



Solid State Burner Management Controls Series D10-20 for Automatic Burners



UV90



45UV5



UV8A



45UV3-1050



UV1A



69ND1



48PT2

DESCRIPTION

Fireye Series D10-20 Burner Management controls provide ignition and main flame failure protection for automatically ignited oil and gas burners. In conjunction with limit-operating controls and interlock devices, it automatically programs with solid state timing logic, the burner/blower motor, ignition, main fuel valve(s) and firing rate motor. The control cycles automatically when the operating control closes and also following a power interruption, but must be manually reset following a safety shutdown.

The start-up programming includes a safe start check on each start. If flame signal (real or simulated) is detected, the ignition will not be energized and safety lockout will occur. An open damper prepurge and subsequent proof of the low fire position of the firing rate motor before ignition occurs at each start up. Terminals are provided for a main fuel valve proof of closure interlock which must be closed before startup and during the prepurge. An interlock circuit is provided for airflow switches, fuel pressure switches etc. which must be closed during the prepurge and firing period. Control type 70D10 will initiate a safety lockout if this circuit opens during the prepurge, ignition or firing period. Control 70D20 will recycle and initiate a complete restart if this circuit opens during the prepurge, ignition or firing period.

The control system is designed to deenergize all fuel valves within 4 four seconds following flame failure. An alarm circuit actuates audible and visual alarms after a safety lockout. Plug-in amplifier modules permit the selection of Ultraviolet, repetitive self-check Ultraviolet, "AUTOCHECK" infrared, or Rectification methods of flame detection. For increased safety and reliability, Fireye 72DIR1-3 Autocheck infrared amplifiers (using the pulsing flame signal) and 72DUVS-45UV5 Ultraviolet amplifier scanner (using a scanner shutter) check the function of the flame detecting system for any component failure during each burner firing cycle. Meter test jacks on each amplifier module provide flame signal readout with a DC voltmeter.

The solid state programmer is a plug-in module. An optional spark cutoff model is available. A test switch permits the operator to stop the startup programming before energizing the main fuel valves, for test purposes.



SPECIFICATIONS

Supply Voltage: 120V (Max. 132V, Min. 102V) 50/60 Hz

Power Consumption: Operating: 20VA Standby: 13VA

Maximum simultaneous connected load: 2000VA

OPERATING TEMPERATURE LIMITS:	Maximum	Minimum
Control-Amplifier-Programmer	140°F (60°C)	- 40°F/C
UV1A, UV2, UV8A, UV90 Scanner	200°F (93°C)	- 40°F/C
45UV5 Scanner	200°F (93°C)	- 40°F/C
48PT2 Scanner	140°F (60°C)	- 40°F/C
69ND1 Flame Rod (TIP 2460°F)	1500°F (816°C)	- 40°F/C
Humidity 85% RH MAX. NON-Condensing		

Maximum Load Ratings for Series D10-20 Controls

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)	50VA Pilot Duty (Solenoid Valves) plus 500VA (Transformer)	125VA Pilot Duty (Solenoid Valve) plus 250VA (Transformer)
7	Main Fuel Valve(s)	250VA Pilot Duty (Solenoid Valve)	1250VA Opening 500VA holding (Motorized Valve) plus 65VA Pilot Duty (Solenoid Valve)
M	Burner/Blower Motor	9.8 F.L.A. 58.8 L.R.A.	240VA Pilot Duty (motor starter coil)
10-11-12-X	Modulator	125VA Pilot Duty	
A	Alarm	50VA Pilot Duty	

Terminal ratings may be selected from either column A or B; (selecting the rating from the column for each terminal which best applies to the connected load on that terminal).

Approvals

Underwriters Laboratories Inc. Listed: Guide MCCZ, File MP 1537

Underwriters Laboratories Inc. Recognized: Guide MCCZ2, File MP 1537

Canadian Standards Association Approved: Guide 140-A-2/300-1-90.2

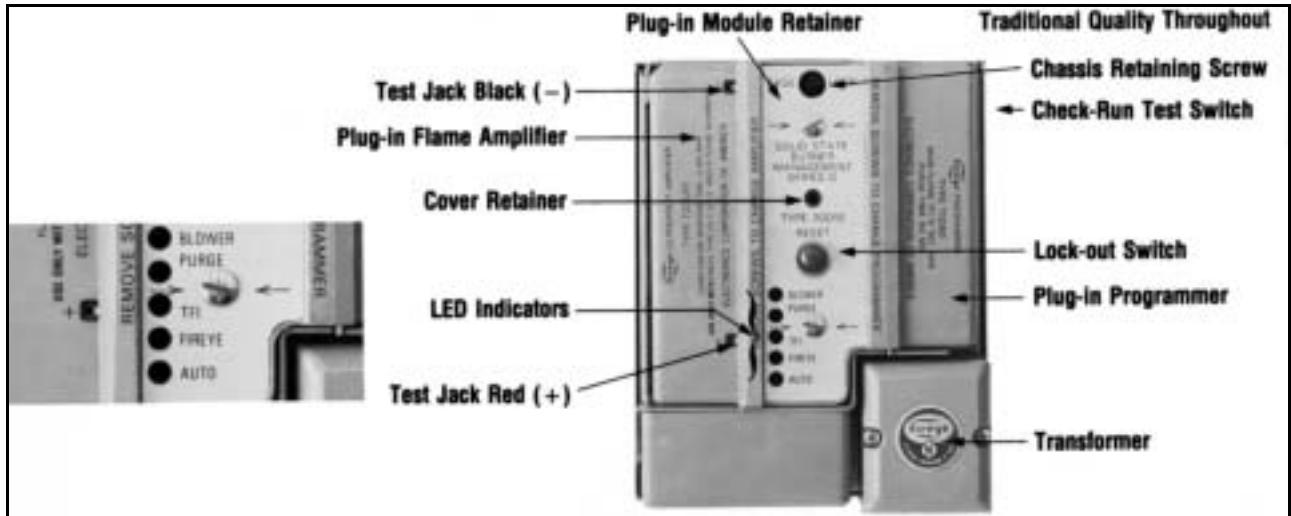
Factory Mutual System Approved: Report ICIAI.AF

New York Board of Standards and Appeals 743-68-SA

Five LED lights on the FIREYE chassis provide the following indication:

- Blower— Lights when blower motor circuit is energized.
- Purge—Lights when operating control closes, and deenergizes when Firing Rate Motor starts to drive to low fire start position.
- TFI — Lights during Pilot trial-for-ignition period.
- FIREYE — Lights when flame is detected.

Auto— Lights when firing rate motor is released to automatic control of the potentiometer control.



