accomplished the same way as the first event. See "3.3.1. E1 SETPT (setpoint for event 1)" on page 33.

**3.3.4. E2 TIME** (time for event 2)

Creating the time for event 2 is accomplished the same way as the first event. See "3.3.2. E1 TIME (time for event 1)" above.

**3.3.5. EXIT** (exit from selected time period settings)

After entering the time for event 2, use the ◀ button to exit the schedule time period and return to the Schedule menu (Fig. 71 on page 31) to select a different time period.

When you finish scheduling the time periods, continue with "3.4. Exiting Scheduling Mode".

**3.4. Exiting Scheduling Mode**

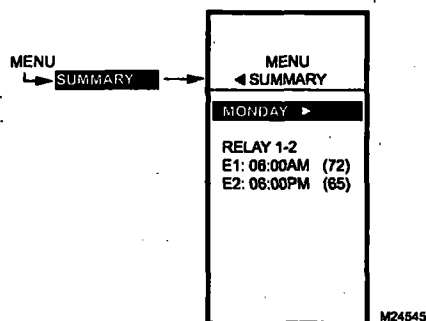
Press the HOME button to exit the Schedule menu and return to the home screen display.

This completes the Scheduling procedure.

## SUMMARY MENU

The Summary menu provides the ability to view the schedule (E1 and E2 times) for each relay for each day of the week.

**NOTE:** Scheduling must be enabled for the Summary menu to display. Enabling the schedule is determined in the Setup process for the Output Options (see "2.3.3.1. USE SCHED" on page 25).



**Fig. 79. Summary Example - Monday Settings.**

For each relay, the Summary display indicates the time and temperature (in parenthesis) for each of the two scheduled events E1 and E2.

1. Press the **MENU** button to view the menu.
2. Use the **▲** and **▼** buttons to highlight **SUMMARY**.
3. Press the **►** button to display the Summary settings.
4. Use the **►** button to scroll forward through each day of the week (Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, and Sunday).
5. While viewing a specific day, use the **▲** and **▼** buttons to cycle through the individual relay schedules for that day.

When finished, press the home key to return to the home display screen.

## TROUBLESHOOTING

### Power Loss

The date and time settings are retained for 24 hours after a power outage. After a power loss of more than 24 hours, the date and time settings may need to be reentered. All other settings are stored permanently.

### Errors and Diagnostics

The controller provides an error message and diagnostic status as described below.

#### Error Message

There is a two-character error code that displays in response to controller software problems:

#### EE

**EEPROM Failure** — The values read back from the EEPROM are not the same as written into the EEPROM. This error cannot be field repaired. Replace the device.

#### Diagnostic Messages

There are two diagnostic messages that can display in response to sensor problems. The diagnostic codes that can flash on the display are:

--

**Sensor Open or Shorted** — Two dashes display when a sensor (typically temperature) is open or shorted. An open circuit is considered anything greater than 1570 ohms (greater than 300F), shorted anything less than 770 ohms (less than -73F). Whichever stages are operating with this sensor cease to control (meaning relays go to OFF and proportional outputs go to zero percent).

This message can also mean that the sensor is programmed, but not physically connected.

#### -60° or 270° F (-51° or 132° C) Blinking

**Temperature Out of Range** — The temperature display blinks when the sensed temperature range is outside of the display range, below -60° F (-51° C) or above 270° F (132° C). The displayed value remains at that displayed limit and control continues. Controller continues to function unless an open or shorted state is detected.

#### Blinking relay status

**Relay Minimum Off Time is Active** — On the home screen, each relay's indicator (■) blinks while the relay's minimum off time is active.



## SPECIFICATIONS

**Power:** 24, 120, or 240 Vac; 50/60 Hz;  
A separate earth ground is required for any power source.

**Power Consumption:**

- 8 VA maximum at 60 Hz
- 10 VA maximum at 50 Hz

**Operating & Storage Temperature Ambient Rating:**

- -40° to 125° F (-40° to 52° C) @ 50 Hz
- -40° to 140° F (-40° to 60° C) @ 60 Hz

**Relative Humidity:** 5% to 95% non-condensing

**Relay Contact Output Ratings (N.O. and N.C.):**

- 1/2 hp; 9.8 AFL, 58.8 ALR @ 120 Vac
- 1/2 hp; 4.9 AFL, 29.4 ALR @ 240 Vac
- 125 VA pilot duty @ 120/240 Vac
- 10A @ 24 Vac (resistive)

**Modulating Outputs:**

- 0-10 Vdc; drive a minimum of 2,000 Ohms
- 2-10 Vdc; drive a minimum of 2,000 Ohms
- 4-20 mA; drive a maximum of 600 Ohms
- Electronic Series 90
- Floating

## DOC

### Emissions Compliance

EN 55022: 2006  
CISPR 22: 2006  
VCCI V-3/2006.04  
ICES-003, Issue 4: 2004  
FCC PART 15 SUBPART B Class B Limit

### Immunity Compliance

EN 61000-6-1: 2001 covering  
EN 61000-4-2: 1995 + A1: 1998 + A2: 2001  
EN 61000-4-3: 2002  
EN 61000-4-4: 2004  
EN 61000-4-5: 1995 + A1: 2001  
EN 61000-4-6: 1996 + A1: 2001  
EN 61000-4-8: 1993 + A1: 2001  
EN 61000-4-11 2nd Ed.: 2004

### Safety Compliance

UL 60730-1 for US and Canada

### FCC Compliance Statement:

This equipment has been tested and found to comply with limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television equipment reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Move the equipment away from the receiver
- Plug the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/television technician for additional suggestions

You are cautioned that any change or modifications to the equipment not expressly approved by the party responsible for compliance could void Your authority to operate such equipment.

This device complies with Part 15 of the FCC Rules. Operation is subjected to the following two conditions 1) this device may not cause harmful interference and 2) this device must accept any interference received, including interference that may cause undesired operation.

### Automation and Control Solutions

Honeywell International Inc.  
1985 Douglas Drive North  
Golden Valley, MN 55422  
customer.honeywell.com

Honeywell Limited-Honeywell Limitée  
35 Dynamic Drive  
Toronto, Ontario M1V 4Z9

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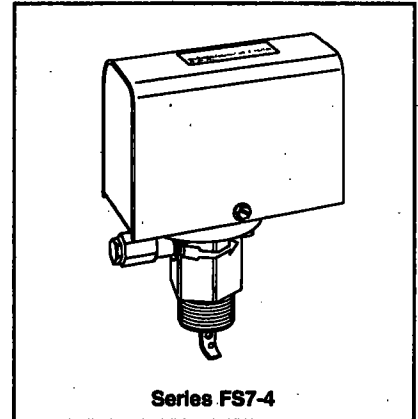


**McDonnell & Miller**  
Installation & Maintenance  
Instructions  
MM-607(B)

**Series FS7-4**  
**Industrial Liquid Flow Switch**

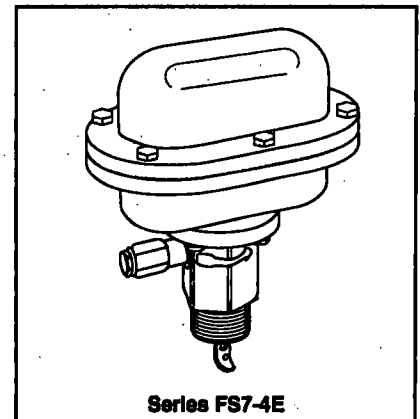


**CE** (specified models only)



**OPERATION**

This control is an independently mounted water flow sensing device that makes or breaks an electrical circuit when flow stops or starts.



**⚠ 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 an electrical fire or equipment damage, electrical wiring insulation must have a rating of 167°F (75°C) if the liquid's temperature exceeds 180°F (82°C).



- To prevent electrocution, when the electrical power is connected to the flow switch, do not touch the terminals.

- Make sure flow switch electrical cover is secured before turning on electric power.

Failure to follow this warning could cause property damage, personal injury or death.

