

FIREYE FLAME MONITOR

MICROPROCESSOR BASED BURNER
MANAGEMENT CONTROL WITH
MESSAGE CENTER AND
SELF-DIAGNOSTICS



Photocell



UV Self-Check Scanner



UV Scanners



45UV3 Scanner



UV Scanners



Flame Rod



IR Scanner

DESCRIPTION

The FIREYE® FLAME-MONITOR™ System is a microprocessor based, burner management control system with self-diagnostics, non-volatile memory and vocabulary of 42 different messages which scroll out on the message center to provide the operator with status and failure mode information.

The FLAME-MONITOR Series is 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. On a safety shutdown, the message center will advise the operator that the control is in "lockout" and scroll a message indicating the cause as well as the position in the sequence it occurred.

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 timing, recycling interlocks, high fire proving interlock and trial for ignition timing of the pilot and main flame are determined by the programmer module. The FLAME-MONITOR can be used with ultraviolet, autocheck infrared, photocell, flame rod or self-check ultraviolet flame scanners by choosing the proper amplifier module.

The eighteen terminal wiring base allows for many functional circuits including motors, valves and ignition transformers as well as multiple interlocks such as hi-purge, low purge, fuel valve and running circuits. The FLAME-MONITOR uses the same wiring base as the Fireye D Series and C Series Controls and is designed to be 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 which eliminates the need for a DC voltmeter.
- Read-out of main fuel operational hours and complete cycles.
- A run/check switch which allows the operator to stop the program sequence in any of four different positions.
- Remote Display Capability.



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

Power Consumption: 25 VA

Maximum Simultaneous Connected Load: 2000 VA

Operating Temperature Limits: - 40°F Minimum, +125°F Maximum
- 40°C Minimum, +52°C Maximum

Humidity: 85% R.H. Maximum (Non-condensing)

Terminal	Typical Load	Maximum Rating @ 120V-60Hz (A)	Alternate Rating @ 120V-60Hz(B)
5.6 Individually or Combined	Pilot Valve(s) and Ignition Transformer(s)	50 VA Pilot Duty (Solenoid Valves) plus 500 VA (Transformer)	125 VA Pilot Duty (Solenoid Valves) plus 250 VA (Transformer)
7	Main Fuel Valve(s)	250 VA 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

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, solenoids, relays, etc. which chatter will lead to premature failure of switches in the Fireye control. Similarly, the contacts cannot be expected to handle short circuit currents without damage. 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.

In applications which appear to have excessive electrical noise, it may be helpful to add an electrical noise suppressor to the power supply of the control circuit.

We recommend the following: Fireye Part Number 60-2333, CORCOM Part Number 10VRI, EM1 Filter or Cornell Dublier Part Number APFV-31.

APPROVALS

Underwriters Laboratories Inc.: Listed Guide MCCZ File MP1537

Canadian Standards Association: File #LR7989

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

Factory Mutual Approved



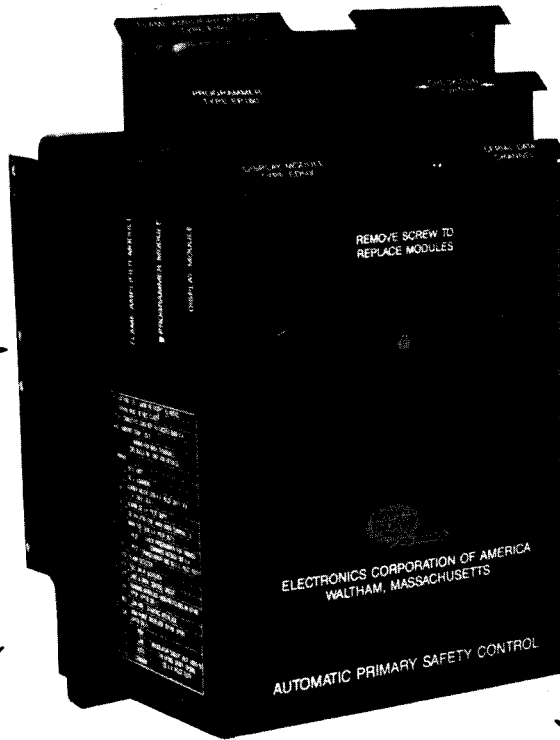
WARNING: This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to 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.

Mounting Screw*



EB700 Chassis only

Wiring Label



← Amplifier Module

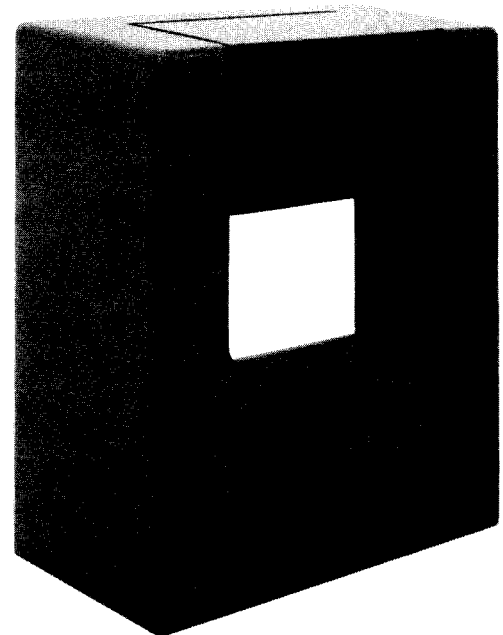
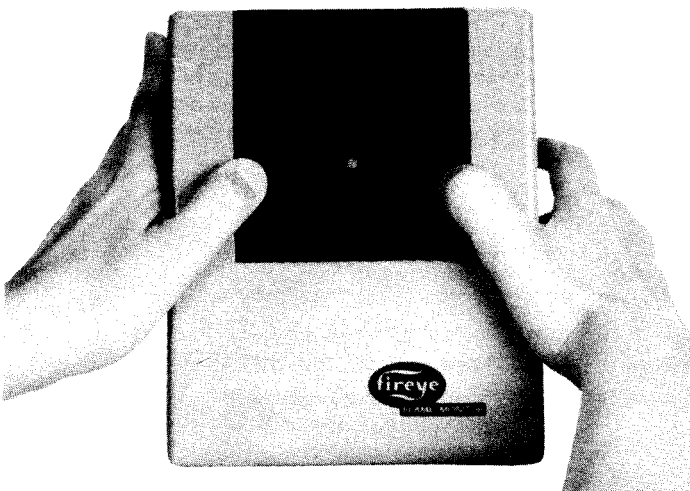
← EP Series Programmer Module

← ED500 Display Module

Reset Button

Serial Number Label on Bottom

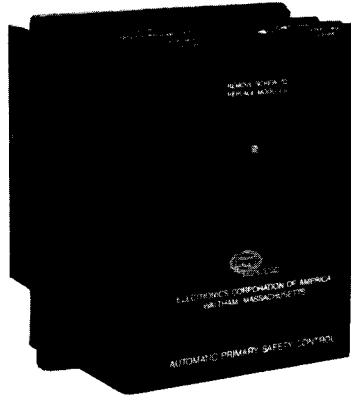
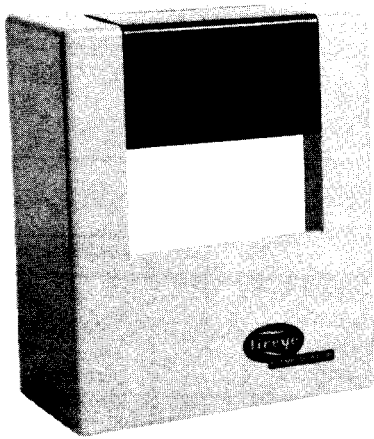
*The mounting screw must be removed to replace the Modules. This screw must be used to prevent electrical shock or damage to the control.



Dust Cover

To remove cover, place your fingers and palms on each side and pull forward as shown in the diagrams. Press down with thumbs while pulling out with your palms and fingers. The cover will snap off and can be snapped back into place easily.

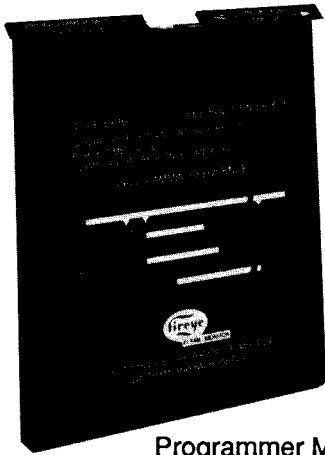
FLAME MONITOR ORDERING INFORMATION



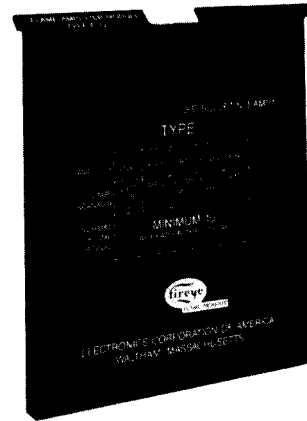
Mounting Screw
48-1805



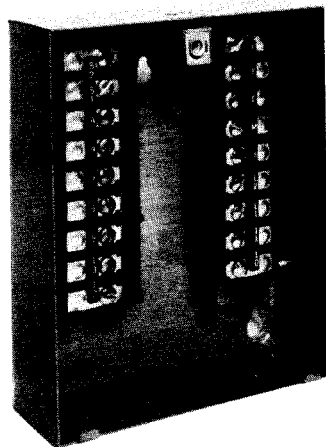
E100 consists of:
EB700 – chassis
EC600 – dust cover
ED500 – display module
Mounting Screw



Programmer Module
EP Series
(See Page 7 for details)



Flame Amplifier Module
(See Page 6 for details)



Wiring Base
60-1386-2 Surface Mtg. (shown)
60-1466-2 Cabinet Mtg.