DESCRIPTION OF FIREYE SERIES D10-20 SYSTEM COMPONENTS

CONTROL CHASSIS AND COVER	70D10 — has non-recycling running interlock circuit 70D20 — has recycling running interlock circuit and does not include purge interlock circuit.		
PLUG-IN PROGRAMMER MODULE	71D60 — Standard 71D70 — with spark cutoff and 10 second main flame trial-for-ignition		
PLUG-IN AMPLIFIER MODULE AND FLAME SCANNER	AMPLIFIER	FLAME-SCANNER	
	72DRT1 Rectification	69ND1-1000K4 69ND1-1000K6 69ND1-1000K8	1/2" mount - 12" flame rod 1/2" mount - 18" flame rod 1/2" mount - 24" flame rod
	72D1R1 Intra-red (IR) AUTOCHECK 72D1R3 For special applications, note below	48PT2-1003 48PT2-9003 48PT2-1007 48PT2-9007	1/2" straight mount 96" cable 1/2" angle mount 96" cable 1/2" straight mount 48" cable 1/2" straight mount 48" cable
	72DUV1 Ultraviolet (UV)	UV8A UV1A3 UV1A6 UV2 UV90-3, -6, -9 45UV3-1050	1/2" angle mount 72" (1800mm) wire (no cable). 1/2" straight mount 36" (900mm) cable. 1/2" straight mount 72" (1800mm) cable. 3/8" straight mount 36" (900mm) cable. 90° side opening, 36" (900mm), 72" (1800mm), or 108" (2700mm) cable. 3/4" straight mount cast aluminum housing, 72" (1800mm) wire (no cable).
	72DUVS4. Ultraviolet Repetitive Self-check 2-4 sec. FFRT. 72DUVS1T. Ultraviolet Repetitive Self-Check 1 sec. FFRT.	45UV5-1009	1" mount, 72" wire leads.
WIRING BASE	60-1386-2 Standard base for surface mounting 60-1466-2 Open base for cabinet mounting.		
	CAUTION: The 72D1R1 is not to be used with solid fuel applications, it is designed for oil fog rejection. The 72D1R3 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 damage or personal injury.		

ORDERING INFORMATION

Each complete FIREYE series D10-20 system requires:

1. A control chassis and cover
2. A plug-in Programmer Module
3. A plug-in Amplifier Module

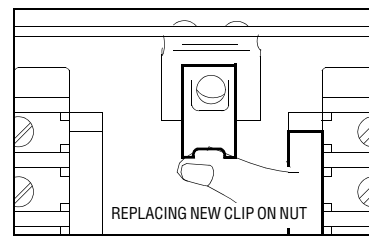
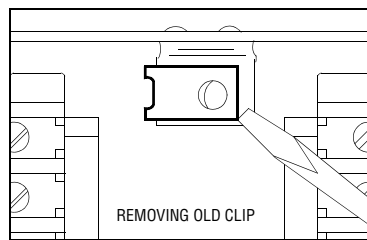
4. A Flame Scanner
5. A Wiring Base.

To specify a control system with a non-recycling running interlock circuit, with infrared (AUTOCHECK) flame detection for surface mounting, select the following:

- 70D10 Control and Cover
- 71D60 Programmer
- 72D1R1 Plug-In Amplifier
- 48PT2 Flame Scanner (specify cable length and mount).
- 60-1386 Wiring Base.

Note the following:

1. When a FIREYE C-Series unit is replaced with a D-Series unit, the chassis retaining clip (for quarter turn fastener) in the wiring base must be replaced with a threaded clip that is supplied with each D series control.



2. Specify programmer 71D70 if spark cutoff is desired before the expiration of pilot flame trial-for-ignition.

Fireeye Series D10-20 controls supersede similar Fireeye Series C Controls and are directly plug-in interchangeable. The following chart illustrates the comparison.

SERIES D		SERIES C
UNIT	COMPONENTS	UNIT
D20-5015	70D20 Control 71D60 Programmer 72DRT1 Amplifier	Type 24CJ5 Model 5015
D10-5016	70D10 Control 71D60 Programmer 72DRT1 Amplifier	—
D10-5065	70D10 Control 71D60 Programmer 72DUV1 Amplifier	Type 25CU6 Model 5065
D20-5066	70D20 Control 71D60 Programmer 72DUV1 Amplifier	Type 25CU6 Model 5066
D10-5022	70D10 Control 71D60 Programmer 72D1R1 Amplifier	Type 26CF6 Model 5066
D20-5023	70D20 Control 71D60 Programmer 72D1R1 Amplifier	Type 26CF6 Model 5023



CAUTION: While all controls in the D Series 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.

INSTALLATION



CAUTION: installer must be a trained safety control technician. Verify that electrical power is disconnected before starting installation. Follow the burner manufacturer's instructions, if supplied. Otherwise proceed as follows:

Wiring Base

Mount the control 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 and be suitable for 75C min. The terminals in the wiring base are designed to permit a variety of connection methods — wire loop, eyelet, lug or quick connect. A green grounding terminal is provided for equipment bonding. Circuit recommendations are provided on page 8. Consult with the factory for assistance with non-standard applications.

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 10 times the rating.

Running and locked rotor 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.



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.

INSTALLING THE PROGRAMMER AND AMPLIFIER MODULES

To assemble or disassemble a control and its plug-in modules, place the unit on a work bench, remove the two module retained hold-down screws and lift off the module retainer. The module retainer **cannot** be removed if the control is secured onto a wiring base.

Insert the appropriate Amplifier module in the slots at the left side of the unit and gently push the module into position. Insert the appropriate Programmer module in the slots at the right side of the unit and gently push the module into position.

Replace the module retainer and tighten the two hold-down screws. The unit **cannot** be installed on a wiring base if the module retainer is not in place.



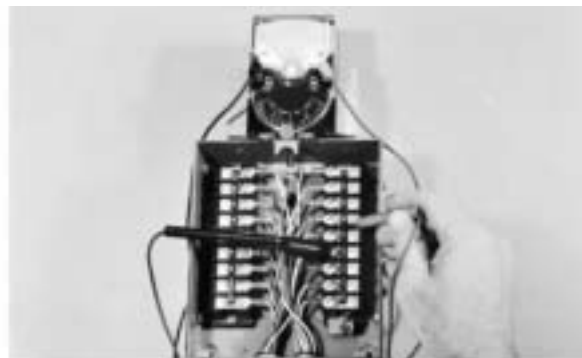
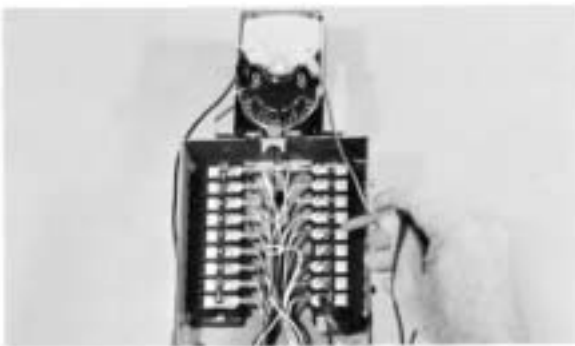
BEFORE INSTALLING THE CONTROL



CAUTION: Make sure that electric power is shut off.

Verify that the supply voltage connected to Terminals L1, L2 is 120 volts AC nominal. 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.

1. Touch the meter probes together and calibrate it accurately to assure 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 meter read other than infinity.



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.
4. 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. Otherwise, the control may be destroyed or improper operation occur.

INSTALLING THE CONTROL



CAUTION: Make sure that electric power is shut off.

1. Check the electrical tabs on the bottom of the chassis—if they are bent out of position, reposition them with your fingers using the angle on the bottom of the red tag shipped with the control as a guide.

2. Insert the slots at the bottom of the assembled control in 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.



Before testing the control operation on the boiler, close the manual main fuel supply. Failure to do this may cause injury or property damage.

Step: 1.

Close the manual main.

Step: 2. Re-check all limit circuit wiring for proper operation and correct connection.

Step: 3. Confirm that the automatic main fuel valves are wired to terminal 7.

Step: 4. Power the control and electrically check the proper sequence of operation according to the *Operation* section in this bulletin.

Step: 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 valve and proceed cautiously through the boiler light off process. Check all safety interlocks for proper shut down of the boiler.