## SPECIFICATIONS

### Maximum Liquid Pressure:

300 psi (21 kg/cm<sup>2</sup>) (All models except "S")  
1000 psi (70 kg/cm<sup>2</sup>) ("S" models)

### Liquid Temperature Range (T<sub>L</sub>):

32 - 300°F (0 - 149°C) (All models except "W")  
-65 - 300°F (-54 - 149°C) ("W" models)

### Ambient Temperature Range (T<sub>s</sub>):

32 - 120°F (0 - 49°C) (All models except "W")  
-65 - 300°F (-54 - 149°C) ("W" models)

### Electrical Enclosure Rating:

Nema Type 1 (IP 21) (All models except "E" and "W")  
Nema Type 4X (IP 56) ("W" models)  
Nema Type 7 and 9 ("E" models)

### Maximum Velocity:

10ft/sec (3M/sec)

### Pipe Connection Thread Size:

1 1/4" NPT (All models except "J")  
1 1/4" BSPT ("J" models)

## ELECTRICAL RATINGS

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC 50 or 60 cycles
240 VAC	3.7	22.2	

CE Circuit Rating	
7.4 (7.4)/120~	0.3/120=
3.7 (3.7)/240~	0.15/240=

### Models that meet CE Conformance:

**FS7-4EJ-E**

**FS7-4J-E**

**FS7-4SJ-E**

**FS7-4WJ-E**

- **This Control:** is for continuous operations  
is not electronic  
has Type 1C action (micro interruption  
on operation)

- **LVD 73/23/EEC**

- **EMC 89/33/EEC**

For applications with loads between 14mA and 3.7  
Amps, power factors exceeding 0.65, an anticipated

system switch operation rate of less than 5 times per  
minute, and any one cycle greater than 3 seconds on  
and 3 seconds off.

Additional suppression may be required for applica-  
tions outside these ranges.

- **Declaration of Conformity**

Available on request.

# FLOW RATES

Flow rates required to activate flow switch are shown in chart below. The values are calculated for sensing water (potable, non-polluted) in a horizontal pipe.

Settings will vary when used to sense flow of other fluids.

## Flow Rates

Model	Size NPT in. (mm)	Settings	Mode of Operation		Max. Flow Rate gpm (lpm) w/o Paddle Damage
			Flow gpm (lpm)	No Flow gpm (lpm)	
FS7-4	1 1/4 (32)	Factory or Minimum	4.8 (18.2)	3 (11.4)	47 (178)
		Maximum	7.7 (29.1)	5.9 (22.3)	
	1 1/2 (40)	Factory or Minimum	6.3 (23.8)	3.6 (13.6)	63 (239)
		Maximum	10 (37.9)	7 (26.5)	
	2 (50)	Factory or Minimum	9.9 (37.5)	5.9 (22.3)	105 (398)
		Maximum	15.8 (59.8)	11 (41.6)	
	2 1/2 (60)	Factory or Minimum	15.3 (57.9)	9.5 (36)	149 (565)
		Maximum	23.7 (89.7)	17 (64.3)	
	3 (80)	Factory or Minimum	24.4 (92.4)	15.4 (58.3)	230 (872)
		Maximum	35.5(134.4)	29.2(110.5)	
	4 (100)	Factory or Minimum	33.3 (126)	21.1 (79.9)	397 (1505)
		Maximum	61.4(232.4)	37.7(142.7)	
	5 (125)	Factory or Minimum	44.4(168.1)	31 (117.3)	654 (2479)
		Maximum	84 (317.9)	51 (193)	
	6 (150)	Factory or Minimum	56.3(213.1)	48.7(184.3)	900 (3411)
		Maximum	114.8(434.5)	71 (270.6)	
FS7-4L	8 (200)*	Factory or Minimum	104(393.6)	89 (336.9)	1,500 (5,677.5)
		Maximum	210(794.9)	131(495.8)	
	10 (250)*	Factory or Minimum	184(696.4)	157(594.2)	2,500 (9,462.5)
		Maximum	369 (1397)	231(874.3)	
	12 (300)*	Factory or Minimum	289 (1094)	247(934.9)	3,500 (13,247.5)
		Maximum	582 (2203)	363 (1374)	
	14 (355)*	Factory or Minimum	387 (1465)	323 (1223)	4,000 (15,140)
		Maximum	753 (2850)	495 (1874)	
FS7-4L	16 (405)*	Factory or Minimum	513 (1942)	428 (1620)	5,000 (18,925)
		Maximum	998 (3777)	656 (2483)	
	20 (500)**	Factory or Minimum	520 (1968)	260 (984)	8,000 (30,280)
		Maximum	780 (2952)	693 (2623)	
	24 (600)**	Factory or Minimum	752 (2846)	376 (1423)	12,000 (45,420)
		Maximum	1128(4269)	1002(3793)	
	30 (760)**	Factory or Minimum	1177(4455)	589 (2229)	20,200 (76,457)
		Maximum	1766(6684)	1570(59842)	
FS7-4L	36 (910)**	Factory or Minimum	1723(6522)	861 (3259)	28,270 (107,002)
		Maximum	2584(9870)	2297(8694)	

**NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW VELOCITY GREATER THAN 10 FEET (3M) PER SECOND.**

Values are  $\pm 10\%$

\* Equipped with a 6" (152mm) paddle

\*\* Equipped with a 12" (304mm) paddle

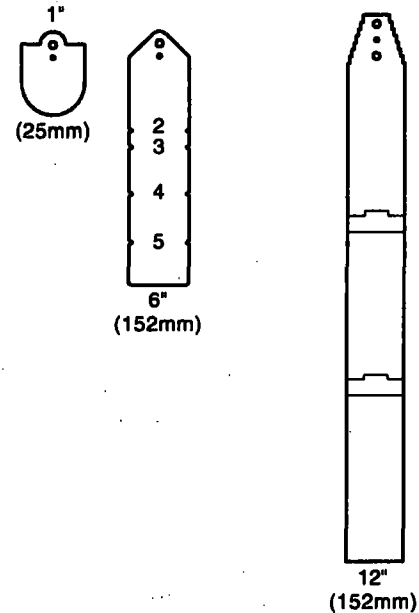
# INSTALLATION –

## STEP 1 - Paddle Sizing

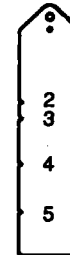
Pipe size determines the paddle length. Use the chart below to choose the correct paddle size for your installation.

Pipe size in. (mm)	Paddle To Use
1-1/4" (32)	1" Paddle
1-1/2" (40)	1" Paddle
2" (50)	6" Paddle Trimmed to 2
2-1/5" (65)	6" Paddle Trimmed to 2
3" (80)	6" Paddle Trimmed to 3
4" (100)	6" Paddle Trimmed to 4
6" (150)	6" Paddle
8" (200) to 16" (405)	6" Paddle
20" (500) to 36" (910)	12" Paddle

**Note:** 12" paddle will only fit on 'L' model units



- a. Trim paddle by cutting at appropriate notch with non-serrated tin snips.



- b. The paddle length can be adjusted if the desired setpoint exceeds the maximum adjustment as shown in flow rate chart. Use the following formula to change the paddle length.

$$\text{Paddle Length} = \frac{K}{\text{Flow Rate (GPM)}}$$

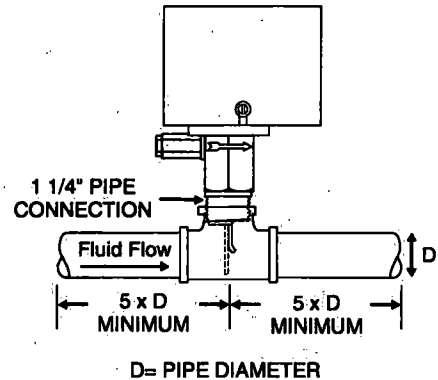
**NOTE:** If trimming the paddle for a no-flow action make sure there is enough flow to activate switch.