NOTE: Always ground the green grounding screw on the wiring base

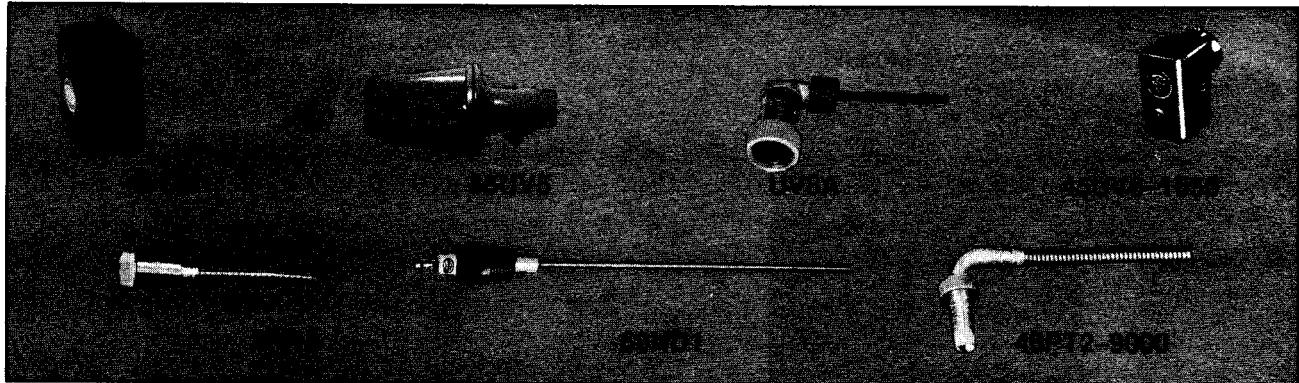
FLAME AMPLIFIER SELECTION

Fireye P/N	Description	Use with Scanner
EUV1	Standard UV Amplifier	UV1A, UV8A, 45UV3
E1R1	Autocheck Infrared Amplifier	48PT2
ERT1	Rectification Amplifier	45CM1, 69ND1
EUVS4	Self-Check UV Amplifier	45UV5-1007/1008/1009
E1R3	Autocheck Infrared Amplifier (For use on solid fuel burners only)	48PT2

SCANNER SELECTION

Fireye P/N	Description	Use with Amplifier
48PT2-1003 48PT2-9003 48PT2-1007 48PT2-9007	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	E1R1
UV1A3 UV1A6 UV8A UV2 45UV3-1050	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 3/4" cast alum. housing, 8' cable	EUV1
45CM1-1000 45CM1-1000Y 69ND1-1000K4 69ND1-1000K6 69ND1-1000K8	Photocell Scanner with filter Photocell Scanner without filter 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
45UV5-1007 45UV5-1008 45UV5-1009	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	EUVS4

FLAME SCANNERS



CAUTION: The UV1, UV2, UV8, 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. (see Operation). If component checking is required during burner operation for constantly fired burners, utilize the self-checking ultra-violet flame scanners (45UV5) and associated amplifier module (EUVS4).



FLAME-MONITOR PROGRAMMER SELECTION

All programmers for the FLAME-MONITOR Series are designated with the prefix "EP." The functional operation, flame failure response time, purge timings, Firing Rate motor circuit, trial for ignition timings, recycling function and readout messages are determined by the programmer selected. A chart of the most common programmers is found below. Descriptive information associated with the programmer selected is found on the bulletin for that programmer.

Take note of the programming sequence chart for each programming module for the proper explanation of prepurge timings.

Fuel Valve Proof of Closure: All programmers provide for input from a fuel valve proof of closure switch (fuel valve end switch).

Flame Failure Response Time (FFRT): All programmers have four seconds FFRT.

Post Purge: EP382 has 10 seconds post purge. All other programmers have 15 seconds post purge.

A-B P/N	Prepurge Timing (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	Trial for Ignition/Pilot (Seconds)	Trial for Ignition/Main (Seconds)	Running Interlock (3/P CKT)	Firing Rate Motor Circuit
EP160 EP162	30 *Supervised	Yes	Yes	No	Yes	No	10 10	10 15	Non Recycle	Yes
EP161	30 *Supervised	Yes	Yes	No	Yes	No	10 10	10 30	Non Recycle	Yes
EP170	30 *Supervised	Yes	Yes	No	Yes	Yes	5 10	0 10	Non Recycle	Yes
EP260	30*	No	Yes	No	Yes	No	10 10	10 15	Recycle	Yes
EP261	30*	No	Yes	No	Yes	No	10 10	10 30	Recycle	Yes
EP270	30*	No	Yes	No	Yes	Yes	5 10	0 10	Recycle	Yes
EP380	30	No	Yes	Yes	Yes	Yes	10 ** 10	10 Intermittent	Recycle	None
EP381	15	No	Yes	Yes	Yes	Yes	5 ** 10	10 Intermittent	Recycle	None
EP382	0	No	Yes	Yes	Yes	Yes	5 ** 10	10 Intermittent	Recycle	None
EP390	90	No	Yes	Yes	Yes	Yes	5 ** 10	10 Intermittent	Recycle	None

*EP100 and EP200 programmers add a 30 second waiting period to the prepurge while the modulator motor is driving to low purge.

**EP380, EP381, EP382, EP390 programmers can use Terminal "X" for ignition. This requires jumping Terminals 5 & 10 on the wiring base. PTFI Timing is 5 sec. on Terminal "X."

Note: EP162 messages are in Spanish

PART NUMBER	BULLETIN NUMBER
EP160, EP161, EP170	EP-1601
EP260, EP261, EP270	EP-2601
EP380, EP381, EP382, EP390	EP-3801
EP162	EP-1621

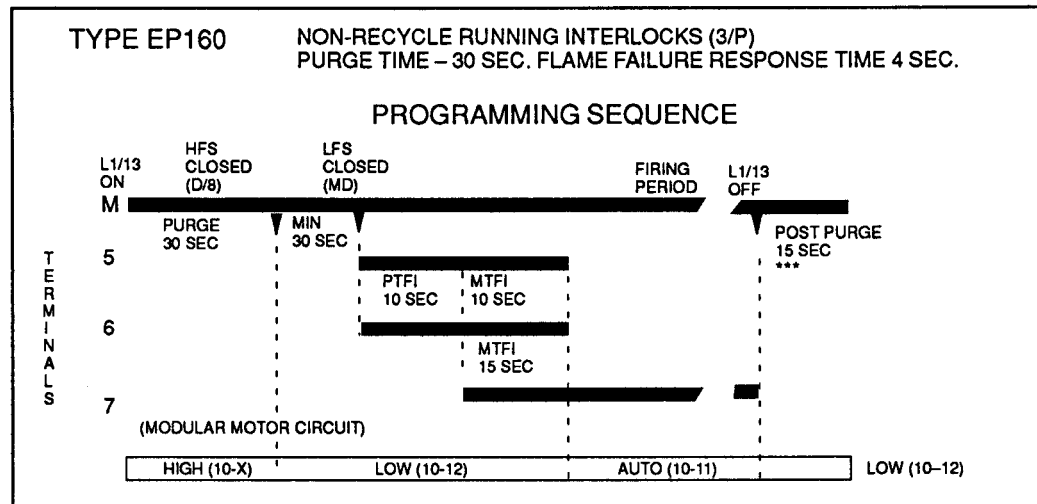
ACCESSORIES

Fireye P/N	Description	For More Information
E300	Expansion Module	See Bulletin E3001
ED150	Remote reset cables	See Bulletin E8001
ED550	Remote display cables	See Bulletin E8001
ED400	Remote display mounting kit	See Bulletin E8001
ED600	Multiple Cable Adapter	See Bulletin E8001
E500	Communication Interface	See Bulletin E5001
E700	Software Program to Monitor E500 Operation IBM Compatible	See Bulletin E7001
E900	Service Tool	See Bulletin E9001
60-2333	Noise Line Filter	See Bulletin E1021

OPERATION

The Fireye FLAME-MONITOR provides the operator with a constant status read-out as well as diagnostic information. It has 42 messages which are simple to understand and interpret.

For purposes of illustration, we will be looking at the EP160 Programmer functions and messages in this bulletin. Because the messages change depending upon which programmer is being used, it is necessary to check the bulletin covering the specific programmer for exact details.