INSTALLATION—UV SCANNERS

Where possible, obtain the Burner Manufacturer's Instructions for mounting the scanner. This information is available for most standard burners manufactured. The scanner mounting should comply with the following General Instructions:

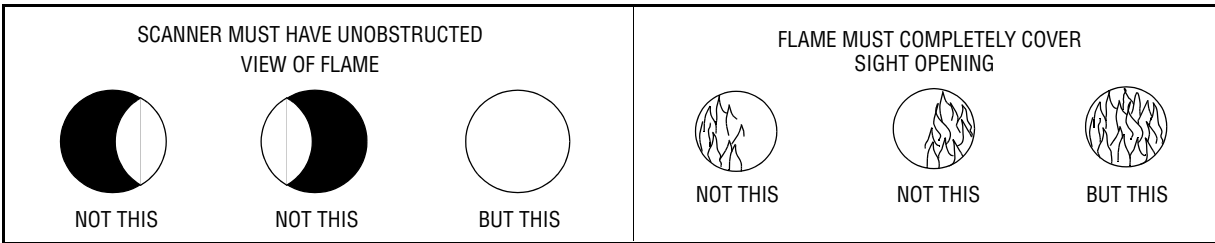
1. Position the UVI, UV2 scanner within 18 inches of the flame to be monitored, the 45UV5 within 30 inches, closer if possible.
2. Select a scanner location that will remain within the ambient temperature limits of the UV Scanner. If cooling is required, use an insulating coupling (Fireye #35-69 for UVI, UV2 Scanners, #35-127-1 for 45UV5) to reduce conducted heat.
3. The UVI, 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 UVI, 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 IPS pipe (UVI- $\frac{1}{2}$ ", UV2- $\frac{3}{8}$ ", 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 UVI, 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. **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.**

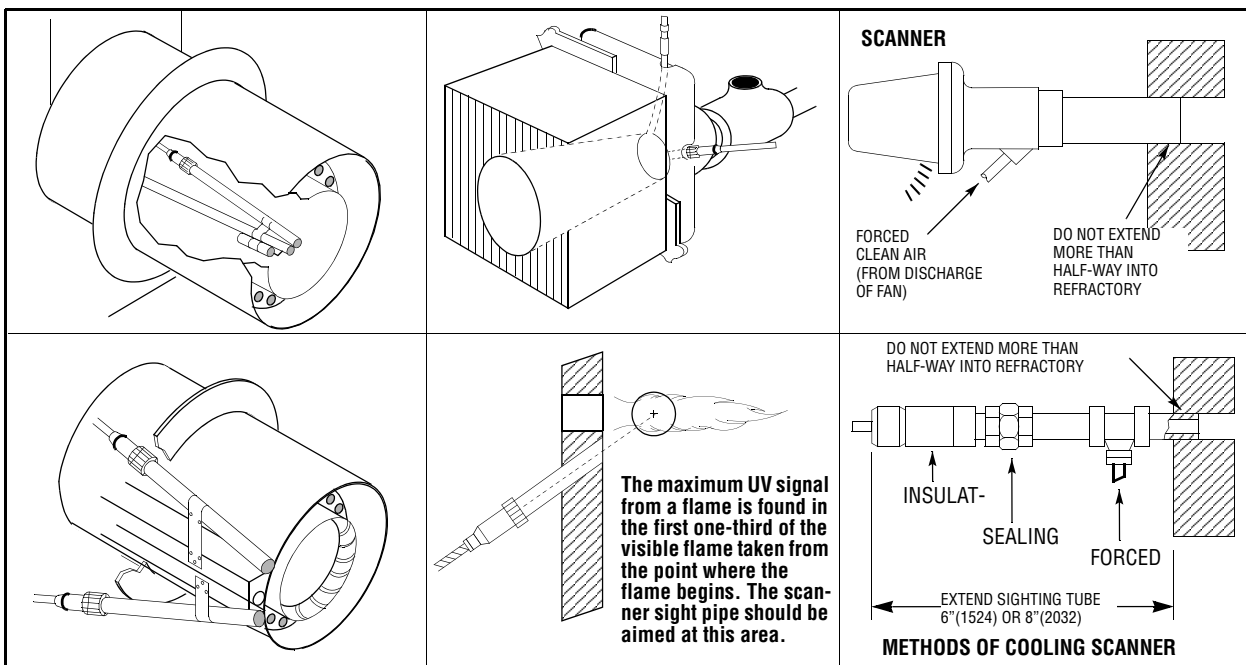
6. Smoke or unburned combustion gases absorb ultraviolet energy. On installations having negative pressure combustion chambers, a small hole drilled in the UVI, UV2 sight pipe will assist in keeping the pipe clean and free from smoke. The 45UV5 has a $\frac{3}{8}$ " plug in the mounting flange that can be removed. For positive pressure furnaces, provide clean air to pressurize the sight pipe, if necessary.
7. Two UVI or UV2 Scanners may be installed on one 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 45UV5-1009 Scanner may be installed on a burner.
8. To increase scanner sensitivity with UVI, UV2 Scanners, a quartz lens permits location of the scanner at twice the normal distance. Use $\frac{1}{2}$ " x $1\frac{1}{2}$ " pipe nipple between UVI Scanner and the coupling. Use $\frac{3}{8}$ " X close pipe nipple and a $\frac{1}{2}$ " x $\frac{3}{8}$ " bushing on UV2 installations.
9. Request the assistance of any Fireye Field Office for recommendations of a proper scanner installation on a non-standard application.

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.



Wiring—UV Scanners

To connect the scanner to the control, the UVI Scanner is supplied with 36" or 72" of flexible cable. The UV2 with 36" of flexible cable. The 45UV5-1009 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.



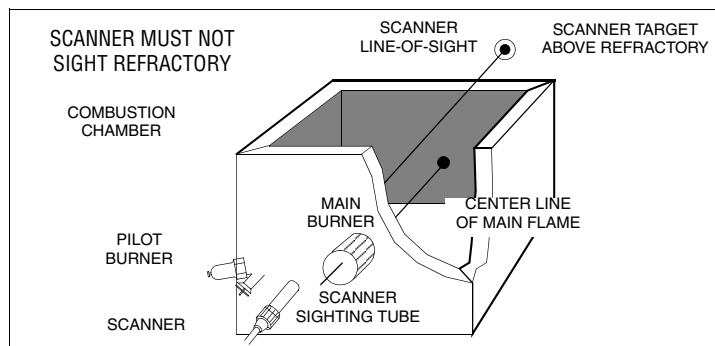
1. Selection of Wire
 - Use #14, 16, or 18 wire with 75°C, 600 volt insulation for up to 100 foot distances (signal loss approximately 20% at 100 feet).
 - For extended scanner wiring up to 500 feet, and for shorter lengths to reduce signal loss, use a shielded wire (Belden 8254-RG62 coaxial cable, or equal) for each scanner wire of UV I, UV2 and red wires of 45UV5-1009. 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 same conduit with flame detector wires.

INSTALLATION — INFRARED SCANNER TYPE 48PT2

Where possible, obtain the burner manufacturer's instructions for mounting the scanner, otherwise proceed as follows: A single scanner is used to detect both pilot and main flames. The sight pipe on which the scanner mounts must be aimed so that the scanner sights a point at the intersection of main and pilot flames.

Proper scanner positioning must assure the following:

1. Reliable pilot flame signal.
2. Reliable main flame signal.
3. A pilot flame too short or in the wrong position to ignite the main flame reliably, must not be detected.
4. Scanner must have unobstructed view of flame being monitored.
5. Flame being monitored must completely cover 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).
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 a 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 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 Firetron 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.
4. Make sure sighting tube does not extend more than halfway into refractory wall.
5. Use Fireeye Sealing Union (Part No. 60-801) when using method 3 above.