### Series FS7-4 "K" Factor

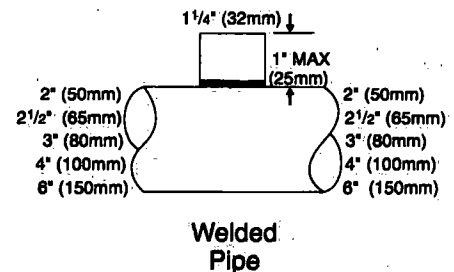
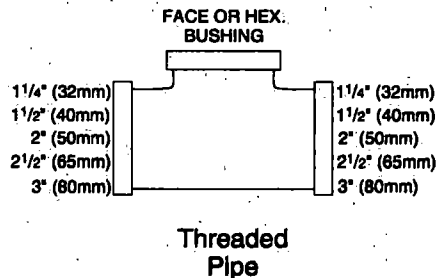
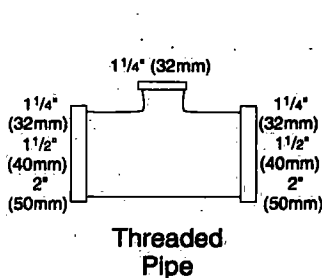
Pipe Size NPT in. (mm)	Flow Maximum Adjustment	No-Flow Maximum Adjustment
2 (50)	34.63	30.43
2 1/2 (65)	54.00	47.46
3 (80)	92.94	81.69
3 1/2 (90)	133.67	117.49
4 (100)	183.35	161.15
5 (125)	322.61	283.55
6 (150)	510.70	448.87
7 (180)	705.05	619.67
8 (200)	1014.47	891.62
9 (230)	1302.47	1144.79
10 (250)	1791.70	1574.74
12 (300)	2776.04	2439.88
14 (350)	3729.02	3255.02
16 (400)	4869.81	4250.81
18 (450)	6164.08	5380.57
20 (500)	7661.11	6687.31
30 (750)	18202.0	15888.0

## STEP 2 - Determine the Location of the Flow Switch

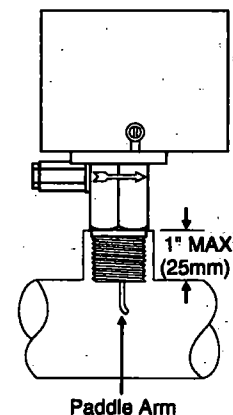
- The flow switch **must be located in a horizontal section of pipe** where there is a straight horizontal run of at least 5 pipe diameters on each side of the flow switch.
- The flow switch **must be installed in the upright position** as shown with arrow mark on side of casting in the same direction as fluid will flow.
- Some system conditions that require more than 5 pipe diameters are high viscosity fluid and high fluid velocity.
- The flow switch must be installed in the pump suction piping when spring-loaded check valves and/or other close coupled accessories are installed in the pump discharge piping.



- a. The flow switch must be installed in the pipe using a threaded tee connection or welding fitting of minimum length such as a half coupling. Use a face or hex bushing to reduce the tee outlet to 1 1/4" pipe thread if a reduced tee outlet thread size fitting is not available.

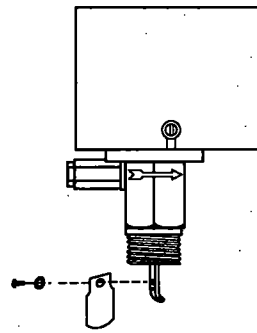


- b. When installing brazed/soldered copper pipe, size the threaded adapter to ensure the paddle arm extends into the main run of the pipe



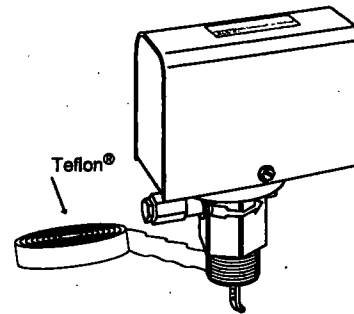
### STEP 3 - Connecting the Flow Switch to Pipe

- a. Insert the 8/32 x 1/4" flathead screw through washer and paddle. Attach screw to opposite side of the paddle arm's curve and tighten to a torque of approximately 12-16 lb•in (1.36-1.81 N•m).

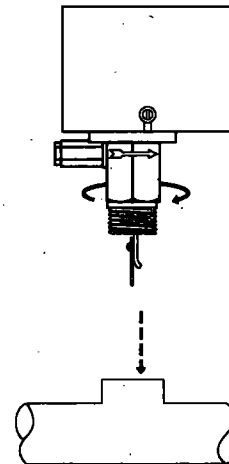


- b. Apply pipe sealing compound or Teflon® tape to the flow switch pipe threads.

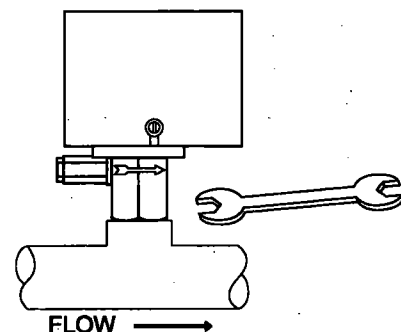
**NOTE:** Do not apply sealant to first threads as this switch is grounded (earthed) via the pipe mounting.



- c. Insert the flow switch into the pipe tee. Turn the flow switch two (2) or three (3) revolutions clockwise until tight. Do not put excessive force on cover when turning.



- d. Place a 1 3/4" open end box wrench on flow switch body to tighten to final position. Final position is with arrow on body aligned in the same direction as liquid flow.



## STEP 4 - Electrical Installation

### WARNING



- To prevent electrical shock, turn off the electrical power before making electrical connections.

- To prevent an electrical fire or equipment damage, electrical wiring insulation must have a rating of 167°F (75°C) if the liquid's temperature exceeds 180°F (82°C).

- To prevent electrocution, when the electrical power is connected to the flow switch, do not touch the terminals.

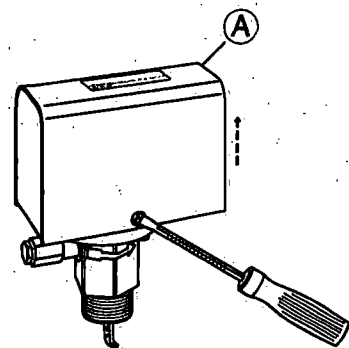
- Make sure flow switch electrical cover is secured before turning on electric power.

Failure to follow this warning could cause property damage, personal injury or death.

#### a. Cover Removal and Installation Procedure

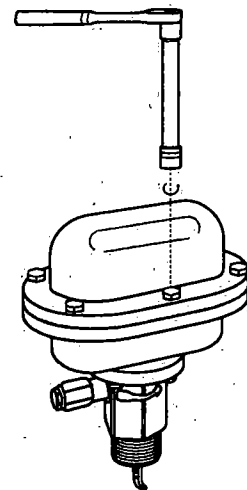
##### For FS7-4 models with NEMA 1 Enclosure

- Using a flathead screwdriver, loosen but do not remove the two cover screws and remove the cover (A).
- Place the cover on the flow switch sliding the slots behind the two loose cover screws. Push the cover down into the flow switch and using a flat blade screwdriver, tighten the cover screws to a torque of 10 lb•in (1.13 N•m).



##### For FS7-4W & FS7-E models

- Using a 5/16" socket wrench, unscrew the six bolts that secure the switch housing and remove cover.
- FS7-4W models have gasket that needs to be removed and replaced.
- Place cover on flow switch and use 5/16" socket wrench to tighten the six bolts to 5 ft•lb (7 N•m) torque.



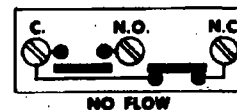
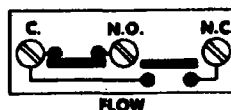


**b. Electrical Conduit Connection**

- Connect electric conduit to flow switch electrical enclosure.
- Follow accepted electrical practices when installing fittings and making connections.
- Refer to and follow local codes and standards when selecting the types of electrical fittings and conduit to connect to flow switch.

**c. Determine which switch action is required for the flow switch.**

- "Flow" means that the switch will close circuit C-N.O. and open circuit C-N.C. when flow rate is increased above setpoint of flow switch.
- "No Flow" means that the switch will open circuit C-N.O. and close circuit C-N.C. when flow rate is decreased below setpoint of flow switch.



- d. Based upon the mode of operation ("Flow" or "No-Flow") required, complete the appropriate steps to connect wires to flow switch. Use a Phillip's head screwdriver to loosen and tighten switch terminal screws when attaching wires.

**For "Flow" Mode of Operation (Fig. 1)**

If the flow switch will be used to actuate a signal, alarm or other device when **flow** occurs, connect the wire from that device to the "N.O." contact. Connect the "Hot" power supply wire to "C" terminal.

**For "No Flow" Mode of Operation (Fig. 2)**

If the flow switch will be used to actuate a signal, alarm or other device when **no flow** occurs, connect the wire from that device to the "N.C." contact. Connect the "Hot" power supply wire to "C" terminal.

