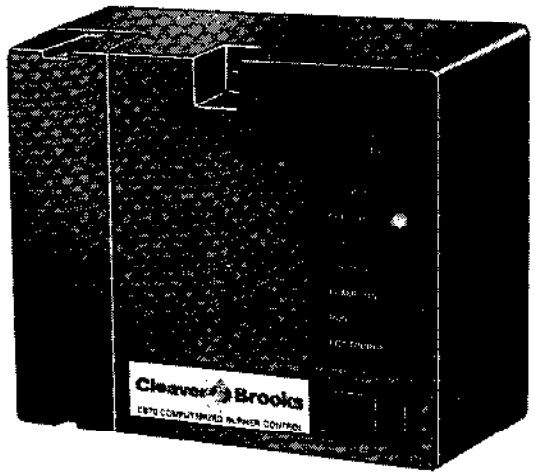
INSTRUCTIONS

Cleaver-Brooks

DIVISION OF AQUA-CHEM, INC.

MODEL CB70
COMPUTERIZED BURNER CONTROL



APPLICATION

THE CB70 is an intelligent microcomputer-based integrated control system for gas, oil, or combination fuel single burner applications. Its principal control and logic element is a high reliability microcomputer that is programmed to provide levels of safety, functional capability, and features beyond the capacity of conventional electromechanical or discrete solid state controls.

The CB70 is Underwriter Laboratories Inc. component recognized, Canadian Standards Association certified, Factory Mutual approved, and Industrial Risk Insurers approvable for automatic fired boilers.

Functions provided by the CB70 Computerized Burner Control include automatic burner sequencing, flame supervision, status indication, first-out annunciation, self-diagnostics, and energy conservation.

FEATURES

DYNAMIC SELF-CHECK provisions continuously monitor system performance to ensure proper operation.

SAFETY FEATURES include:

Dynamic Self-Check logic.
Expanded Safe Start Check.
Dynamic Input Check.
Closed Loop Output Check.
High Fire Purge Switch Test.
Low Fire Start Switch Test.
Tamper resistant timing and logic.

FIRST-OUT ANNUNCIATION and SYSTEM DIAGNOSTICS are provided by a numeric display. Service Codes and time in sequence are alternately displayed.

FAULT CODES isolate the cause of a safety shutdown.

HOLD CODE identifies the cause of a failure to start or procede in the burner control sequence.

LED SEQUENCE STATUS LIGHTS provide positive visual information regarding program position and alarm status.

FIELD-SELECTABLE ENERGY-SAVING FEATURES reduce unnecessary purge-related heat losses.

CB70 UNIVERSAL SYSTEM CHASSIS provides standard burner program sequence, timing, and features with the plug-in PM70 Program Module. Mounts on the standard 833-1966 wiring subbase.

CB70 accepts the standard solid state plug-in flame signal amplifiers.

TRIPLE FUNCTION TEST SWITCH halts the sequence at the end of prepurge, during pilot trial, and drives the firing rate to low fire during run cycle.

DE-BOUNCED INTERLOCK CIRCUITS reduce nuisance shutdowns due to intermittent/bouncing limit switches.

MICROCOMPUTER TECHNOLOGY provides dependable, long-term operation.

SPECIFICATIONS

CB70 Computerized Burner Control features a universal chassis with the burner sequencing and interlock circuits determined by the PM70 Plug-in Program Module, a wiring subbase, and a matching infrared or ultraviolet amplifier and flame detection system.

SEQUENCE PARTICULARS:

Prepurge—30-second proven high fire (IRI applications);
Pilot Flame Establishing Period—10 seconds.
Main Burner Flame Establishing Period—10 or 15 seconds.
Postpurge—15 seconds.
Flame Failure Response Time—2 to 4 seconds.

ELECTRICAL RATINGS:

Voltage and Frequency: 120 Vac (+10, −15%), 60 Hz (+, −10%). Power Consumption (no loads connected to the output terminals): CB70—25 W maximum.

Maximum Total Connected Load—1800 VA.

Form Number CB18-6363

TERMINAL	TYPICAL LOAD	MAXIMUM RATING AT 120 Vac, 60 Hz
5 or 6	Ignition Transformer/Pilot Valve	4.5 amp ignition and 50 VA pilot duty OR 2.5 amp ignition and 75 VA pilot duty
7	Main Fuel Valve(s) (Solenoid/ Motorized/ Diaphragm) and Vent Valve if required	250 VA pilot duty OR 65 VA pilot duty in parallel with motorized valve or valves using a total of 1150 VA locked rotor (inrush), 460 VA to open, and 250 VA to hold OR motorized valve or valves using a total of 1500 VA locked rotor (inrush), 600 VA to open, and 250 VA to hold
8	Burner Motor	9.8 amp full load, 58.8 amp locked rotor (inrush)
9	Alarm	75 VA pilot duty
10,11,13 and 16	Firing Rate (damper) Motor Contacts	75 VA pilot duty

NOTE: Allowable inrush can be up to 10 times the pilot duty rating.