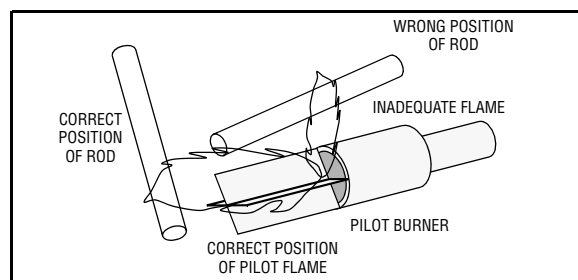
INSTALLATION—69ND1 FLAME ROD

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

The flame rod may be located to monitor only the gas pilot flame or both the gas pilot and main gas flames. It is mounted on a 1/2" N.P.T. coupling. The following instructions should be observed:

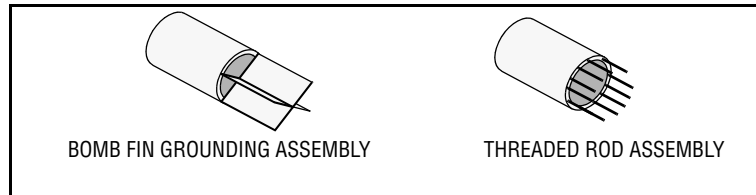
1. Keep flame rod as short as possible.
2. Keep flame rod at least 1/2" any refractory.
3. Flame rod should enter the pilot flame from the side so as to safely prove an adequate pilot flame under all draft conditions.
4. If the flame is nonluminous (air and gas mixed before burning), the electrode tip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

Note: Interference from the ignition spark can alter the true test-meter 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, and may be made ineffective 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.



DESCRIPTION OF OPERATION

Fireye Control Type 70D10 (with non-recycling running interlock circuit), 70D20 (with recycling running interlock circuit) and Programmer type 71 D60, 71 D70 and with amplifier 72DIRI (infrared), 72DUVI (UV), 72DUVS4 (UV-SC), 72DRTI (Rectification), provide the following burner operation:

Note: For direct spark ignited oil burners, substitute the words “main oil valve” for “pilot valve.”

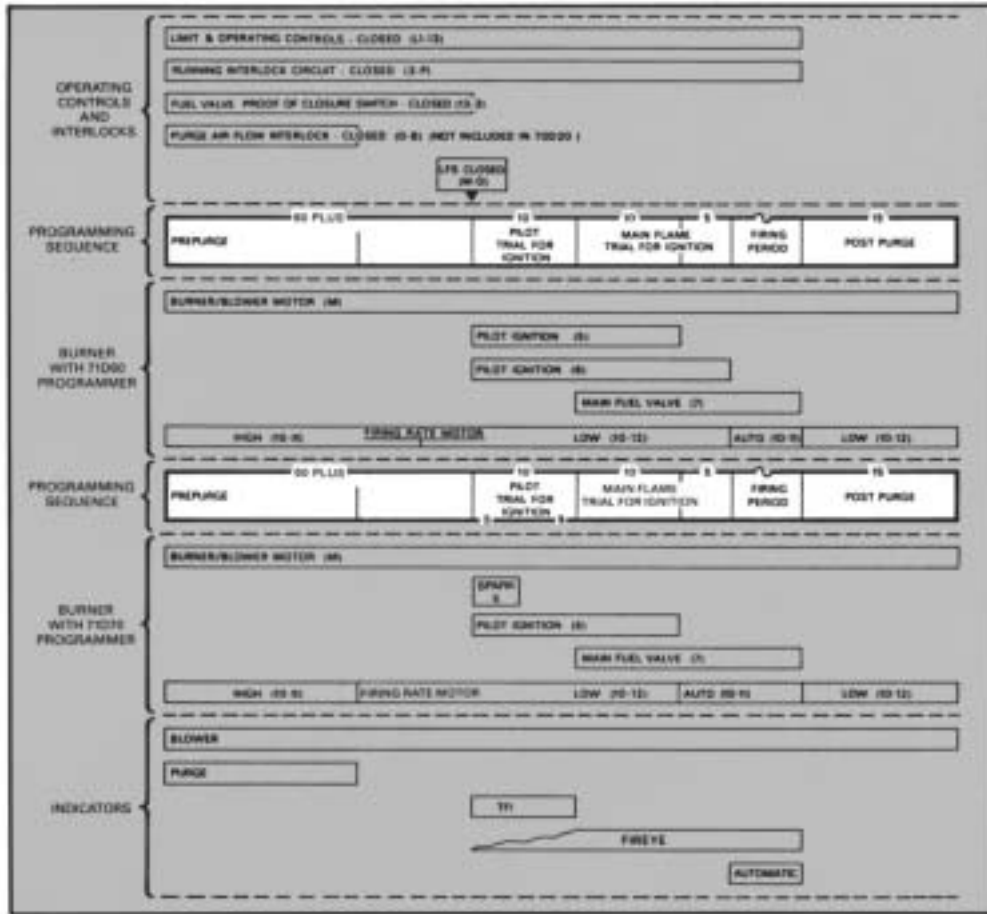
Start-up

1. With power applied, the limit-operating control circuit closed and the main fuel valve interlock closed, the burner/blower motor (Terminal M) is energized, the running interlock circuit (air flow switch) closes. The “Blower” indicator (LED), and “Purge” indicator (LED) lights.
2. The firing rate motor is driven toward the open damper position.
3. Control type **70D10** - when the firing rate motor reaches its open damper position (Highfire), the open damper interlock closes and initiates the prepurge interval of 30 seconds. If the interlock does not close, the programming will pause until it closes. Control type **70D20** - a prepurge of 30 seconds is initiated
4. When the prepurge is completed, the “Purge” indicator (LED) goes out, the firing rate motor is driven toward the low fire position.
5. Following the 30 second delay to permit the firing rate motor to reach the low fire position, a check is made for the low fire start interlock. If it is not closed, the programming sequence will pause until it closes.
6. With proven low fire position, the spark ignition and pilot valve are energized (Terminal 5 and 6). The “TFI” indicator (LED) lights.
7. Programmer 71D70 deenergizes the spark ignition after 5 seconds, when connected to Term. 5.
8. When the pilot flame is proven, the “Fireeye” indicator (LED) lights.
9. Following a 10 second proven pilot stabilization period, the main fuel valve(s) (Terminal 7) is energized. The TFI indicator (LED) goes out.
10. With 71D60 programmer, following a 10 second (Terminal 5) or 15 second (Terminal 6) main flame trial for ignition, the pilot ignition is deenergized. With 71 D70 programmer, following a 10 second main flame trial for ignition, the pilot ignition (Terminal 6) is deenergized. The firing rate motor is released to automatic control, and the “AUTO” indicator lights.
11. End of supervised start-up program.

Normal Shutdown

1. When the operating control circuit opens, the main fuel valve is deenergized, the firing rate motor is driven to the closed damper position.
2. Following a 15 second post purge, the burner/blower motor is deenergized.
3. All indicators (LED) go out.