**NOTE:** Repeat above to connect wires to second switch on "D" model flow switches.

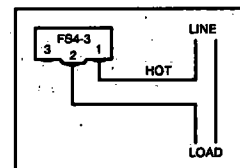
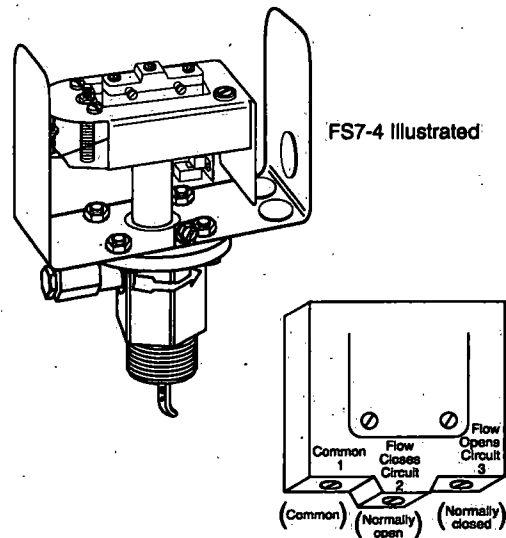


Fig. 1

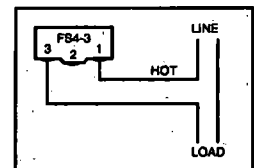
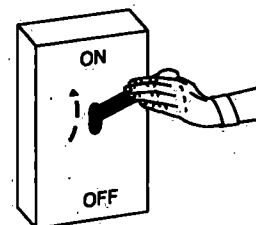


Fig. 2

## STEP 5 - Testing

- Place cover on flow switch and turn on power. Initiate fluid flow through the system. Observe the device being activated by the flow switch to determine if device is operating as required.
- Turn off fluid flow to determine if device is operating as required.
- Repeat initiating and turning off fluid flow several times to test flow switch and device for proper operation.
  - If operating as required, put system into service.
  - If not operating as required, flow switch may need to be adjusted.



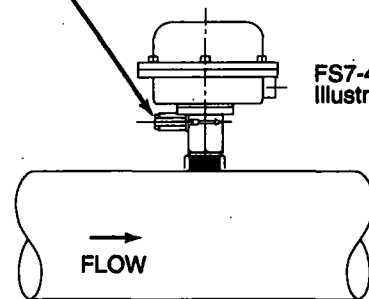
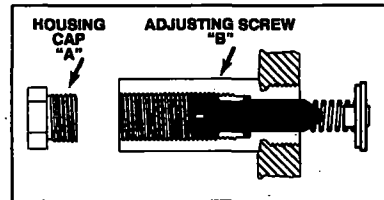
## STEP 6 - Adjustment

Adjustment is necessary only if required flow/no flow set-points are **above** factory set minimum.

- a. Unscrew housing cap (A) using a flathead screwdriver.
- b. Turn the adjusting screw (B) clockwise to increase setpoint.

**IMPORTANT:** Do not attempt to lower flow switch setpoint from original factory minimum setting. Lowering (turning adjusting screw counterclockwise) the setpoint from original factory setting may cause erratic flow switch operation.

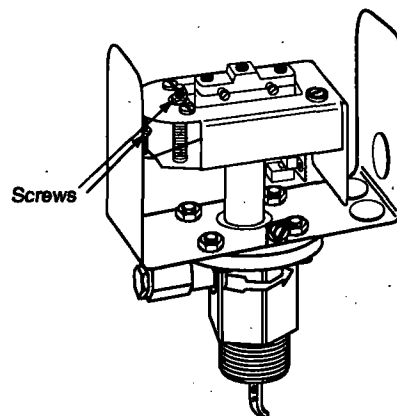
- c. Replace housing cap (A) and tighten to approximately 11 ft•lb (15 N•m) torque.
- d. Test the operation of the flow switch after each adjustment.



FS7-4E / FS7-4W  
Illustrated

### CAUTION

- These screws are for factory adjustment only.
- Adjusting these screws in the field can cause the flow switch to become inoperative.



---

## MAINTENANCE

### SCHEDULE:

- **Inspect paddles annually.** Turbulent or high flow velocity conditions may require more frequent inspection and/or replacement.
- **Replace paddles if damaged or showing signs of wear.**
- **Replace flow switch every 5 years or 100,000 cycles, whichever occurs first.**

## TROUBLESHOOTING

Problem:

### 1. Flow Switch Does Not Operate

#### Solution:

- a. Make sure power has been turned on to device and flow switch.
- b. Verify that flow rate is high enough for flow switch to activate. Measure flow rate and match with velocities shown in flow rate chart.
- c. Check to see if paddle moves freely. Some system piping disassembly may be required.

### 2. Flow Switch Operates Erratically

#### Solution:

- a. Flow switch may be located in an area of high turbulence causing paddles to flutter.
- b. Adjustment screw may have been turned below original factory setpoint. Verify that flow rate is high enough for flow switch to activate. Measure flow rate and match with velocities shown in flow rate chart.
- c. Check to see if paddle moves freely. Some system piping disassembly may be required.

### 3. Flow Switch Does Not Deactivate

#### Solution:

- a. Check to see if paddle moves freely. Some system piping disassembly may be required.
- b. Measure flow rate and match with velocities shown in flow rate chart. Flow switch must prove flow before it can indicate no flow.

**McDonnell & Miller**  
8200 N. Austin Ave.  
Morton Grove, IL 60053  
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Model 900

# KUNKLE

## Features

- **Available** with soft seats.
- **Threaded cap** standard (back pressure tight). Maximum back pressure 50 psig [3.4 barg].
- **Hex on valve nozzle** provides for easy installation.
- **Single control ring** offers easy adjustability of blowdown.
- **Pivoting disc design** offers exceptional seat alignment.
- **Guide to nozzle ratio** reduces friction.
- **Valve bodies** are heavy duty casting.
- **Full nozzle design** for optimum flow performance.
- **Threaded side outlet** for piped off discharge to eliminate fugitive emissions.

## Model Descriptions

**Model 910:** CS body and bonnet with SS trim.

**Model 911:** All SS construction.

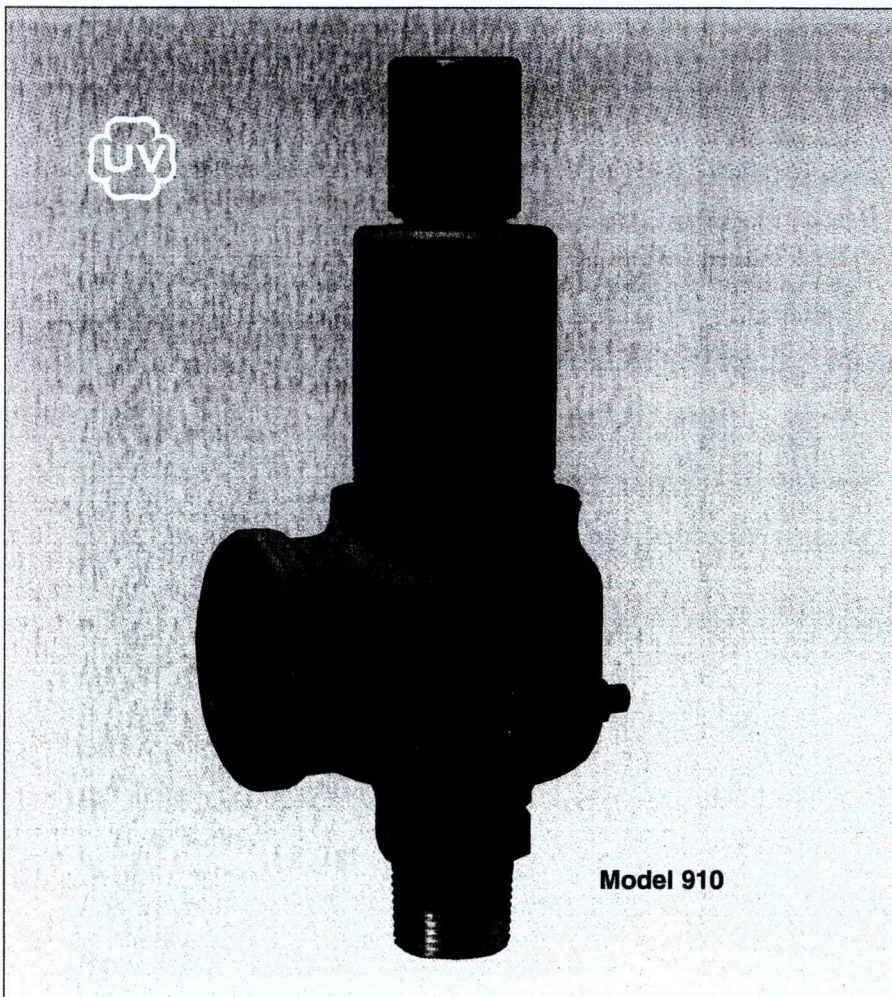
**Model 916:** Same as Model 910 except resilient seat/seals. Superior 'leak-free' performance.