Note: PTFI - Pilot trial for ignition MTFI - Main burner trial for ignition



CAUTION: On initial power-up and on restarts following a power failure, the display on the control will not become active for 15 seconds when using a Programmer having a date code followed by a number greater than 11. (i.e. date code 8740-12)

Refer to the suggestions shown in this bulletin before proceeding to power the Fireye FLAME-MONITOR system. Items such as scanner installation, short circuit tests and safety information should be reviewed.

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. 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 (eg: all limits, interlocks, etc. are proven).
4. The firing rate motor (Modulator Motor) is driven toward the high purge open damper position (10-X ckt. made).

5. When the firing rate motor reaches its open damper position, the Hi Purge switch closes (D-8) and initiates the prepurge interval of 30 seconds. 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).
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). 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. If flame is detected during this 10 second period, the main flame trial for ignition sequence will start.

Note: When the flame is detected, the message center will provide a constant readout of the signal strength.

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. Terminal 5 is de-energized 10 seconds later and Terminal 6 is de-energized after another 5 seconds.
1. The firing rate motor is now sent to the auto position (10-11 ckt mode) and is under the command of the proportional controller. The message center displays a read-out of the flame signal.

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 mode).
2. Following a 15 second post purge, the burner/blower motor is de-energized.
3. The burner is now off and the message center displays the burner operating history for two minutes and then the message center displays the message "OFF."

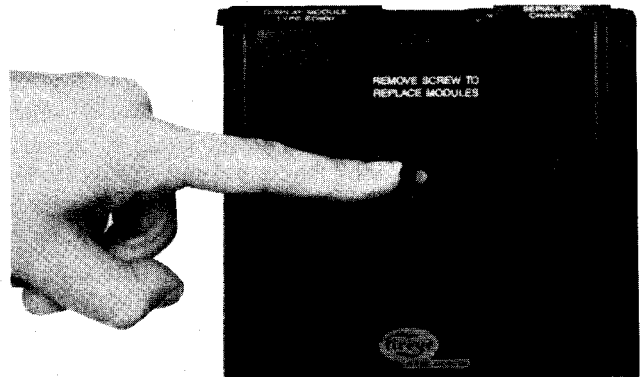
LOCKOUTS

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 button just above 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 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.
3. 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.
4. If the main flame fails during a firing cycle, all fuel valves will be de-energized within 4 seconds after loss of flame signal and the control will lockout on safety.
5. A flame seen at an improper time will cause a lockout.
6. Additional lockout messages and causes are described in the following pages.

Note: Manual Reset is required following any safety shutdown.



Note: Depressing 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 startup 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** — Limit switches may be connected in the circuit between Terminals 3 and P. If a limit switch opens during the trial for ignition or firing period, all fuel valves will be de-energized and the control will lockout on safety. If the limit switch opens ten seconds after the purge begins, the control will lockout on safety.
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.

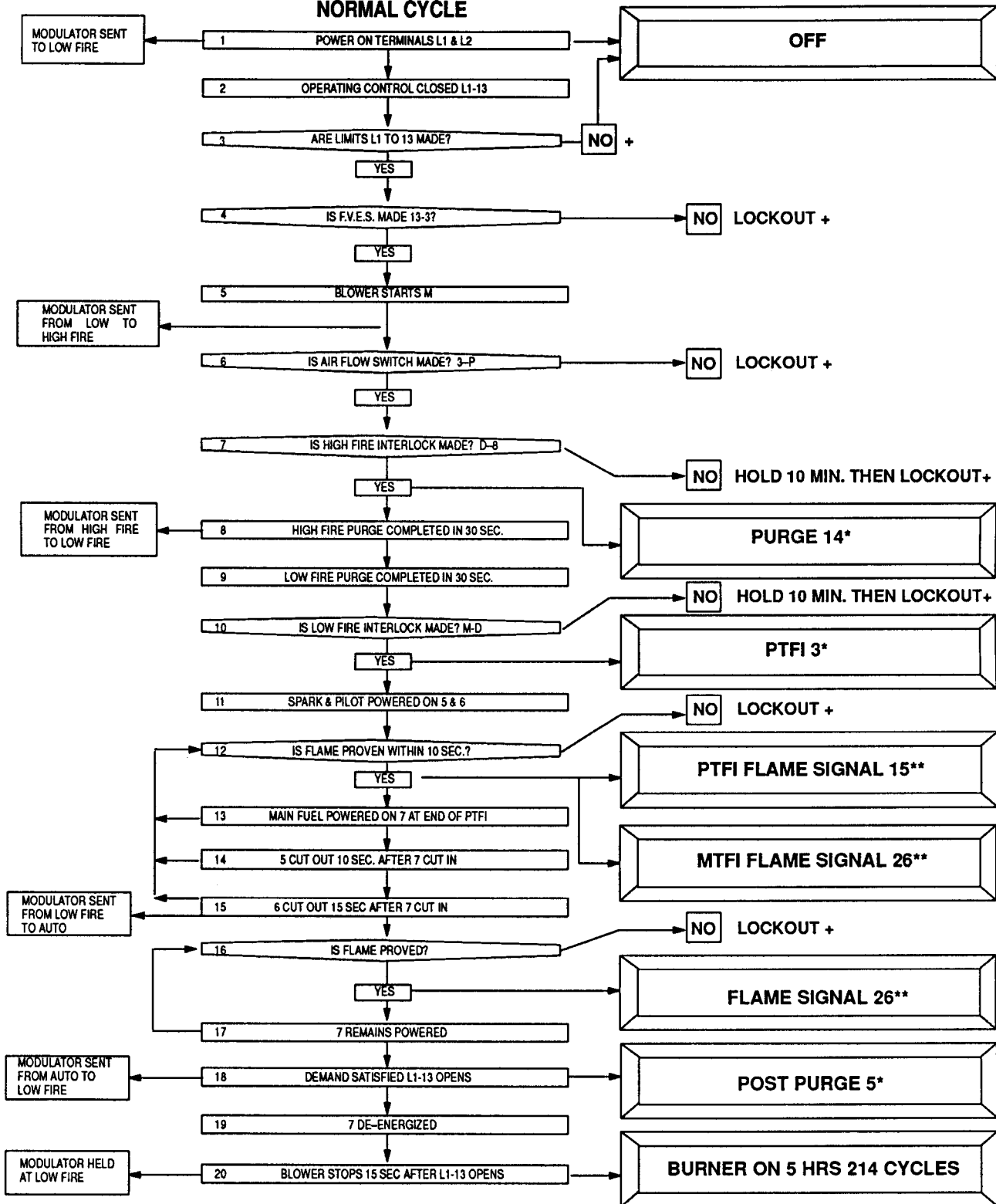


CAUTION: The use of a Fuel Valve End Switch is recommended. All FLAME-MONITOR systems have provision to accept the Fuel Valve End Switch Interlock. This will add additional safety to prevent hazardous situations.

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.

**EP160 LOGIC FLOW DIAGRAM
NORMAL CYCLE**

DISPLAY MESSAGE



*TIMING IN SECONDS **FLAME SIGNAL STRENGTH NUMBER FROM 0-99 +THESE LOCKOUT AND HOLD MESSAGES ARE EXPLAINED IN THE FOLLOWING PAGES.

Note: Messages more than 8 characters in length will scroll continuously from right to left on the display.

EP160 ADDITIONAL MESSAGES

HOLD MESSAGES	DESCRIPTION
HOLD 3-P RUN INTLK OPEN	The running interlock circuit (3-P) has opened during the burner on period. This message will be on the display for 15 sec. (post purge) and then the appropriate lockout message will appear.
HOLD 3-P RUN INTLK OPEN MTFI	The running interlock circuit (3-P) has opened during the main trial for ignition period. This message will be on the display for 15 sec. (post purge) and then the appropriate lockout message will appear.
HOLD 3-P RUN INTLK OPEN PTFI	The running interlock circuit (3-P) has opened during the pilot trial for ignition period. This message will be on the display for 15 sec. (post purge) and then the appropriate lockout message will appear.
HOLD D-8 HI PURGE OPEN	The control has driven the firing rate motor to high purge and is waiting for the high fire switch (D-8) to close. It will hold in this position for ten minutes and then lockout if the D-8 circuit does not close.
HOLD FALSE FLAME 00	The flame has been sensed sometime during the burner off time. This message will hold for 60 seconds and display Flame Signal (00) strength. This can be used as an aid in trouble shooting scanners and amplifiers.
HOLD FLAME FAIL	A flame failure occurred during the main burner on period. The control will hold this message for 15 sec. (post purge) and then lockout.
HOLD FLAME FAIL MTFI	No flame was proven during the main trial for ignition period. The control will hold this message for 15 sec. (post purge) and then lockout.
HOLD FLAME FAIL PTFI	No flame was proven during the pilot trial for ignition period. The control will hold this message for 15 sec. (post purge) and then lockout.
HOLD CHECK SCANNER	See description on page 15 for "LOCKOUT CHECK SCANNER"
HOLD M-D LOW PURGE OPEN	The control has finished purge and the firing rate motor is driving to the low fire position waiting for that switch (M-D) to close. It will hold in this position for ten minutes and then lockout if the M-D circuit does not close.
HOLD SCANNER NOISE	See description on page 14 for "LOCKOUT SCANNER NOISE"
HOLD SHORT CIRCUIT TERMINAL 5, 6, OR 7	The control has sensed an excessive current or short circuit external to Terminals 5, 6, or 7. This message will hold for 15 sec. (post purge) and then the control will lockout on the second consecutive event and display the appropriate message.