Note: If the main fuel valve interlock is not closed at the start, the control will not initiate a start up—(70D10 will lock out). If it opens during the prepurge—and remains open, the programming sequence will not proceed. The burner/blower motor will be deenergized in 15 seconds



Safety Shutdown

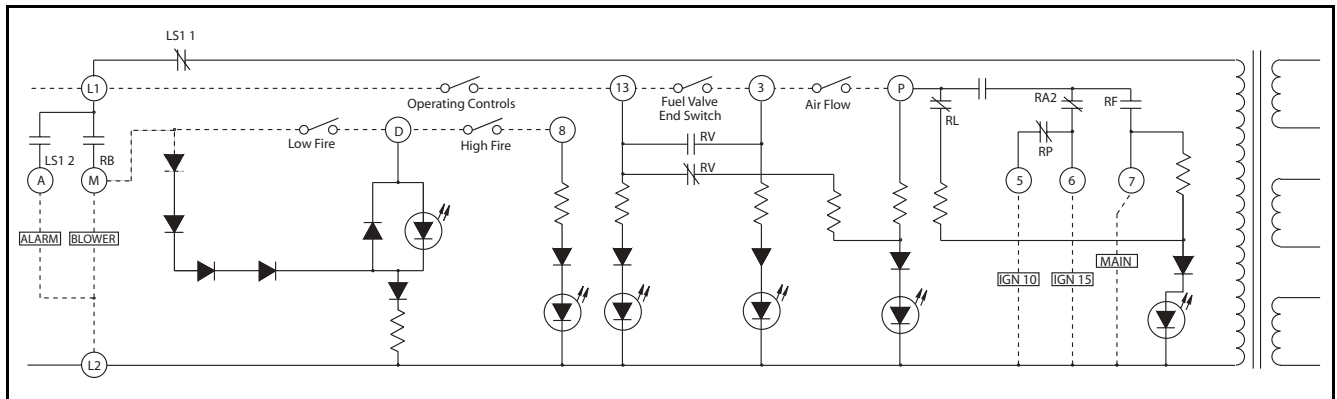
- Control D10.** If the running interlock circuit does not close, the control will lock out and the blower motor will be de-energized. If the interlock circuit opens during a firing period, all fuel valves will be de-energized and the control will lock out. **Control D20.** If the running interlock circuit does not close, the burner/blower motor will continue to run. The start-up programming sequence will not be initiated. If the interlock circuit opens during a firing period, the burner will be shut off, and a new start up programming will be initiated.
- If pilot flame is not detected during the 10 second pilot trial for ignition period, the pilot valve and ignition transformer will be deenergized and the control will lockout on safety.
- If main flame is not detected at the end of the main flame trial for ignition period, all fuel valves will be deenergized and the control will lockout on safety.
- If the main flame fails during a firing cycle, all fuel valves will be deenergized within 4 seconds after loss of flame signal and the control will lockout on safety.
- Manual reset is required following any safety lockout.

Description of Functions of Operating Controls

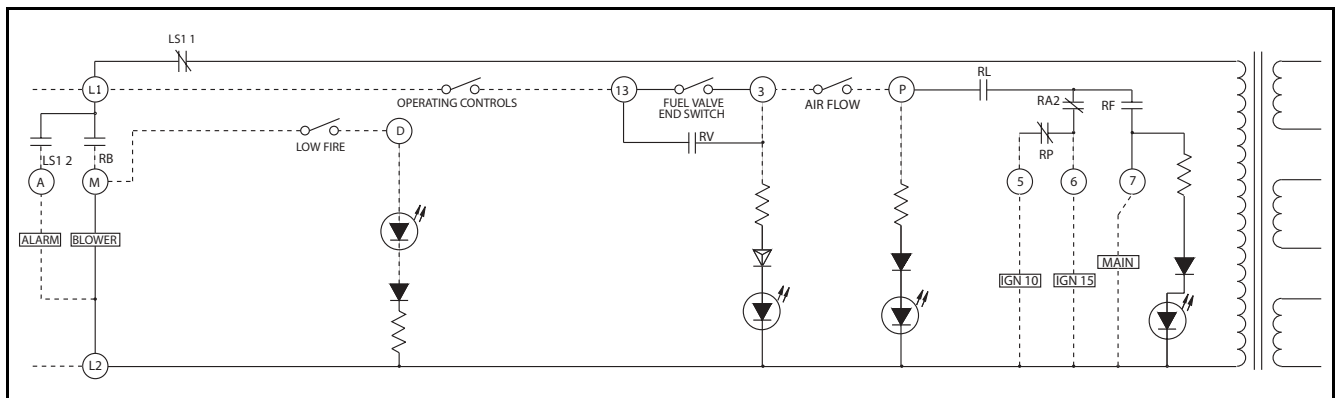
- Operating Controls:** Generally pressure or temperature activated. Normally, when the operating control closes, the burner start-up programming starts. When the operating control opens, the burner shuts off. They are connected between Terminals L1 and 13. **Limit switches:** Generally pressure, water level or temperature activated.
- Recycle** - When it is desired to stop the burner when the limit switch opens and restart it when the limit switch closes, they are connected between Terminals L1 & 13.
- Non-Recycle** - With the D10 unit, 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 deenergized and the control will lockout on safety. If the limit switch opens momentarily during the prepurge period and recloses, the purge period will be extended for the amount of time the switch was open. If the limit switch stays open during the purge period, the control will lockout on safety.

SIMPLIFIED SCHEMATIC DIAGRAM 70D10 CONTROL



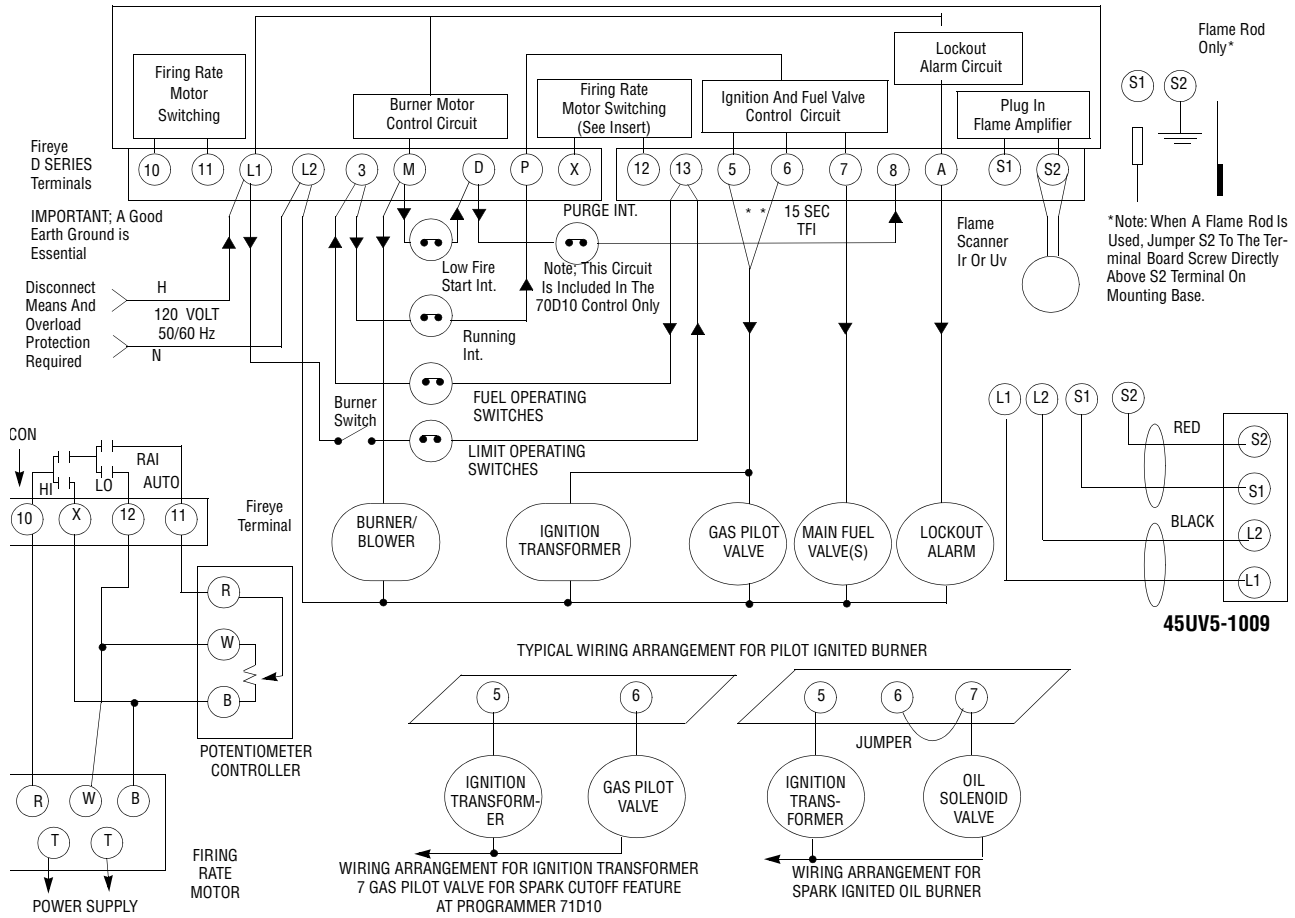
SIMPLIFIED SCHEMATIC DIAGRAM 70D20 CONTROL