**Model 917:** Same as Model 911 except resilient seat/seals. Superior 'leak-free' performance.

**Model 920:** Steel body and bonnet with screwed cap and stainless steel spring for organic fluid vaporizers (ASME Section I - 'V' Special Use or application). 800 psig [55.2 barg] maximum set pressure.

**Model 921:** Steel body and bonnet with plain lift lever and stainless steel spring for forced flow steam generators (ASME Section I - 'V' Special Use or application). 800 psig [55.2 barg] maximum set pressure.

**Models 910, 911, 916, 917, 920, 921 and 927 – ASME Section VIII, Air/Gas/Steam/Liquid, 'UV' National Board Certified. Also available for Vacuum Service. PED Certified for Non-Hazardous Gas.**



**Model 927:** Steel body and bonnet with packed lift lever and SS spring for high temperature/pressure hot water boilers (ASME Section I - 'V' Special Use or application). 800 psig [55.2 barg] maximum set pressure.

## Applications

- Air/gas compressors, intercoolers, aftercoolers.
- Liquid filled pressure vessels/systems, ASME Section VIII (UV).
- Vacuum systems including pumps, tanks and equipment.
- Pressure vessels - containing gas, air, liquid or steam, including tanks and receivers.
- Oil/gas separators.
- Overpressure relief and protection of pumps, tanks, lines and hydraulic systems.
- Bypass relief or pressure regulation.
- All SS Model 911 may be suitable for sanitary/edible applications.
- Process and industrial corrosive applications.

**tyco** / Flow Control

Total Flow Control Solutions™



**tyco**

Flow Control

**KUNKLE****Pre-Installation****Verification of Model and Service Media/Capacity/Temperature/Pressure Limits**

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

**Pressure Relief Valves**  
Installation and Operating Instructions**Handling**

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

**Installation**

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

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

**Operation**

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

**Maintenance**

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

**WARNING!**

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

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

[www.kunklevalve.com](http://www.kunklevalve.com)

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Rev E 05/24/2007

KUKMC-6302-EN-0705



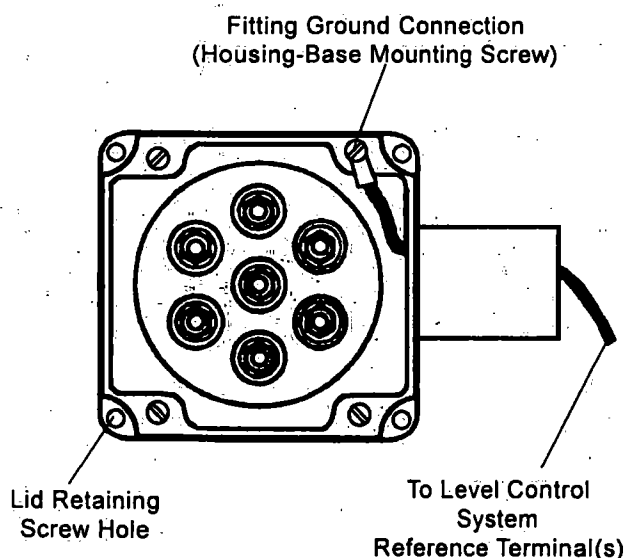
## Recommended Grounding Methods for Warrick® Electrode Fittings

### GENERAL:

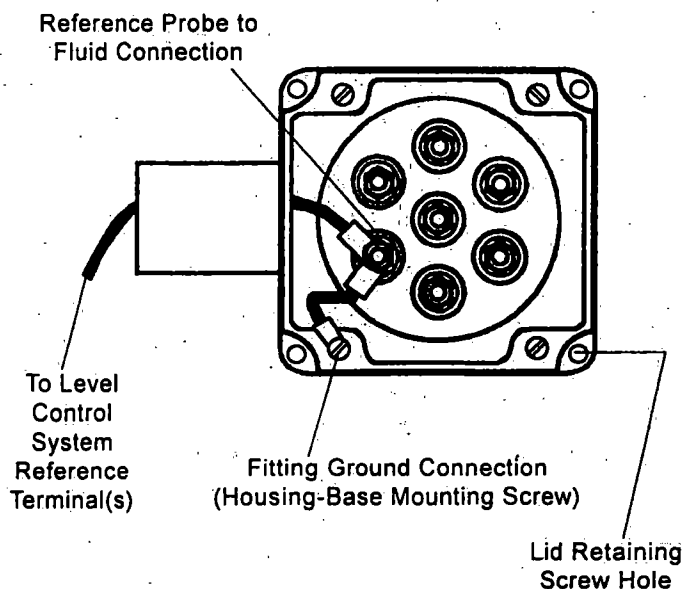
1) Always follow good N.E.C. (C.E.C.) grounding and bonding wiring procedures. 2) Use 'approved' insulated ring terminals for all wiring connections. 3) Use # 14 or # 16 AWG, type MTW or THHN copper wire only. 4) Wiring must be rated higher than nominal voltage and temperature values anticipated in installation.

**INSTALLATION:** 1) During installation orient the fitting so the tapped hub on the terminal housing faces the most favorable direction for receiving the conduit from the control box. 2) After conduit has been installed and conductors pulled through same, fasten the incoming ground conductor(s) as shown below; the ground connection should be facilitated by securing that end of the system ground wire to one of the four screws provided which hold the terminal housing to the body of the electrode fitting or to the ground screw when provided.

### For Metallic Vessel



### For Non-Metallic Vessel





## 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.

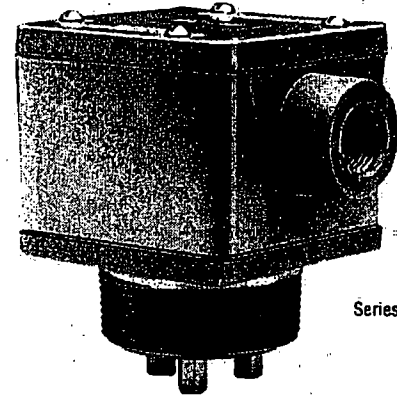
Series 3N fittings accommodate 1-3 probes operating at atmospheric pressure. The assembly mounts on a flat surface atop open tanks or closed vessels. 3N Fittings require the use of 3R rigid or 3W wire suspended electrodes.

### Specifications

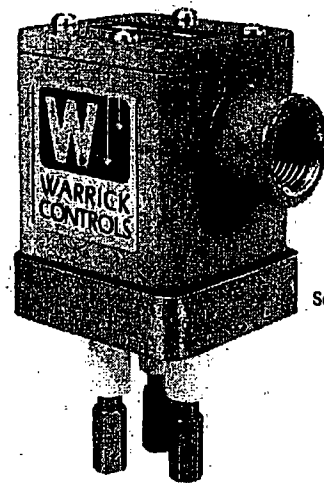
<b>Type of Connection</b>	
Series 3E	Threaded
Series 3N	Flat Surface Mounting
<b>Probes</b>	
Series 3E	1 thru 7
Series 3N	1 thru 3
<b>Terminal Housing</b>	
Die cast aluminum, epoxy coated	
<b>Body Material</b>	
Series 3E	Cast iron, red brass, 316 stainless steel
Series 3N	PVC, red brass, 316 stainless steel
<b>Pressure/Temperature</b>	
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.)
<b>Approvals</b>	
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



Series 3E



Series 3N

### Applications

- Open Tanks
- Closed Vessels
- Water
- Diluted Corrosive Liquids

### How to Order

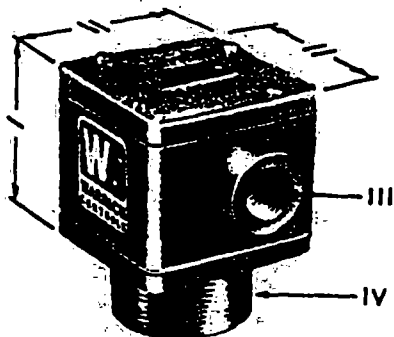
Use the **Bold** characters from the chart below to construct a product code.