EXAMPLE—Pilot Duty Rating = 50 VA.
At 120 V, running current is
$\frac{50}{120}$ = 0.42 ampere

Maximum allowable inrush is
10 times 0.42 = 4.2 amperes

Interlock Ratings—

INTERLOCKS	REQUIREMENTS Must be able to carry and break current to:
Limits, Burner Controller, Preignition (valve closed) Interlocks, and Lockout Interlocks (including Airflow Switch)	Ignition transformer, pilot valve, and main fuel valve(s)

AMBIENT OPERATING TEMPERATURE RATING:
Wall mounted: 32 F to 130 F [0 C to 55 C].
Horizontal mounting: 32 F to 125 F [0 C to 53].
STORAGE TEMPERATURE RATING: −30 F to 150 F [−34 C to +66 C).
MOUNTING: 3-sided 833-1966 Wiring Subbase with 20 knife-blade contacts.
DIMENSIONS: See Figs. 3 and 4.
WEIGHT: 8 lb. (3.6 kg).
APPROVAL BODIES:
UNDERWRITERS LABORATORIES INC. LISTED SECTION OF PRIMARY SAFETY CONTROL: File No. MH11790; Guide No. MCCZ.
CANADIAN STANDARDS ASSOCIATION CERTIFIED: Certified, LR52545-1.
FACTORY MUTUAL APPROVED: Report No. J.I. 1F6A1.AF.
INDUSTRIAL RISK INSURERS: Approvable.

ORDERING INFORMATION

Specify—	PART NUMBER
1. CB70 Computerized Burner Control (BC7000L1018)	833-2290
2. PM70 (60 HZ) Program Module	833-2291
3. Wiring Subbase 3-sided (Q520A1170)	833-1966
4. Flame Detection System	
Infrared System	
Flame Detector, Infrared (C7015A1118—includes lead sulfide cell, bushing with magnifying lens, and heat block)	817-1742
Plug-In Flame Signal Amplifier, Red—	
Standard Model (R7248A1046—with 2-4 sec flame failure response time)	833-2204
Dynamic Ampli-Check Model (R7248B1010—with 2-4 sec flame failure response time)	833-2205
Ultraviolet System	817-1743
Flame Detector, Ultraviolet (C7027A1023)	
Plug-in Flame Signal Amplifier, Violet	
Standard Model (R7249A1037—with 2-4 second flame failure response time)	833-2207
Order Separately	
5. Accessories and Service Parts:	
Flame Simulator, Ultraviolet (12514A— for 833-2207 Amplifiers only)	881-248
Meter Connector Plug (196146)	884-72
Lead Sulfide Cell (104662D)	817-1801
Test Meter (W136A includes 196146 Meter Connector Plug)	

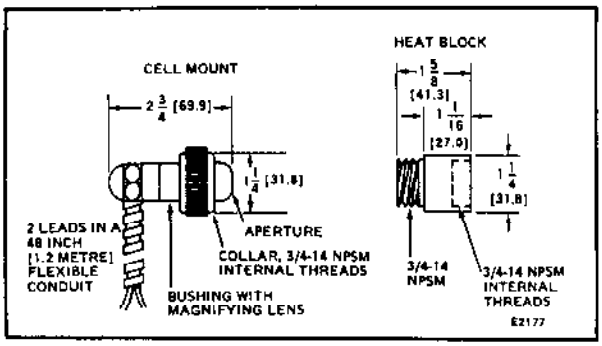


FIG. 1—INSTALLATION DIMENSIONS OF THE 817-1742 INFRARED FLAME DETECTOR (in in.).

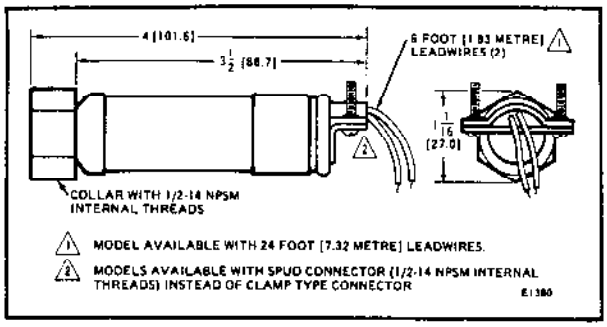


FIG. 2—INSTALLATION DIMENTIONS OF THE 817-1743 ULTRAVIOLET FLAME DETECTOR (in in.).