4. Fuel Valve Proof of Closure Interlocks: Usually an integral switch mounted on the main fuel valve and activated by the valve stem and is connected between Terminal 3 and 13. The valve proof of closure interlock prevents a burner start-up if the valve stem is not in the *valve closed* position.

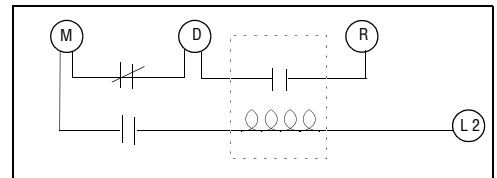
Note: The use of a Fuel Valve End Switch is highly recommended. All D-Series systems have this provision and when properly connected, the switch will add additional safety to prevent hazardous situations.

5. Purge Interlock: Generally a firing rate motor linkage position switch or a differential air-pressure switch, that proves a purge air flow rate. It is connected between terminals D & 8 on the D10. The purge interlock proves that the purge air-flow rate is at maximum during the purge.
6. Running Interlocks: Generally are air flow switches, high and low fuel pressure switches, oil temperature switches, atomizing medium 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.
7. Low Fire Start Interlocks: Generally a firing rate motor linkage position switch or a damper position switch, that prove the linkage and dampers are in their proper positions for burner light off. They are connected between Terminals M and D.



USE OF AUXILIARY DEVICE IN M-D-8 CIRCUIT AT 70D10 CONTROL

The function of the low fire start and high fire purge interlock circuits internally in a new Fireye 70D10 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. If a need arises for an auxiliary function such as an extended purge timer, it may be connected as shown on right.



INSTALLATION TESTING

To test the Series D10-20 controls for flame signal, a 1,000 ohm/volt (or greater) DC voltmeter or a Digital meter with input impedance of 500K ohms or greater, should be used, set on a scale to read the following test voltages:

Flame Signal	DC Test Voltage
Drop Out	Normal
5 volts	20-25 volts

Note: The Fireye 45UV5-1009 is a repetitive self-check scanner that contains a highly reliable shutter that closes every 4 seconds to initiate a system check. When the shutter closes, the test jack voltage should go down to approximately zero, and then back to the normal reading in about 2 seconds. To assure sufficient flame signal margin to hold in the flame relay during random momentary downward fluctuations of flame signal, it is recommended that a signal close to normal be obtained. The leads from the test meter plug into the red and black test jacks on the amplifier (red + black -).

Normal Pilot Flame Test



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

1. Place the “check-run” switch on the programmer in the “check” position. A small tool such as a screwdriver is required. Turn power on and initiate a normal start-up.
2. Observe the pilot flame signal on the test meter. If the average voltage is below normal, readjust the pilot flame or realign the detector.
3. During the pilot flame test and adjustment period, if flame is not detected the control will lock-out. To reestablish the pilot flame trial for ignition (TFI), manual reset of the lock-out switch is required, and a complete repurge 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 TFI light comes on, observe the test meter which should read no more than 1 volt. If more than 1 volt is observed realign the UV scanner, and/or shield the spark from the scanner's view. Programmer 71D70 provides for ignition spark cutoff prior to pilot flame proving when the ignition transformer is connected to Terminal 5 to assist with installations where UV radiation from spark ignition is difficult to eliminate from the view of the UV scanner.
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 deenergize the pilot assembly at the end of the trial for ignition interval, and the control will lockout. The “check-run” switch must be in the “run” position for this test.

MEASURING TEST JACK VOLTAGE

Main Flame Test (This test requires an interrupted pilot).

1. Proceed through a normal startup. After the pilot flame is shut off, observe the reading on the test voltmeter. If the voltmeter 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 deenergized. The alarm circuit will be energized following safety lockout.



Minimum Pilot Test

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 repositioning of the flame detector. This procedure should not be used on a direct spark ignited burner.



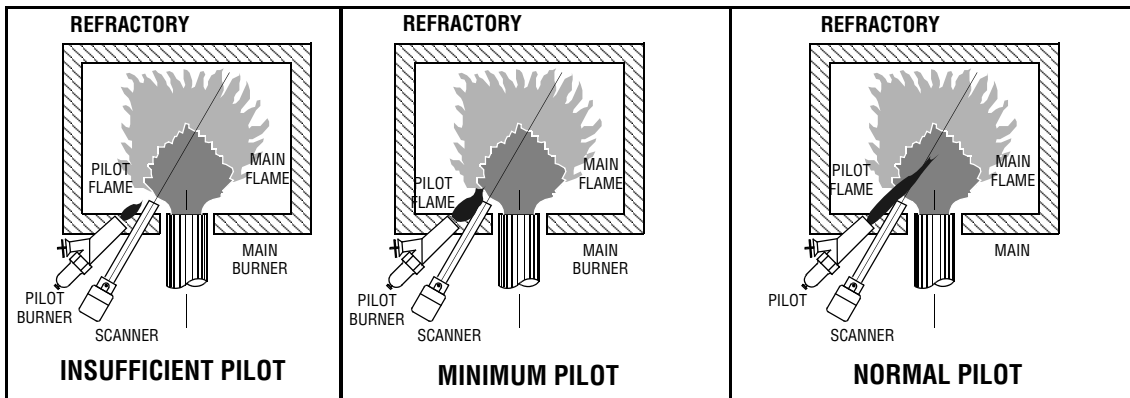
CAUTION: The minimum pilot test must be accomplished by a qualified burner technician.

1. Turn off the main fuel supply manually.
2. Place the “check-run” switch in the “check” position.
3. Turn power on and initiate a normal start-up.
4. Reduce the fuel supply to the pilot until the “Fireye” light goes out. (If a test meter is used, the DC test jack voltage will be below 5 volts.)
5. Slowly increase the fuel to the pilot until the DC test jack voltage reads about 16-20 volts. This is the minimum pilot flame that the flame detector will reliably detect.
6. 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.
7. Observe the light-off of the main flame. It must be smooth and normal.



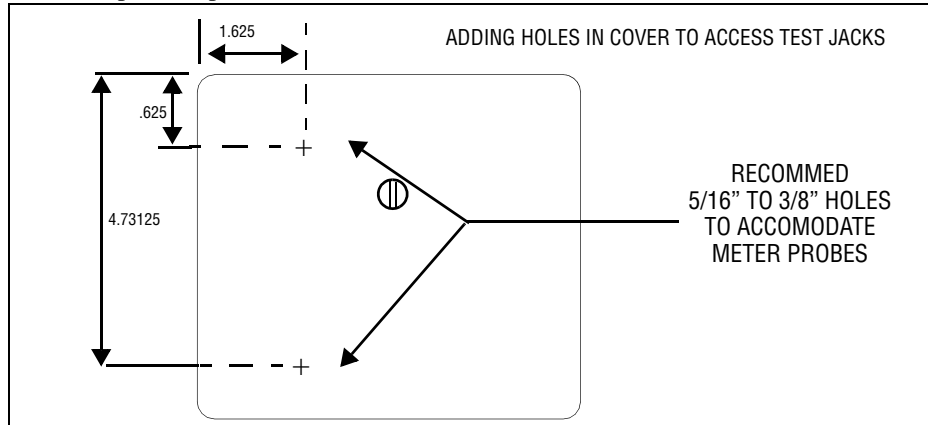
8. CAUTION: If the main flame does not ignite immediately, shut off the main fuel. Realign the detector to require a larger minimum pilot flame.