Series	3E	3N	3E	X	X
Number of Probes <sup>1</sup>	1	2	3	4	5
Body Material	A	B	C		
	Cast Iron (3E)	Red Brass	316 Stainless Steel		
	PVC (3N)				

### Notes:

1. 3N features up to three probes only.
2. Special modifications available. Consult factory.

## SERIES 3E ELECTRODE FITTINGS



ORDER BY COMPONENT NUMBER → 3 E X X

### 3RD PLACE SYMBOL & NUMBER OF ELECTRODES ACCOMMODATED

↓	I	II	III	IV
	Inches		NPT	NPT
1	2 $\frac{3}{8}$	2 $\frac{1}{4}$	1/2-14	1-11 $\frac{1}{2}$
2	2 $\frac{3}{4}$	3 $\frac{1}{4}$	1/2-14	2-11 $\frac{1}{2}$
3	2 $\frac{3}{4}$	3 $\frac{1}{4}$	1/2-14	2-11 $\frac{1}{2}$
4	2 $\frac{3}{4}$	3 $\frac{1}{4}$	1/2-14	2 $\frac{1}{2}$ -8
5	2 $\frac{7}{8}$	4	3/4-14	3-8
6	2 $\frac{7}{8}$	4	3/4-14	3-8
7	2 $\frac{7}{8}$	4	3/4-14	3-8

### 4TH PLACE SYMBOL

↓	Body Material
A	Cast Iron
B	Red Brass
C	316 SS

## GENERAL

Series 3E electrode fittings are general purpose, cast metal, pressure-tight assemblies sized to accommodate from one to seven electrodes and equipped with external pipe threads for attachment to the vessel.

## SPECIFICATIONS

**Attachment to Vessel:** Body provided with external pipe thread to mate with NPT tapping on vessel.

**Electrodes Accommodated:** Choice of fittings for one to seven electrodes. Directly accept 1/4 inch diameter, rod type, Series 3R electrodes. With 3Z1B adapters, accept wire suspended, Series 3W electrodes.

**Identification:** A component number establishes the number of electrodes accommodated & body material.

**Materials:** Choice of cast iron, red brass or 316 stainless steel body. Insulation sleeves are teflon.

**Pressure/Temperature Limits:** (a) With cast iron body: 0 psig @ 500°F., 125 psig saturated steam (353°F.), 175 psig @ 150°F. (b) With red brass and 316 stainless steel bodies: 0 psig @ 500°F., 250 psig saturated steam (406°F.), 400 psig @ 150°F.

**Terminal Housing:** Cast aluminum with epoxy coat. Nema-1 to 5 integrity. NPT tapped boss for conduit.

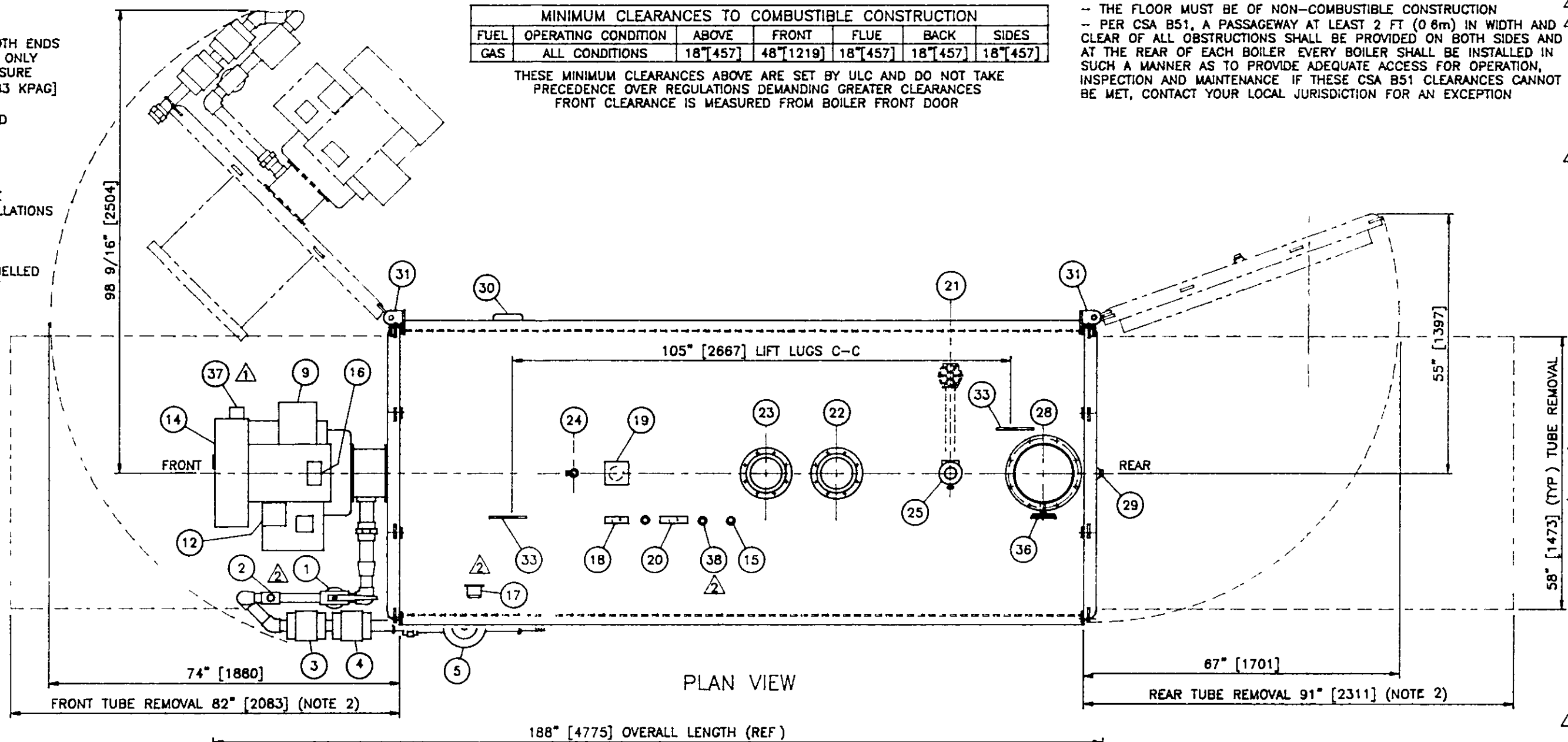
**U/L & CSA:** U/L Guide MBPR File MP1430 and Guide MCUR2 File MP2489. CSA Guide 184-N-13.90 File 11644.

- NOTES
- 1 DIMENSIONS IN BRACKETS ARE SI UNITS
  - 2 MAINTENANCE ACCESS REQUIRED FROM BOTH ENDS
  - 3 TUBE REMOVAL REQUIRED FROM ONE END ONLY
  - 4 MAXIMUM RECOMMENDED OPERATING PRESSURE (LIMITED BY SAFETY VALVE) 128 PSIG [883 KPA]
  - 5 EXTERIOR SURFACES ARE PAINTED WITH TWO COATS OF MANUFACTURER'S STANDARD HEAT RESISTANT OXFORD BLUE ENAMEL
  - 6 NOZZLE CONNECTION TIE-IN TOLERANCES  $\pm 3/8"$  NATURAL GAS & DRAIN TIE-IN TOLERANCE  $\pm 3/4"$
  - 7 REAR CHAMBER WATER ARCH TYPE BAFFLE
  - 8 BOILER ELECTRICAL IS FOR INDOOR INSTALLATIONS ONLY
  - 9 BOILER CRN U14632 (SASK PENDING)
  - 10 BOILER IS ASME CODE SYMBOL STAMPED, NATIONAL BOARD REGISTERED & ULC LABELLED
  - 11 NATURAL GAS VENTS TO ATMOSPHERE BY CUSTOMER

MINIMUM CLEARANCES TO COMBUSTIBLE CONSTRUCTION					
FUEL	OPERATING CONDITION	ABOVE	FRONT	FLUE	BACK
GAS	ALL CONDITIONS	18" [457]	48" [1219]	18" [457]	18" [457]