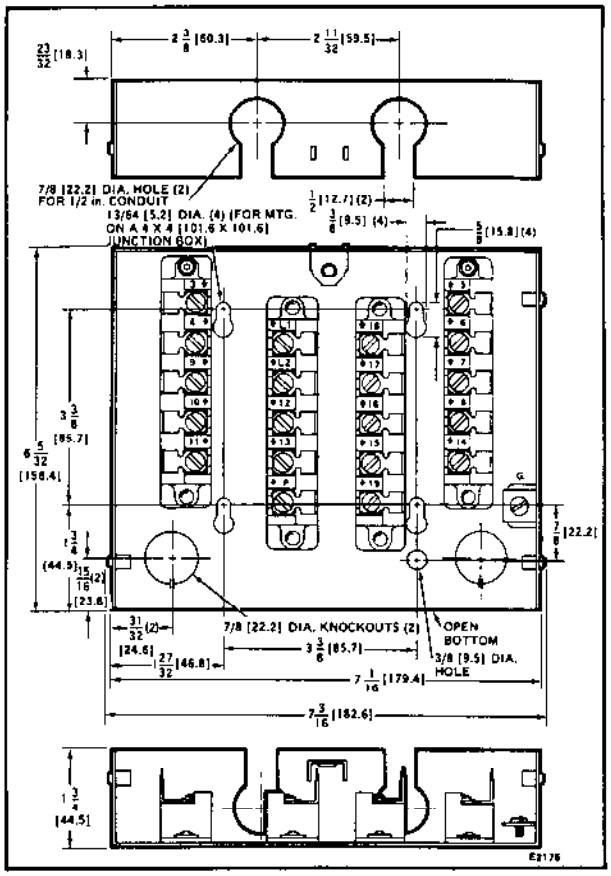


FIG. 3—MOUNTING DIMENSIONS OF THE 3-SIDED 833-1966 SUBBASE (in in.).

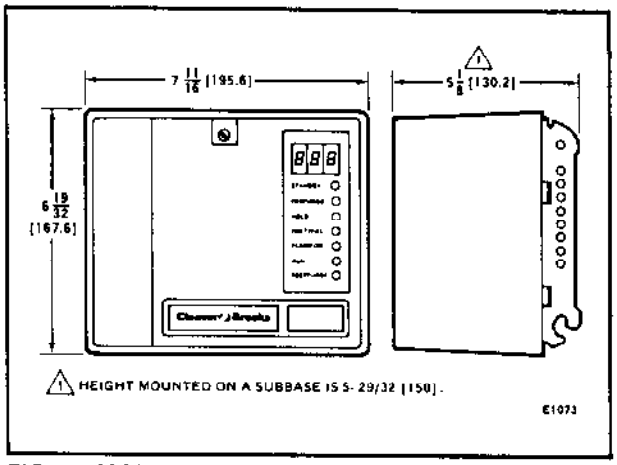


FIG. 4—MOUNTING DIMENSIONS OF THE CB70 (in in.).

PRINCIPAL TECHNICAL FEATURES

The CB70 Computerized Burner Control performs all customary flame safeguard functions while providing significant advancements in the areas of safety, annunciation, self-diagnostics and energy conservation.

SAFETY PROGRAMS

Since combustion safety is the main task of the CB70 Computerized Burner Control, 60 percent of the running time of the microcomputer is devoted to doing 15 different but overlapping safety routines. More than 400 safety checks are performed every second that the CB70 is in operation to check the performance of the total Burner Control (microcomputer operation, program memory and execution, timing functions, input signals, logic operations, and output commands). This assures that the CB70 is able to do its fundamental combustion safeguard task with the highest degree of safety available.

SAFETY SHUTDOWN (LOCKOUT) OCCURS IF:

1. A flame signal is present continuously for more than 30 seconds during standby (F70).
2. A preignition interlock opens during standby (F73).
3. The low fire start switch fails to close within 3 minutes when the firing rate motor is commanded toward the low fire position at the end of prepurge (F11 with the PREPURGE and HOLD lights blinking) or is jumpered (F11 with the PREPURGE light blinking).
4. The pilot (or first stage oil burner) fails to ignite (F30).
5. The main flame fails to ignite (F40).
6. The contacts for the interlocks, limits, and controllers are recurrently intermittent (F81, F82, F83, F84,

F85, F86, F87).