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



EXTERNAL METER CONNECTIONS

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



Test for Incandescent Refractory Hold-In With Photocell Detector

Type 45CM I 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 "Fireye" light (LED), which must go out within 4 seconds.
4. If the flame failure response time exceeds 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.

Operational Test

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 shutoff of all fuel valves.

Note: Before attempting to reset the lockout switch, wait approximately 2 minutes for the lockout switch heater to cool.

SERVICING



Caution: Only trained and qualified Safety Control Technicians should attempt to service Flame Safeguard Control installations. Special care must be exercised in troubleshooting a burner control system. Electrically live parts are exposed when covers of devices are removed. Additionally, safety interlocks and limit switches (air flow, fuel pressure, LWCO, etc.) should not be jumpered out during troubleshooting, nor should any attempt be made to eliminate or alter any portion of the programming sequence beyond use of the “Run-check” switch during the pilot “trial for ignition” period of pilot ignited burners.

Servicing of Fireeye D Series units is facilitated by the use of Plug-in Programmer and Amplifier modules. Trouble with installations equipped with Fireeye 70D10, 70D20 Controls can be readily isolated by following the procedure in the sequence listed below. An AC-DC test meter is required. Test points are located on the chassis board to assist with measuring line and load voltages (150 volt AC scale).

Before beginning any troubleshooting, make sure that:

1. Installation and wiring have been made in accordance with the installation instructions.
2. Contact tabs on bottom of chassis are not bent out of position.
3. Chassis is properly secured to the wiring base.
4. The programmer is securely plugged in and the “Run- Check” switch is in the “Run” position.
5. The correct amplifier for the method of flame detection desired is securely plugged in
6. The flame detector is clean.
7. The lockout switch is reset.

Voltage at Terminal S1, S2, should read approximately 560 volts AC for 72DUV1, 72DUVS4 and 72DUVSIT Amplifiers, 7 volts DC for 72DIRI Amplifier, 280 volts AC for 72DRTI Amplifier, with power on, and burner off.





TROUBLESHOOTING

In the following tabulation, trouble symptoms appear below and possible causes listed underneath.

Note: For direct spark ignited oil burners, substitute the words "main oil valve" for "pilot valve".

1. Zero volts at Terminals LI-L2. All indicators off.
 - Electrical disconnect switch off.
 - Blown fuse or tripped circuit breaker.
 - Bent tab on bottom of control.
 - Broken wire, loose connection or wiring error.

2. Low volts at Terminals LI-L2. All indicators off.
 - Minimum operating voltage 102 volts.

3. Zero volts at Terminals 13-L2. All indicators off.
 - Burner on-off switch off.
 - Open limit switch or operating control.
 - Bent tab on bottom of control.
 - Broken wire, loose connection or wiring error.

4. Zero volts at Terminals 3-L2. 70D10—"Purge" indicator on, unit locks out. 70D20—All indicators off.
 - Fuel valve proof of closure switch open (or jumper wire not installed at terminals 13-3).
 - Bent tab on bottom of control or broken wire, loose connection or wiring error.
 - Replace 70D series control.

5. Burner-Blower motor does not start. "Blower" and "Purge" indicators on.
 - Motor electrical power off.
 - Blown fuse or tripped circuit breaker.
 - Broken wire, loose connection or wiring error. or Bent tab on bottom of control.
 - Defective motor or motor contactor.
 - Replace 70D series control, if no voltage at terminals M-L2.

6. Burner-Blower motor starts. Purge is not initiated. "Blower" indicator on, 70D10 locks out, 70D20 doesn't. |
 - Running interlock circuit open, terminal 3-P.
 - Broken wire, loose connection or wiring error. or bent tab on bottom of control.
 - Replace 70D series control.

7. Burner-Blower motor runs, control locks out "Blower", "Purge", "Fireye" indicators on.
 - Flame scanner is detecting actual flame.
 - Replace flame scanner or correct scanner wiring.
 - Replace 72 series amplifier module. or replace 70D series control.



8. Firing rate motor does not drive to high fire. “Blower” and “Purge” indicators on.
 - Firing rate motor not powered or defective.
 - Linkage jammed.
 - Broken wire, loose connection or wiring error. **or** bent tab on bottom of control.
 - Replace 71D series programmer module. **or** replace 70D series control.
9. Firing rate motor drives to high fire position, and stays there forever. “Blower” and purge indicator on.
 - 70D10—Purge interlock circuit (High fire) not closed, Terminals D-8.
 - Linkage jammed.
 - Broken wire, loose connection or wiring error.
 - Bent tab on bottom of control.
 - Replace 71D series programmer module. **or** replace 70D series control.

Note: Test the Low Fire Interlock (M to D) and purge interlock (D to 8) on a 70D10 control installation with an AC voltmeter as follows. The burner blower must be operating. Measure D to L2 and with Low Fire Interlock closed obtain 120 V; with L.F.I. open obtain 30 to 42 VAC. Measure 8 to L2 and with Hi Fire Interlock switch closed obtain 30 to 120 VAC and with H.F.I. open obtain 0 VAC.

10. Firing rate motor returns to low fire, pilot ignition (Terminals 5, 6) not powered after short delay. “Blower” indicator on.
 - Low fire start interlock not closed, Terminals M-D.
 - Bent tab on bottom of control.
 - Replace 71D60 programmer module. **or** replace 70D series control.
11. Pilot ignition Terminals 5-6 powered momentarily and then control locks out. “Blower,” “TFI” indicators on. — Replace 70D series control.
12. Pilot flame not established. “Blower” and “TFI” indicators on, “Fireye” indicator off.
 - Defective pilot valve, ignition transformer, electrode or adjustment.
 - Improper gas pressure or burner adjustment.
 - Broken wire, loose connection or wiring error.
 - Bent tab on bottom of control.
 - Replace 70D series control.
13. Pilot flame lights, but is not detected. “Blower” and “TFI” indicators on, “Fireye” indicator off. (No test jack voltage)
 - Scanner does not see adequate pilot flame.
 - Broken wire, loose connection or wiring error.
 - Bent tab on bottom of control.
 - Replace 72 series amplifier module. **or** replace flame scanner.
 - With UV units, remove factory installed grounding wire (if present) from Terminal S2 on the wiring base.
14. Main flame not established following 10 second pilot flame “TFI.” “Blower” and “Fireye” indicators on.
 - “Run-check” switch in “check” position.
 - Inadequate main fuel supply. **or** defective main fuel valve.
 - Main burner improperly adjusted.