Note: Messages more than 8 characters in length will scroll continuously from right to left on the display.

EP160 ADDITIONAL MESSAGES

LOCKOUT MESSAGES

DESCRIPTION

LOCKOUT 3-P RUN INTLK OPEN	The running interlock circuit (3-P) has opened during the main burner on period.
LOCKOUT 3-P RUN INTLK OPEN MTFI	The running interlock circuit (3-P) has opened during the main trial for ignition period.
LOCKOUT 3-P RUN INTLK OPEN PTFI	The running interlock circuit (3-P) has opened during the pilot trial for ignition period.
LOCKOUT 3-P RUN INTLK OPEN PURGE	The running interlock circuit (3-P) has opened during the purge period or failed to close within the first 10 sec. of purge.
LOCKOUT 13-3 FUEL VALVE END SWITCH OPEN	The fuel valve end switch wired between terminals 13 & 3 on the wiring base opened during purge or at start up.
LOCKOUT D-8 HI PURGE OPEN	The control has held for more than 10 minutes waiting for the high fire switch (D-8) to make.
LOCKOUT FALSE FLAME	A flame has been sensed by the scanner for more than 60 seconds during the burner off time.
LOCKOUT FALSE FLAME PURGE	A flame has been sensed by the scanner for more than 4 second during the purge period.
LOCKOUT FLAME FAIL	A flame failure occurred during the main burner on period.
LOCKOUT FLAME FAIL MTFI	A flame failure occurred during the main trial for ignition period.
LOCKOUT FLAME FAIL PTFI	A flame failure occurred during the pilot trial for ignition period.
SYSTEM ERROR	An internal failure has been detected in the programmer module. Replace it. Check also for scanner wire routing near ignition noise.

Note: Messages more than 8 characters in length will scroll continuously from right to left on the display.

EP160 ADDITIONAL MESSAGES

HOLD MESSAGES

LOCKOUT M-D LOW
PURGE OPEN

The control has held for more than 10 minutes waiting for the low fire switch (M-D) to make.

LOCKOUT SCANNER NOISE

This message appears because of ignition cable noise. Reroute scanner wires away from high voltage ignition cables. Check for proper sparkgap. Check for proper grounding of wiring base and power supply. Replace worn ignition cable and/or faulty connections

LOCKOUT SHORT CIRCUIT
TERMINAL 5, 6, OR 7

The control has sensed an excessive current or short circuit external to terminal 5, 6 or 7. Check for this short according to the procedure found in this bulletin on page 15 labeled "Before Installing the Control." The control will lockout upon sensing this twice in a row.

CHECK MESSAGES

CHECK D-8 HI PURGE

The "Run-Check" switch is in the Check position and will hold indefinitely. The firing rate motor is being driven to the high purge position.

CHECK M-D LOW PURGE

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

CHECK FLAME SIGNAL 00

The "Run-Check" switch has been placed in the "Check" position during the pilot trial for ignition period. The flame signal strength will be displayed. The control will lockout on safety only if no flame signal is sensed for a continuous 30 seconds while the control is in this check position. The control will not advance in the cycle until the switch is placed in the "run" position again.

CHECK LOW FIRE
FLAME SIGNAL 00

The "Run-Check" switch has been placed in the "Check position during the main burner on period and the firing rate motor has been driven to low fire. The flame signal strength will be displayed as a number from 0-99 and is shown here by the symbols 00.

DIAGNOSTIC MESSAGES

LOCKOUT CHECK AMPLIFIER

POSSIBLE CAUSE

SOLUTION

— High Electrical Noise

— Check for proper ground on power supply.
— Install noise suppressor on power supply (P/N 60-2333)

— Defective Field Wiring

— Make sure line phase on interlock circuits is the same as found on L1/L2 power supply to E100

— Defective Amplifier

— Replace Amplifier

— Defective IR Scanner

— Replace IR Cell

LOCKOUT CHECK CHASSIS

— Voltage On Terminal 7 at improper time. Defective field wiring.

— Check wiring to Terminal 7

— Defective Chassis

— Replace Chassis (EB700)

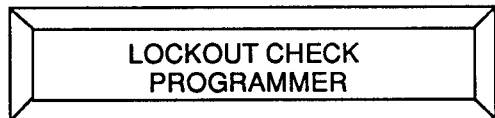
— Defective Programmer

— Replace Programmer

Note: Messages more than 8 characters in length will scroll continuously from right to left on the display.

EP ADDITIONAL MESSAGES

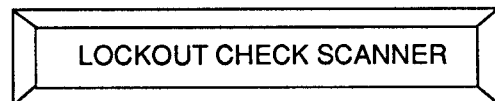
DIAGNOSTIC MESSAGES



POSSIBLE CAUSE

SOLUTION

- | | |
|---|--|
| <ul style="list-style-type: none"> — Voltage on Terminals 5 or 6 at an improper time — High Electrical Noise
 — Fuel Changeover on Burners with Direct Spark Oil
 — Failed Programmer — Worn Chassis | <ul style="list-style-type: none"> — Check field wiring to Terminal 5 and 6 — Check for proper ground on power supply — Install noise suppressor on power supply — Re-route scanner wires away from high voltage wiring
 — Interrupt power when changing fuels — Install time delay relay — Note write-up on page 15 of this bulletin
 — Replace Programmer
 — Replace Chassis |
|---|--|



Scanner signal has been detected during the shutter closed time. This can be caused by a faulty UV tube (4-314-1), faulty scanner (45UV5), or lack of power to the scanner.

BEFORE INSTALLING THE CONTROL



CAUTION: Ensure that electric power is shut off.

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 infra-red scanning, be sure to remove any jumpers on the wiring base which ground the S2 Terminal.

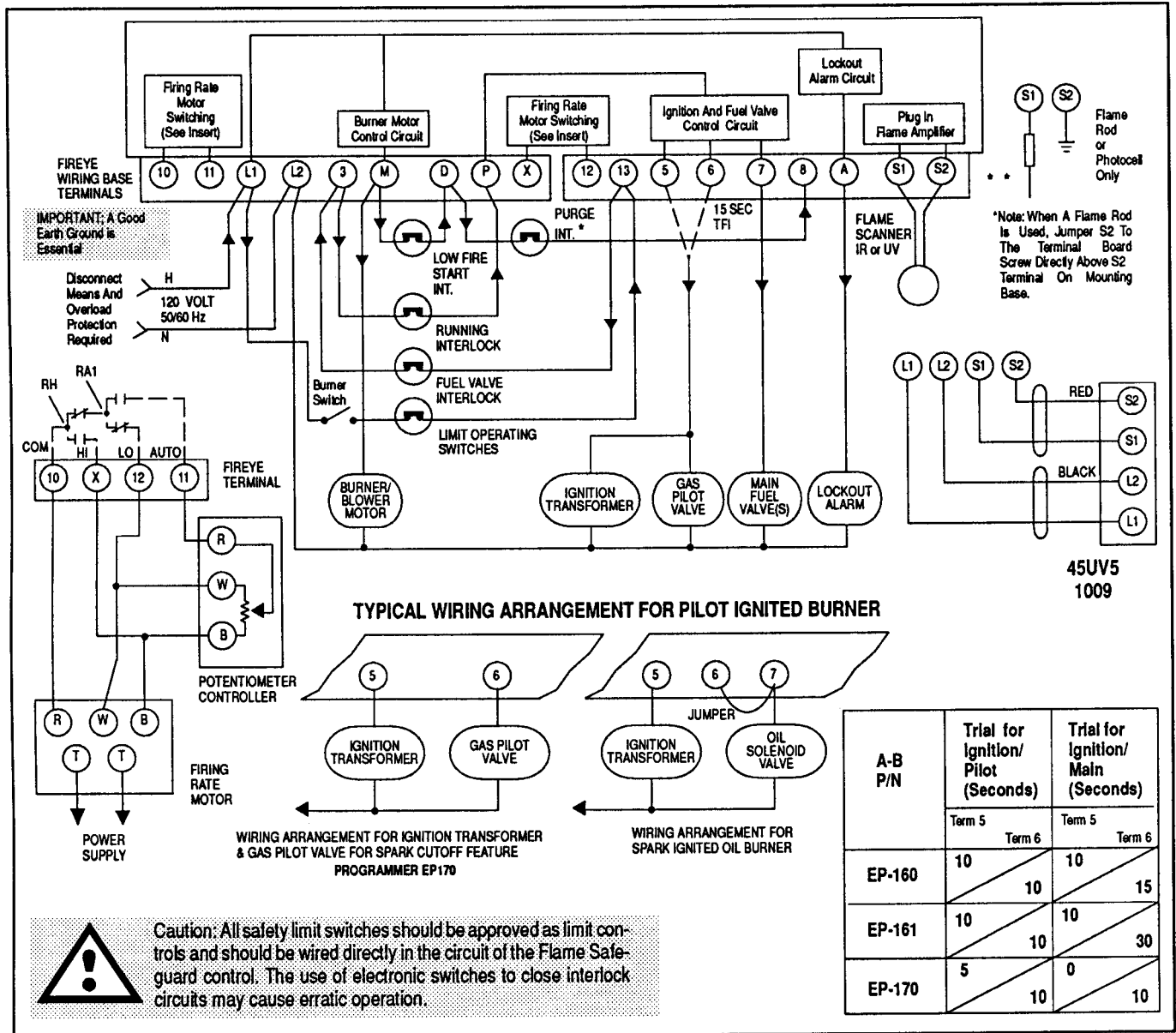
1. Touch the meter probes together and calibrate accurately to ensure a reliable test.
2. Disconnect the neutral wire (L2) from the control system at the power source. Clip one meter test lead to the grounded green terminal on the lower right side of the wiring base and with the other probe touch each 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.