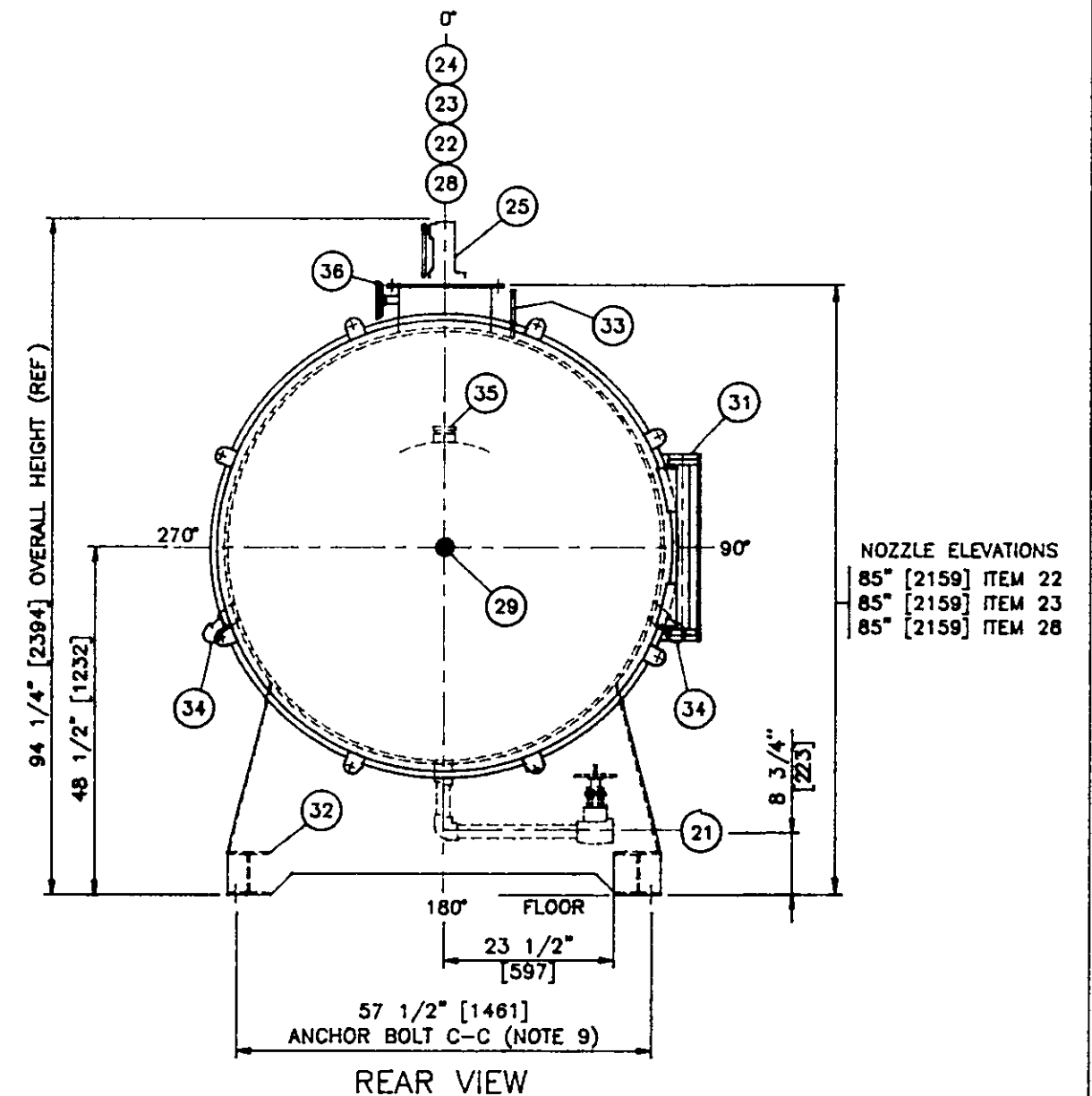
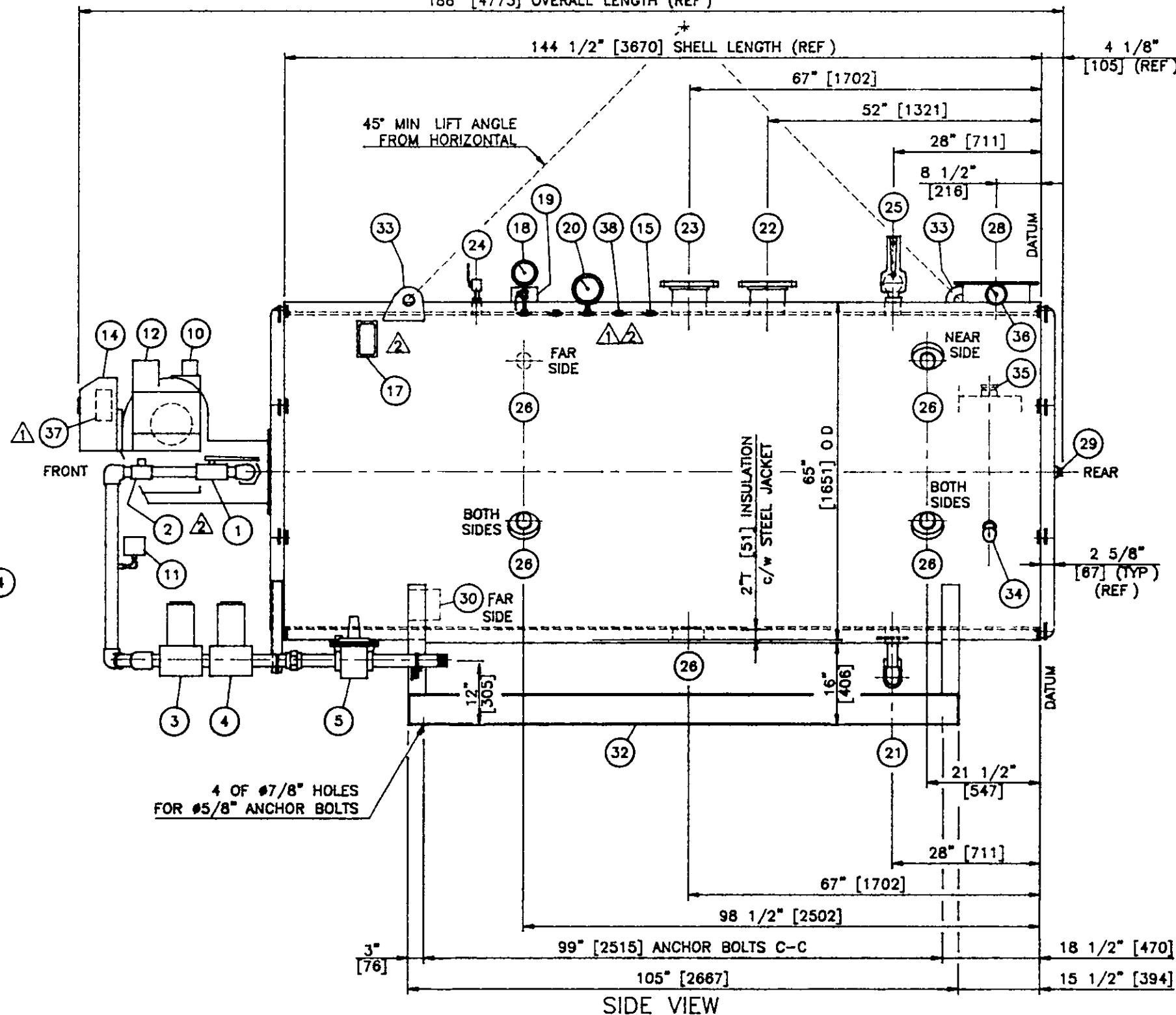
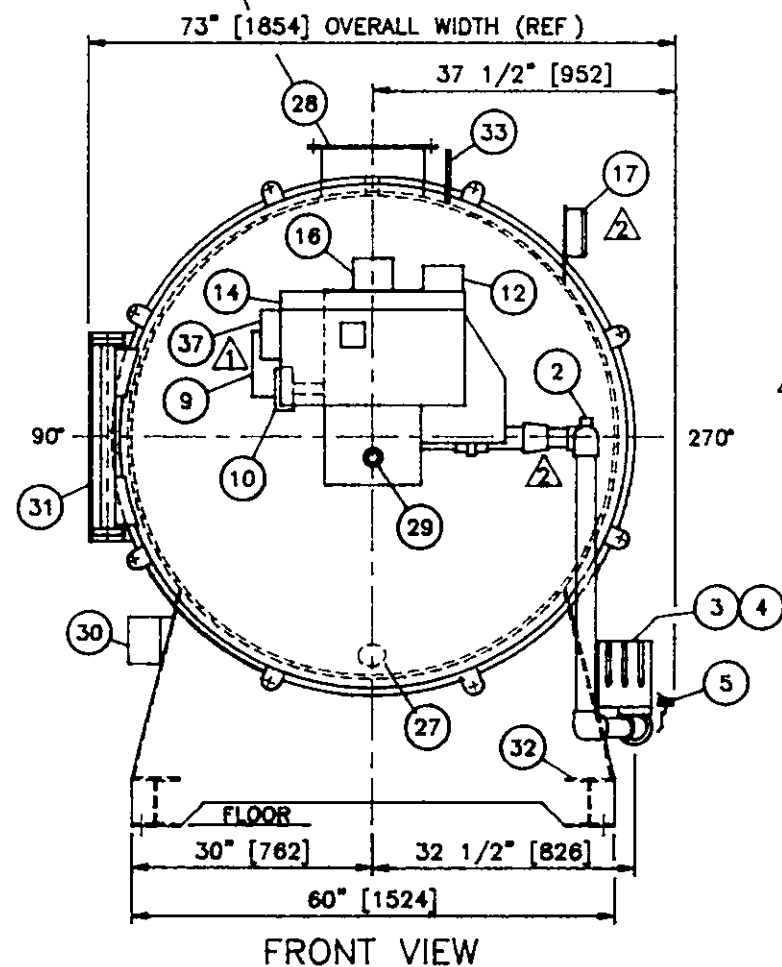
THESE MINIMUM CLEARANCES ABOVE ARE SET BY ULC AND DO NOT TAKE PRECEDENCE OVER REGULATIONS DEMANDING GREATER CLEARANCES  
FRONT CLEARANCE IS MEASURED FROM BOILER FRONT DOOR