- Broken wire, loose connection or wiring error. **or** bent tab on bottom of control.
 - Replace 70D series control.
- 15.** Main flame lights and then goes out. “Blower” indicator on.
- Main flame and pilot blow out.
 - Limit operating control circuit (Terminals L 1-3) or running interlock circuit (Terminals 3-P) opens momentarily.
- Note: 70D10, if running interlock circuit opens, control will lock out. 70D20, if running interlock circuit opens, control will recycle.*
- 16.** Main flame lights normally, but goes out when pilot flame is shut off. “Blower,” “Fireye,” “Auto” indicators on.
- Gas pilot valve stuck open.
 - Wiring error.
 - Replace 70D series control.
- 17.** Firing rate motor does not respond to demand at end of main flame “TFF”. “Blower,” “Fireye,” “Auto” indicators on
- Potentiometer controller set too low or in manual mode.
 - Broken wire, loose connection or wiring error.
 - Bent tab on bottom of control.
 - Replace 71D series programmer. **or** replace 70D series control.
- 18.** Flame signal drops off while main burner is firing and modulating. “Blower”, “Auto” indicators on. “Fireye” indicators off.
- Burner is not properly adjusted.
 - Flame scanner loses sight of flame.
 - Control and/or flame scanner subjected to excessive temperature.
- 19.** Main fuel valve does not close when operating control opens. “Blower, “Fireye” indicators on.
- Main fuel valve stuck open.
 - Wiring error.
- 20.** During post purge period, firing rate motor does not drive to low fire position. “Blower” indicator on.
- Firing rate motor not powered or defective.
 - Linkage jammed.
 - Broken wire, loose connection, wiring error.
 - Bent tab on bottom of control.
 - Replace 70D series control.
- 21.** Burner, Blower motor does not stop following postpurge period. All indicators off.
- Motor contactor defective.
 - Wiring error.

Note: If operating control recloses during the post purge period, a complete restart is initiated. Do not momentarily depress the lockout reset button to recycle the unit, as it will cause some units to lockout. Open and reclose the burner control switch instead.



MAINTENANCE

Type 48PT2 IR and Type UV1, UV2, UV8A and 45UV5-1009 UV Scanners

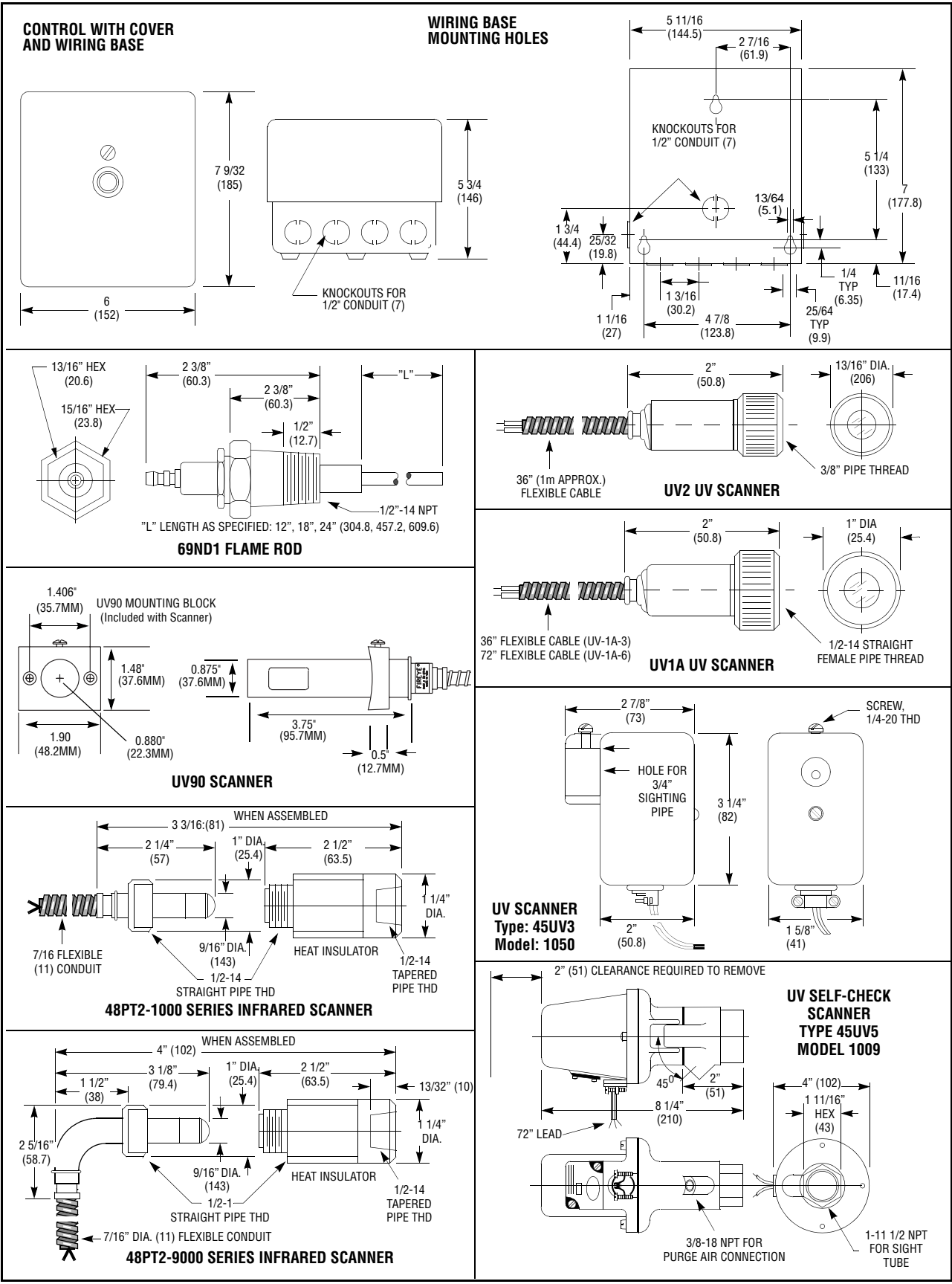
The viewing area of the scanner must be kept clean. Even a small amount of contamination will reduce the flame signal reaching the detector by a measurable amount. Wipe the viewing area routinely using a soft cloth dampened with concentrated detergent. Type **48PT2** Scanners include a replaceable #4-263-1 Firetron cell. Type **45UV5-1009** 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 on a DC test meter plugged into the test jack of the Amplifier will forewarn of any deterioration in the capability of the flame detector or its application.

Contacts: There are no accessible contacts in the Fireeye D10, D20 D Series Controls. Where contacts are used, their design assures long trouble-free life when the load circuits are maintained within the published load ratings. **Humidity:** In areas of high humidity, the control chassis should be removed and placed in a dry atmosphere when the system is expected to be out of service for an extended period. **Periodic Safety Check:** It is recommended that a procedure be established to test, at least once a month, the complete flame safeguard system. This test should verify the proper operation of all limit switches and safety interlocks as well as flame failure protection and fuel safety shut-off valve tightness. **Rotation:** It is recommended that control and scanner units purchased as spares be installed periodically.

Suggested Specs. for Burner Manage Control for Automatically Ignited Oil or Gas or Combination Fuel Burners

1. Each burner shall be equipped with an electronic programming flame safeguard control that is approved by UL, FM, CSA.
2. The programming sequence shall be completely controlled by solid state timing logic. The programmer shall be a plug-in module.
3. The control shall provide for the direct connection of limit and operating controls, Fuel valve interlock, damper position interlocks, running interlocks such as air flow, fuel pressure and temperature, and Burner Motor, Ignition, Main fuel valves, Firing rate motor and lockout alarm.
4. Operational test facilities shall be provided for measuring flame signal strength and line and load voltages.
5. The control shall be a Plug-in design.
6. Plug-in solid state flame amplifiers shall be provided for Rectification, Infra-red ("AUTOCHECK"), Ultraviolet or Ultraviolet repetitive self-check flame detection (select one).
7. The Burner Management Controls shall be Fireeye Series D10-20





NOTICE

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

WARRANTIES

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



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