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

Suggested Wiring Diagram for EP160, EP161, and EP170 Programmers



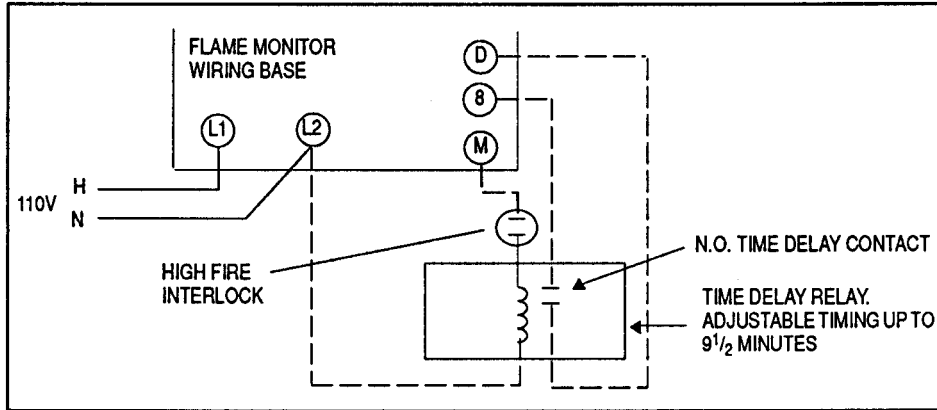
*The purge interlock circuit is included in the EP160, EP161, EP162, and EP170 Programmer Modules only.

** When using an infrared scanner (48PT2), ground S2 on all EB700 Chassis' labeled "ENG CODE 00." Subsequent Eng. Code models do not require that S2 be grounded.

EXTENDED PREPURGE

Occasionally it is 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 9½ minutes. If the time delay relay does not close the D-8 circuit within 10 minutes of the start, the FLAME-MONITOR will LOCKOUT and the message will be "LOCKOUT D-8 HI PURGE OPEN."



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

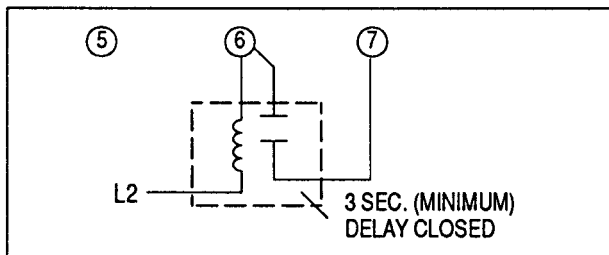
The function of the low fire start and high fire purge interlock circuits internally in a new Fireeye Flame Monitor unit is accomplished by highly reliable solid state electronic circuitry. This prohibits the connection of power consuming devices (i.e. lamps, annunciators, relays, timers, etc.) to the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

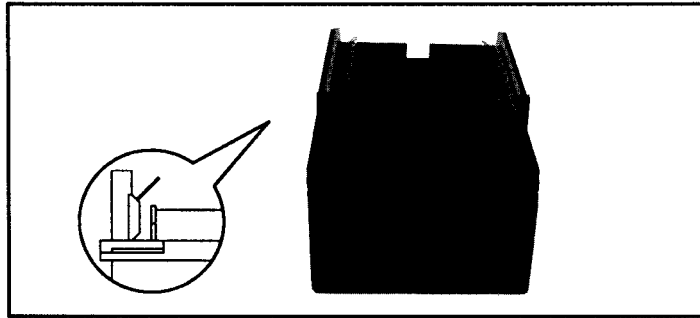


INSTALLING THE CONTROL



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 re in line as shown here.



2. 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.
3. Electric power may now be turned on.

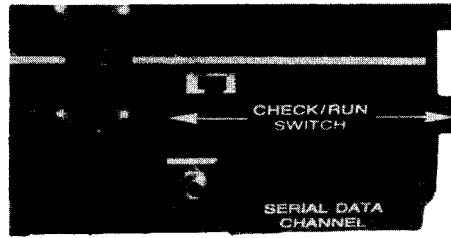
INSTALLATION/TESTING

Check-Run Switch

The *Check-Run* switch is located on the top of the EP Programmer Module (note photograph) 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 He Fire Switch (D-8) is made and the 30 second purge ends, the control will display the message, *Check D-8 Purge 00*. The 00 indicated the purge timing, in seconds, that the control has completed before the switch was moved to *Check*. 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 M-D Low Purge 00*. The 00 indicates the purge timing in seconds, that the control was completed before the switch has moved to the *check* position. 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 the message *Check PFTI Flame Signal 00* where 00 equals flame signal strength. 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 PFTI*.
4. Switching from *run* to *check* during the burner on period will drive the modulator circuit to low fire (10-X 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 Low Fire Flame Signal 00* with 00 again indicating flame signal strength.



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

OPERATIONAL TEST



CAUTION: 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 8 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 cut-off, etc.).
3. Each interlock switch (air-flow 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.

Voltage Test



CAUTION: LIVE VOLTAGE IS NECESSARY TO PERFORM THIS 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 (60-2017), 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.

Main Flame Test

Note: This test requires an interrupted pilot. (A pilot that shuts off after the main flame is 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.

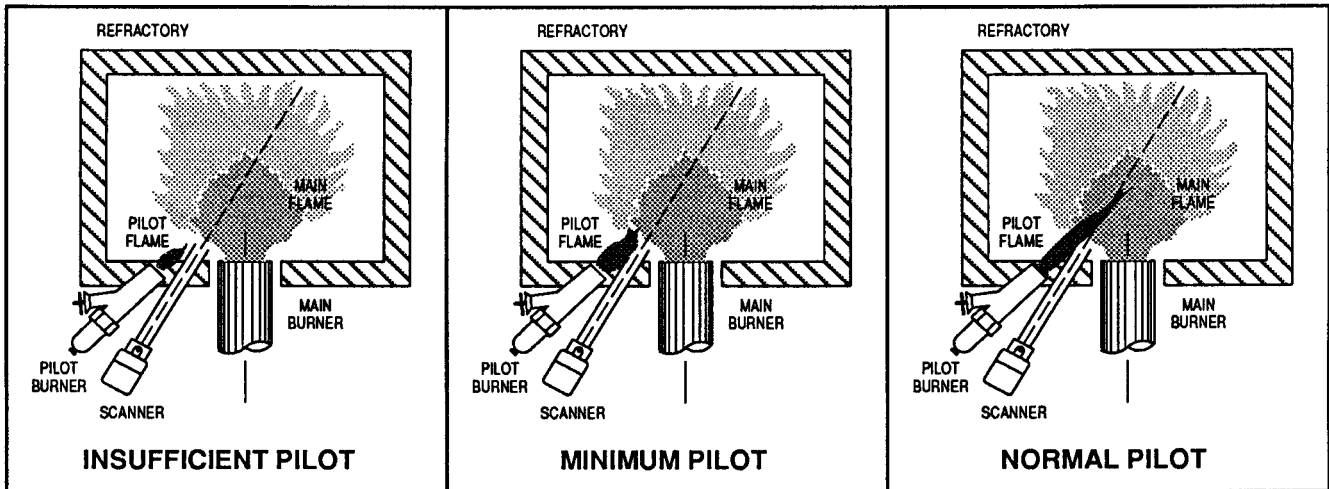
This test assures that the flame detector will not detect a pilot flame too small to reliably light off the main flame. The test should be made on every new installation and following any reapportioning of the flame detector. **This procedure should not be used on a direct spark ignited burner.**

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 a 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.