- THE FLOOR MUST BE OF NON-COMBUSTIBLE CONSTRUCTION  
- PER CSA B51, A PASSAGEWAY AT LEAST 2 FT (0.6m) IN WIDTH AND CLEAR OF ALL OBSTRUCTIONS SHALL BE PROVIDED ON BOTH SIDES AND AT THE REAR OF EACH BOILER EVERY BOILER SHALL BE INSTALLED IN SUCH A MANNER AS TO PROVIDE ADEQUATE ACCESS FOR OPERATION, INSPECTION AND MAINTENANCE IF THESE CSA B51 CLEARANCES CANNOT BE MET, CONTACT YOUR LOCAL JURISDICTION FOR AN EXCEPTION



- 1 MANUAL SHUT-OFF/TEST VALVE (MAIN GAS) 1 1/2"NPT
- 2 MODULATING VALVE (MAIN GAS) 1 1/2"NPT
- 3 AUTO SHUT-OFF VALVE (MAIN) w/ POC 2"NPT
- 4 AUTO SHUT-OFF VALVE (AUXILIARY) 2"NPT
- 5 PRESSURE REGULATOR (MAIN GAS) 2"NPT
- 6 AUTO SHUT-OFF VALVE (PILOT) (NOT SHOWN) 3/8"NPT
- 7 MANUAL SHUT-OFF (PILOT) (NOT SHOWN) 3/8"NPT
- 8 PRESSURE REGULATOR (PILOT) (NOT SHOWN) 3/8"NPT
- 9 BLOWER MOTOR 7.5 HP, 3600 RPM, TEFC 480V/3/60
- 10 COMBUSTION AIR INTERLOCK
- 11 HIGH & LOW GAS PRESSURE INTERLOCK
- 12 COMBUSTION AIR DAMPER MODULATING MOTOR
- 13 FLAME SCANNER ASSEMBLY (NOT SHOWN) INSIDE BURNER
- 14 ELECTRICAL CONTROL PANEL
- 15 MODULATING & TEMPERATURE LIMIT TRANSMITTER
- 16 IGNITION TRANSFORMER
- 17 HIGH LIMIT CONTROL (MAIN RESET) 130-250°F [54-121°C]
- 18 PRESSURE GAUGE 4 1/2" [114] FACE, 300 PSI [2000 KPA]
- 19 LOW LEVEL CUT-OFF (PROBE TYPE) MANUAL RESET AT ITEM 14
- 20 TEMPERATURE GAUGE 5" [127] FACE, 50-300°F [10-150°C]
- 21 DRAIN 1 1/2"NPT
- 22 INLET w/ INTERNAL PREHEAT DISTRIBUTION 6" RF 150# FLANGE
- 23 OUTLET 6" RF 150# FLANGE
- 24 VENT VALVE 1/2"NPT
- 25 SAFETY VALVE KUNKLE 927 1 1/2"NPT INLET x 2 1/2"NPT OUTLET
- 26 HANDHOLE (SHELL) (SEVEN) 2 3/4" x 3 1/2" OB [70 x 89]
- 27 HANDHOLE (FRONT TUBESHEET) (ONE) 2 3/4" x 3 1/2" OB [70 x 89]
- 28 FLUE GAS OUTLET c/w COMPANION FLANGE 12"NPS [DN 300]
- 29 FLAME SIGHT GLASS (TWO)
- 30 ENTRANCE BOX ELECTRICAL TIE-IN HERE ONLY
- 31 DOOR HINGE (FRONT & REAR DOOR)
- 32 SKIDS W6" x 15# [W150 x 22]
- 33 LIFT LUGS (TWO) 1/2" T [13] w/ 2 1/8" [54] HOLE
- 34 WATER ARCH FLUSH DRAIN (TWO) w/ CAP 1 1/2"NPT
- 35 WATER ARCH FLUSH INLET w/ PLUG 2"NPT
- 36 STACK THERMOMETER 3" [76] FACE, 150-750°F [70-400°C]
- 37 MODULATING/OPERATING CONTROL, HNYWL T775M2048 SERIES 2000, -40 to 248°F [-40 to 120°C]
- 38 HIGH TEMPERATURE LIMIT TRANSMITTER

ITEM NO 25 - FLUE GAS OUTLET  
18" [406] OD x 12 1/4" [311] ID x  
3/8" [10] FLANGE c/w 8 OF 1/2" [13]  
DIA HOLES ON A 14 3/4" [375] BOLT  
CIRCLE FOR 3/8" [10] DIA BOLTS



**BOILER CHARACTERISTICS**

**FUEL**  
NATURAL GAS INPUT (177.7 CU M/HR) 6,276 CU FT/HR  
INLET PRESSURE (35 KPA) 5 PSIG  
MAX ALLOW HEAT INPUT (1,839 KW) 6,276,000 BTU/HR  
FIRING SEQUENCE FULL MODULATION

**MANUFACTURER'S RATINGS**  
BOILER SIZE (1,472 KW) 150 HP  
HEATING SURFACE, FIRESIDE (65.7 SQ M) 707 SQ FT  
WATERSIDE (70.7 SQ M) 761 SQ FT  
HEAT OUTPUT (1,472 KW) 5,025,000 BTU/HR  
SAFETY VALVE SETTING (1,103 KPA) 160 PSIG (NOTE 3)  
DESIGN PRESSURE (1,103 KPA) 160 PSIG  
DESIGN TEMPERATURE (121 °C) 250 °F  
ELECTRICAL MAIN SUPPLY 480V/3/60  
CONTROL CIRCUIT 120V/1/60  
APPROXIMATE WEIGHT SHIPPING (6,125 KG) 13,500 LBS  
OPERATING (9,390 KG) 20,700 LBS  
LIQUID VOLUME (3,288 L) 863 US GAL

REVISIONS REV 1, MR, 28 JAN 2011, REV'D SIEMENS BURNER  
CONTROL TO FIREYE  
REV 2, MR, 28 FEB 2011, REV'D TO AS-BUILT

BOILER MODEL OTS-G150W (3 PASS) QTY ONE  
CONSTRUCTION CODE ASME SECTION IV, HEATING BOILERS  
OWNER NORTHERN BLIZZARD RESOURCES INC  
LOCATION MORGAN 10-34-51-04 W4M BATTERY, AB

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2011 QUEBEC AVE, SASKATOON, SASKATCHEWAN, S7K 1W5

150 HP, 3-PASS, 60" ID GAS FIRED HEATING BOILER  
STATIONARY, WATER/GLYCOL SERVICE

DWG BY MIKE ROWE CHKD BY *NS* DATE 09 OCT 10

SCALE 1/2" = 1' - 0" JOB 10-32 DWG 150C035C