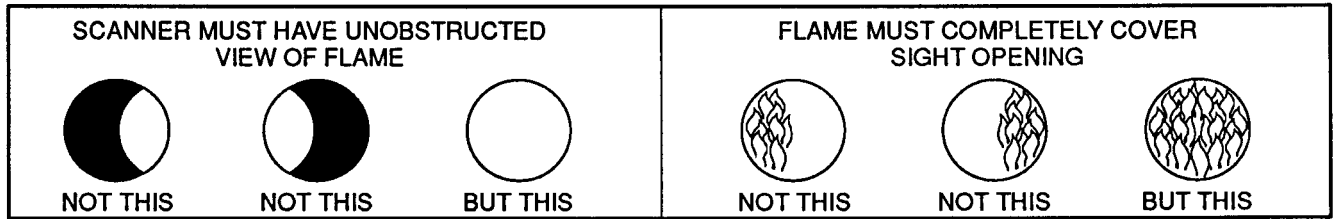
INSTALLATION – UV SCANNERS



CAUTION: The UV1, UV2, UV8, 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. (see Operation). If component checking is required during burner operation for constantly fired burners, utilize the self-checking ultra-violet flame scanners (45UV5) and associated amplifier module (EUVS4).

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

1. Position the UV1, UV2 scanner within 18 inches of the flame to be monitored; the 45UV5 within 30 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 #60-1100 coupling. Add cooling air to reduce the scanner sight pipe temperature.
4. Install the scanner on a standard NPT pipe (UV1: 1/2", UV2: 3/8", 45UV5: 1") whose position is rigidly fixed. If the scanner mounting pipe sights through the refractory, do not extend it more than halfway through. Swivel flanges are available if desired (#60-302 for UV1, UV2 Scanners, #60-1664-3 for 45UV5). The sight pipe must permit an unobstructed view of the pilot and/or main flame, and both pilot and main flames must completely cover the scanner field of view.



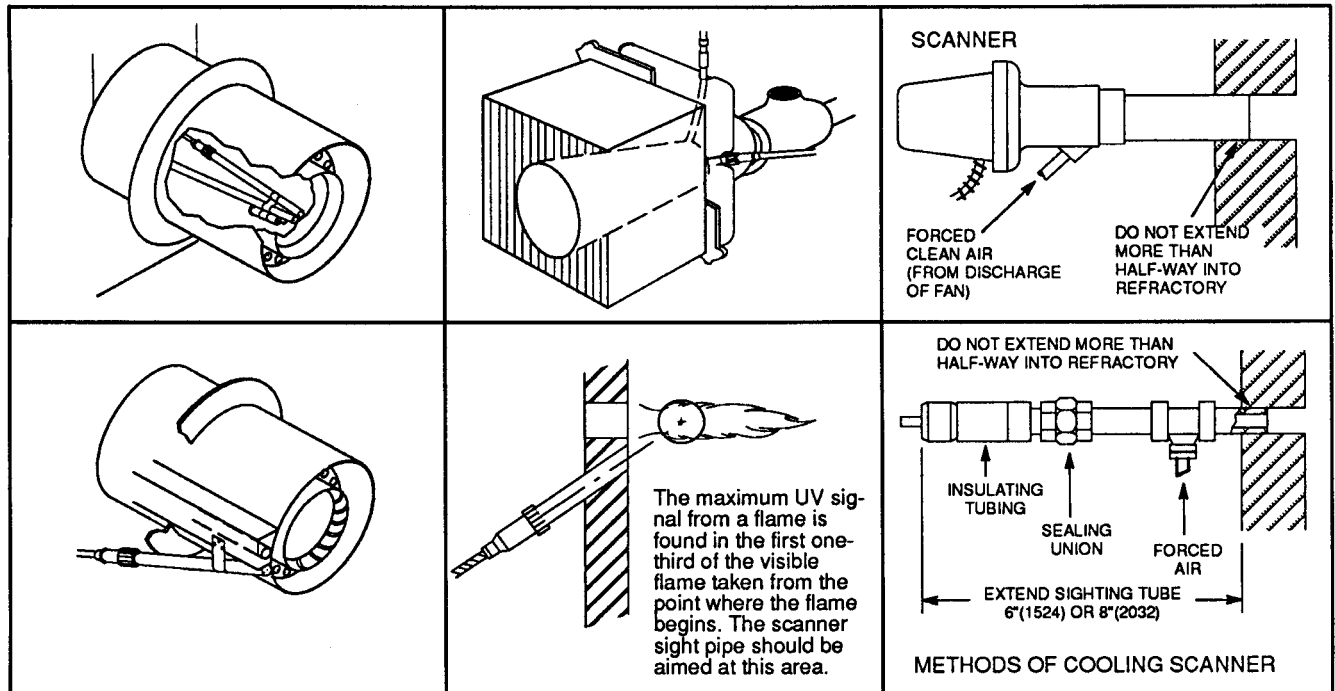
Note: Since oil and gas flames radiate more ultraviolet energy from the base of the flame than from further out in the flame this fact should be taken into consideration when installing the scanner sight pipe.



CAUTION: The scanner must not sight the ignition spark directly, or any part of the burner that can reflect the spark back to the scanner. The scanner must not see a pilot flame that is too small to reliably ignite the main flame.

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. The 45UV5 has a 3/8" plug in the mounting flange that can be removed. For positive pressure furnaces, provide clean air to pressurize the sight pipe, if necessary.
6. Two UV1 or UV2 Scanners may be installed on the burner if it is necessary to view two areas to obtain reliable detection of the flame. They should be wired in parallel. Only one repetitive self-checking 45UV5 Scanner may be installed on a burner.
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



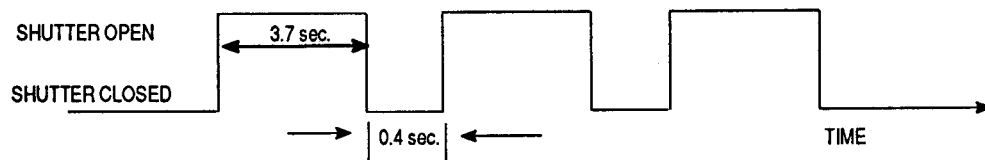
OPERATION – 45UV5 SELF-CHECKING UV SCANNER

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

- Use #14, 16 or 18 wire with 75°C, 600 volt insulation for up to 100 foot distances (signal loss approximately 20% at 100 feet).
- Extended Scanner 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.
- Asbestos insulated wire should be avoided.
- Multiconductor cable is not recommended without prior factory approval.

2. High voltage ignition wiring *should not* be installed in the same conduit with flame detector wires.

INSTALLATION – INFRARED SCANNER TYPE 48PT2

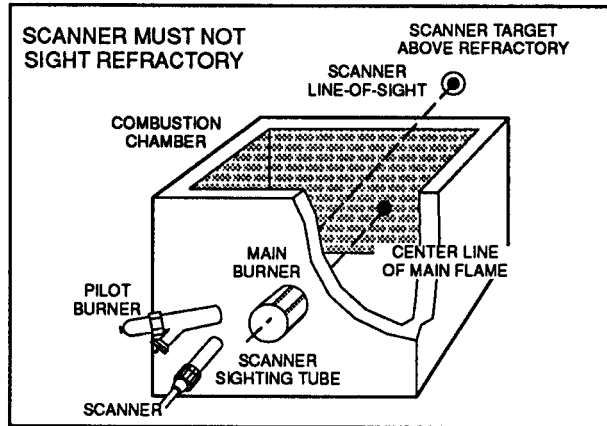
Where possible, obtain the burner manufacturer's instructions for mounting the scanner, otherwise proceed as follows:

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

Proper scanner positioning must assure the following:

- Reliable pilot flame signal.
- Reliable main flame signal.
- A pilot flame too short or in the wrong position to ignite the main flame reliably, must not be detected.
- Scanner must have an unobstructed view of flame being monitored.

- e. Flame being monitored must completely cover the scanner field of view.
- f. To avoid nuisance shutdowns, it is important to avoid sighting hot refractory and to keep scanner temperature low (below 125° F) (50°C).
- g. When the proper position has been established, drill a hole through the furnace wall and install a 4" to 8" length of threaded 1/2" black iron pipe on which to mount the 48PT2 scanner.
- h. 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.

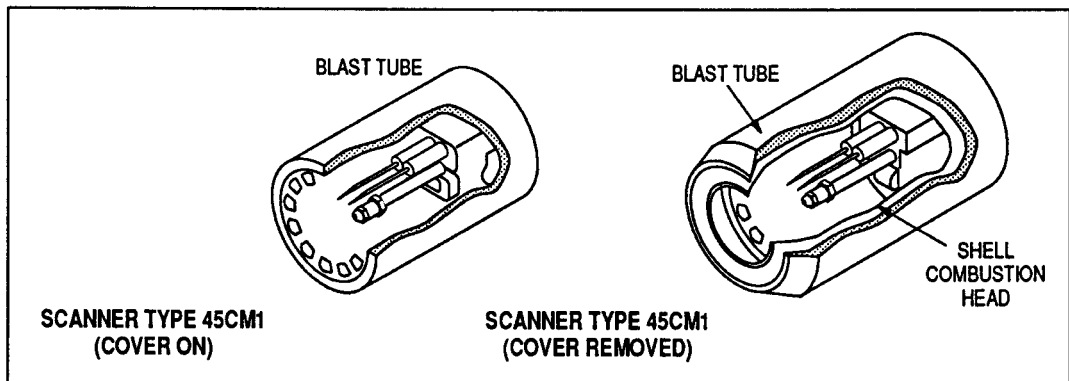
Keeping the Scanner Cool

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 – 45CM1 PHOTOCELL MOUNT

The 45CM1 photocell mount with #922 photocell and Rajah stud terminal, is designed for use in the blast tube on conventional atomizing oil burners. Two typical applications are shown below.



Test for Incandescent Refractory Hold-In with Photocell Detector

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

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

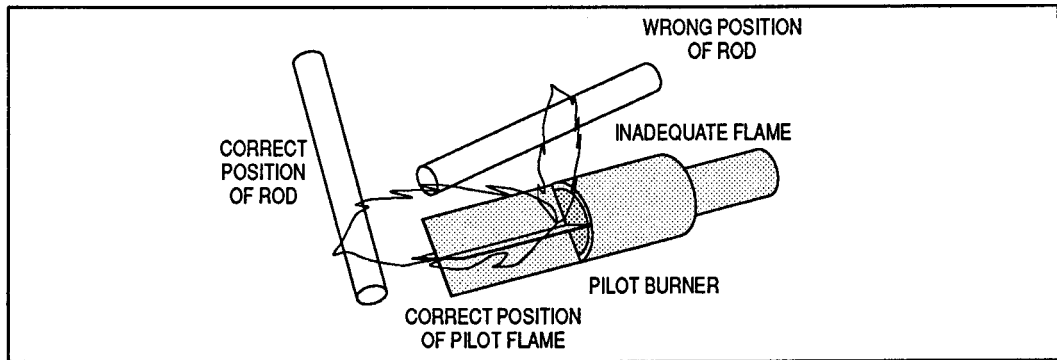
INSTALLATION – 69ND1 FLAME ROD

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:

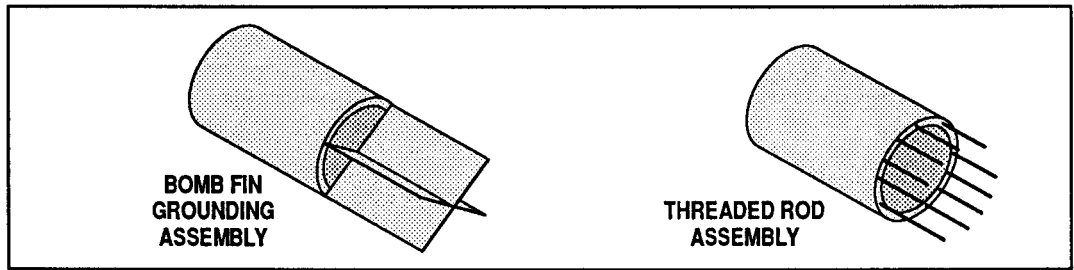
1. Keep flame rod as short as possible.
2. Keep flame rod at least $\frac{1}{2}$ " from any refractory.
3. Flame rod should enter the pilot flame from the side so as to safely prove an adequate pilot flame under all draft conditions.
4. If the flame is nonluminous (air and gas mixed before burning),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



MAINTENANCE

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

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

Type 48PT2 Scanners include a replaceable #4-263-1 Firetron cell.

Type 45CM1 Scanners include a replaceable #4-230 Phototube #922.

Type 45UV5 Scanners include a replaceable #4-314-1 UV tube.

Type 69ND1 Flame Rod

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

Flame Signal Strength

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

Contacts

There are no accessible contacts in the 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 (P/N 60-2333) 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.

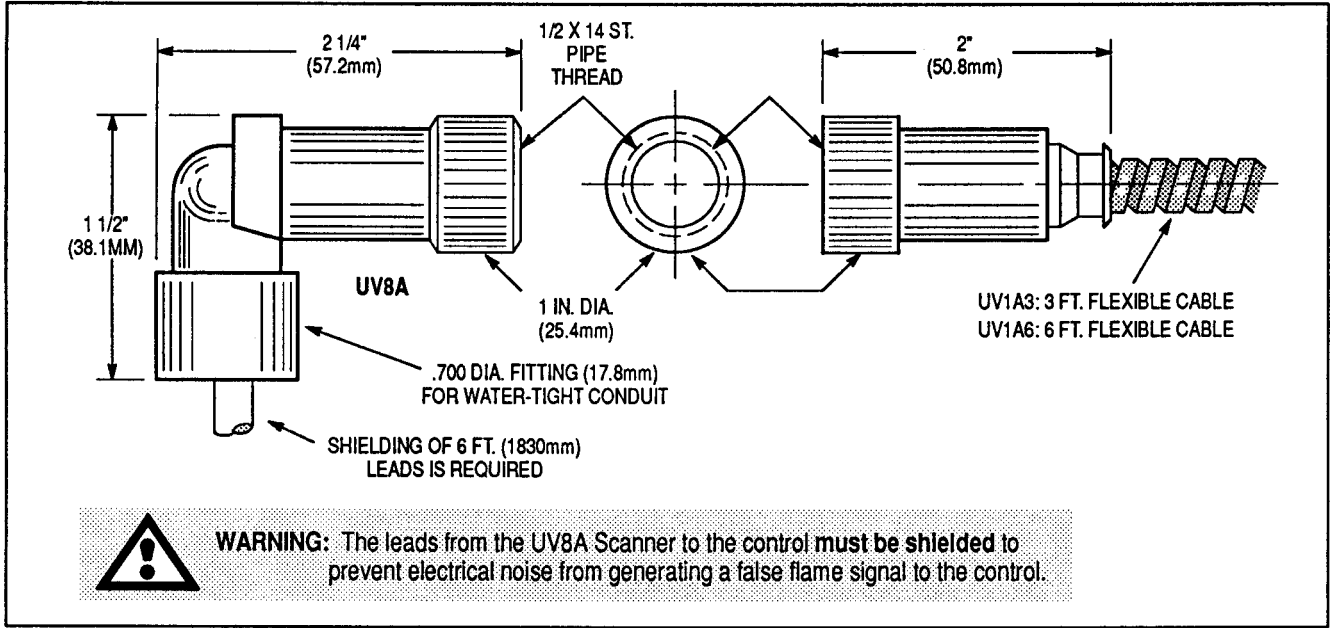
Periodic Safety Check

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.

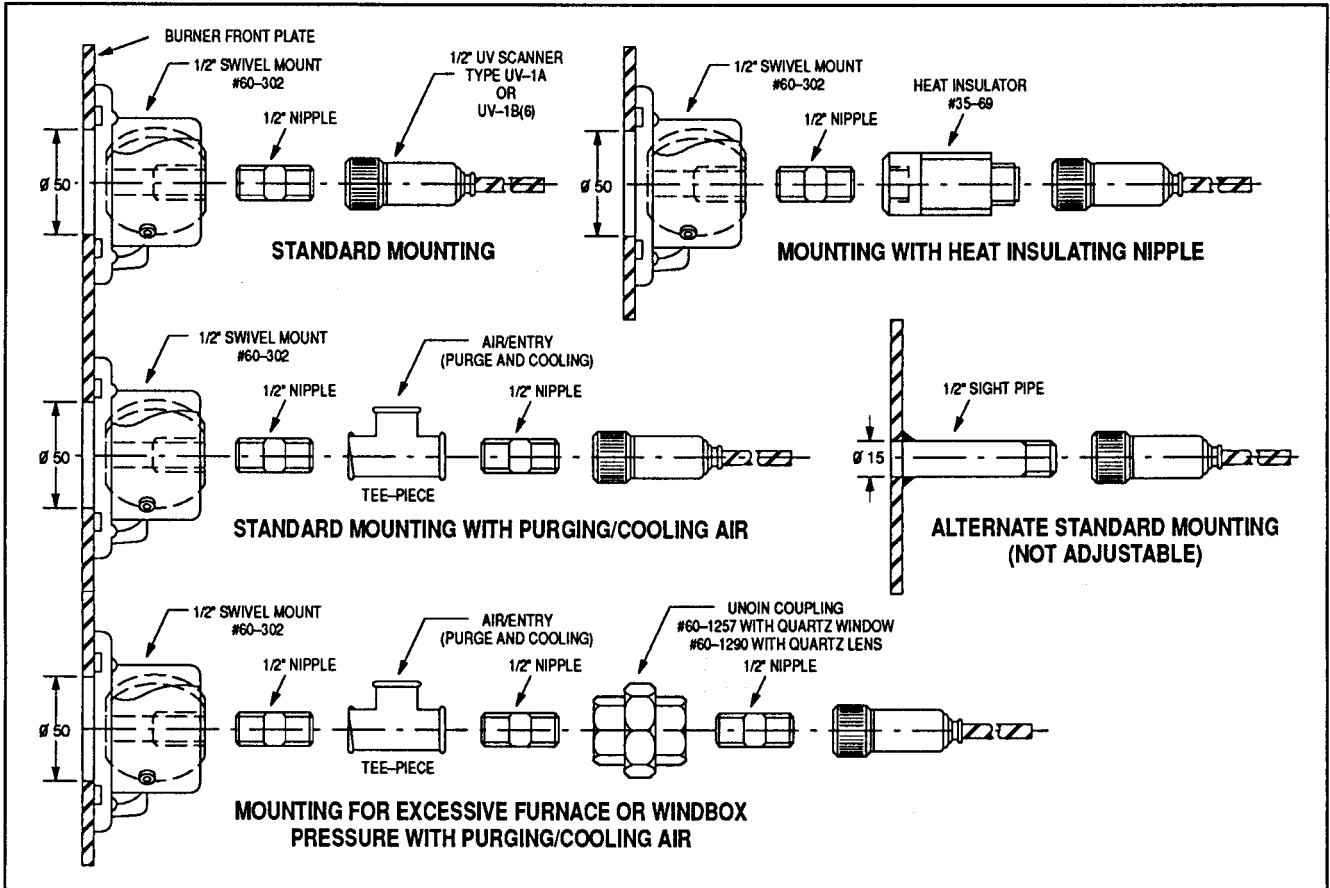
Rotation

It is recommended that control and scanner units purchased as spares be installed periodically.

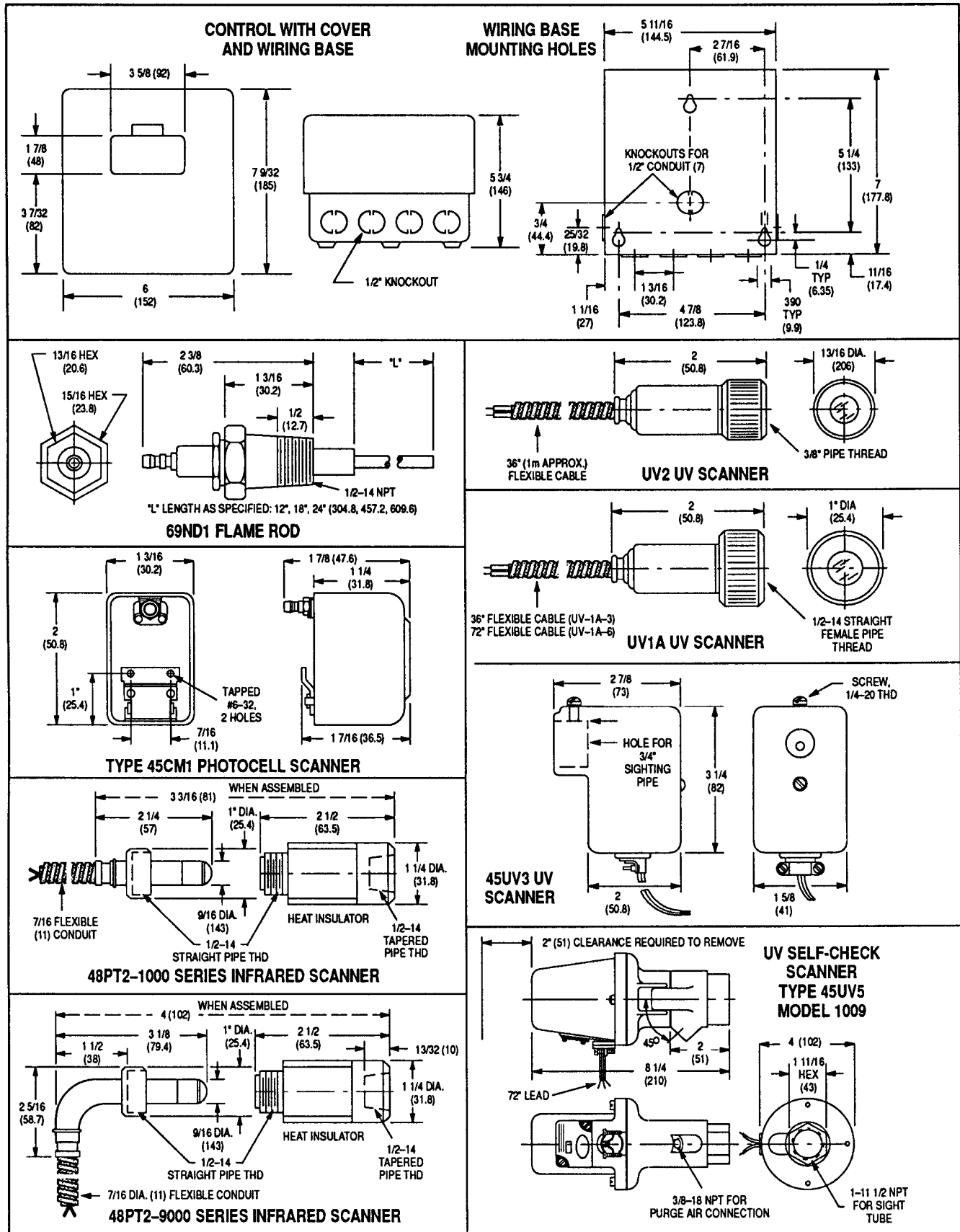
UV8A Scanner



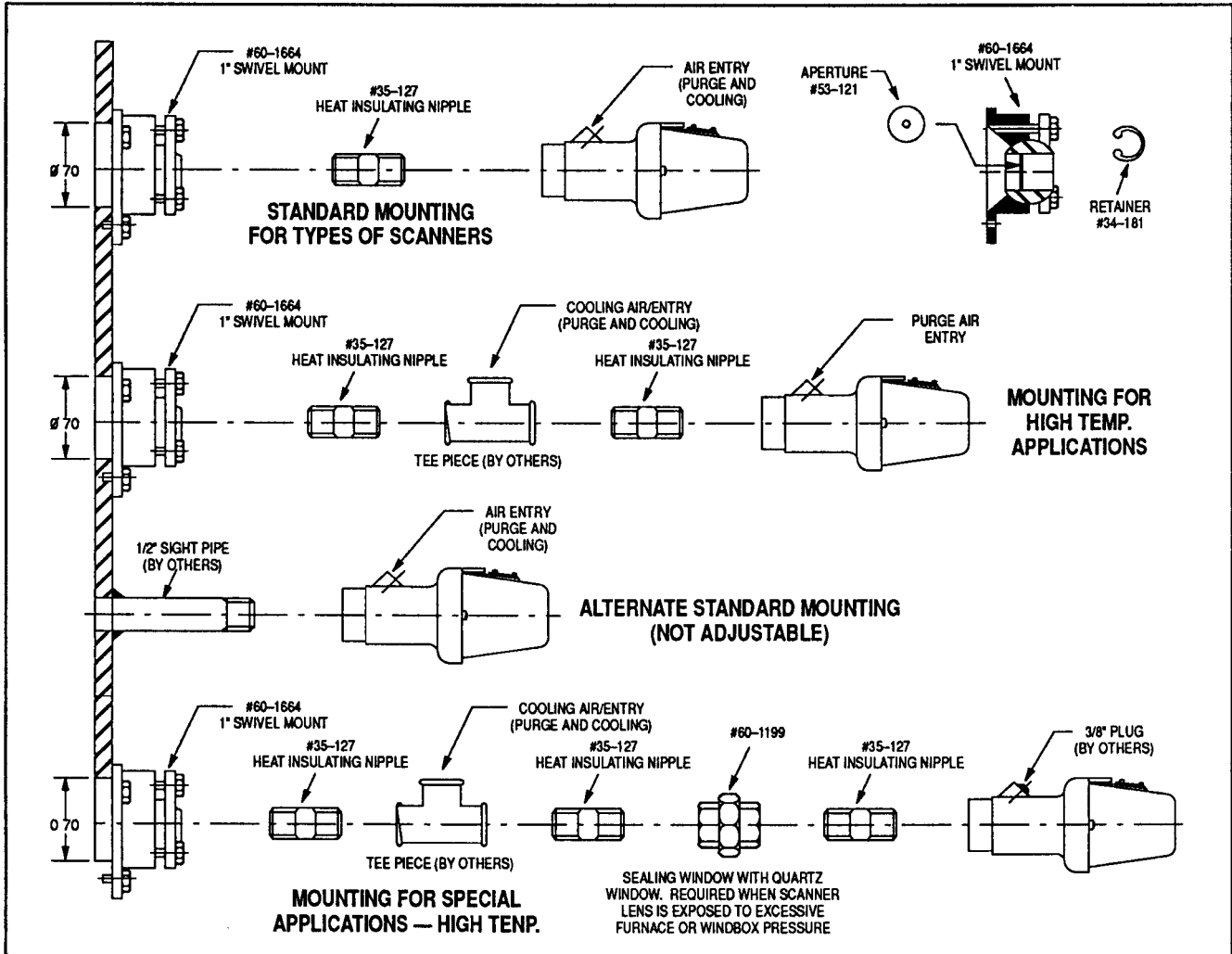
Mounting UV1A/UV18 Scanners



Component Dimensions



Mounting 45UV5 Scanners





WARRANTIES

Fireeye, Inc. guarantees for one year from the date of shipment 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 Fireeye, Inc. 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 manufactured or sold by Fireeye, Inc. shall be limited exclusively to the right to replacement or repair as above provided. In no event shall Fireeye, Inc. be liable for consequential or special damages of any nature which may arise in connection with such product or part.



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