7. The powerline frequency deviates from 60 Hz,(+,−10%) (F97).

8. The Program Module malfunctions or is improperly positioned (F90).

9. The safety critical load terminals are improperly energized (F99, F0E, F1E, F3A, F4A, F4C, F5C, F6E, F7E).

10. An internal failure of the CB70 (F99, FA8, FA9, FAA, FAb, FAC, FAd, FAE, FAF, Fb8, Fb9, F6A, Fbb, FbC).

11. The flame detection system fails (F99).

12. Flame signal detected after the first 10 seconds during prepurge (F00).

13. The high fire purge switch fails to close within 3 minutes after the firing rate motor is commanded to drive to the high fire position at the start of prepurge (F01).

14. A preignition interlock opens during the prepurge period (F03).

15. Flame signal is detected during the low fire hold (F10).

16. A lockout interlock opens during the prepurge (after 10 seconds), ignition trial, or run periods (F04, F14, F34, F44, F54).

17. A preignition interlock opens after five seconds into the postpurge (F63).

18. The low fire proving switch opens during trial for main flame (F41).

Safety shutdown (lockout) has occurred when the reset switch is illuminated and a fault code is displayed.

SAFETY PROVISIONS

DYNAMIC SELF-CHECK SAFETY CIRCUIT

The principal safety provision of the CB70 Computerized Burner Control is its Dynamic Self-Check Safety Circuit; a totally independent multi-element safety circuit that supervises microcomputer performance to ensure its proper operation. The microcomputer tests itself and its associated hardware with comprehensive safety routines. Any malfunction will either be detected by the microcomputer to cause a safety shutdown or cause the Dynamic Safety Relay to de-energize ALL safety-critical loads.

CIRCUIT STATUS MONITORING

Dynamic Input Check examines all system input circuits at the load terminals to assure system capabilty to recognize the true status of external controls, limits, and interlocks. This self-check is accomplished thousands of times every minute. If any input fails the test, the microcomputer will execute a safety shutdown and annunciate the appropriate fault code.

Closed Loop Logic Test verifies the integrity of all safety critical output circuits (terminals 5, 6, and 7). An immediate safety shutdown is executed if these loads are not properly operated.

Dynamic Safety Relay Test checks the ability of the 1K1 relay to open and close. During prepurge (with power to terminal 12) the circuit status monitor immediately "downstream" of 1K1 is checked to verify the de-energized state. At the end of prepurge (but before ignition trials) the Dynamic Safety Relay is energized and both the upstream and downstream circuit status monitors are checked. A miscompare will result in a safety shutdown.

EXPANDED SAFE START CHECK

The conventional safe start check is expanded to include a flame signal check during standby (off-cycle) and a preignition output circuit check.

Off-Cycle (Standby) Flame Signal Check is a provision that monitors the status of the flame detection subsystem (flame detector and amplifier). If a flame simulating condition as a result of marginal or faulty flame detection components (or actual flame) exists, a hold code will be displayed and system startup will be prevented. If the condition continues for more than 30 seconds, a lockout will occur and be annunciated.

Preignition Output Circuit Check makes sure that all safety critical loads (valves and ignition terminals) are de-energized just before the ignition trial. At the end of prepurge (before entering the ignition trial sequence) the Dynamic Safety Relay (IK1) is energized and the pilot valve and main valve terminals are immediately checked for the de-energized condition. A safety shutdown will occur if any of these terminals are energized.

LOW FIRE START SWITCH TEST

Low Fire Start Switch Test examines the low fire start switch at the moment prepurge is over. If the switch is bypassed, welded, or otherwise prematurely closed, the system will automatically lock out. Otherwise ignition trials start after the low fire switch closes.

SUPERVISED LOW FIRE START

The low fire start switch is monitored before entering the ignition trial and during the last 5 seconds of the trial for pilot flame.

TAMPER RESISTANCE

All safety and logic timings are inaccessible and cannot be altered or defeated.

FIRST-OUT ANNUNCIATION AND SELF-DIAGNOSTICS

Control and burner system start-up, troubleshooting, and repair are aided through integral CB70 Burner Control first-out annunciation and self-diagnostic functions.

First-Out Annunciation reports the cause of a safety shutdown (with a Fault code) or identifies the cause of a failure to start or continue in the burner control sequence (with a Hold code). All field input circuits are monitored, including the flame signal amplifier and firing rate position switches. The system distinguishes 7 modes of flame failure and detects and annunciates difficult-to-find intermittents caused by bouncing or marginal limits and interlocks.

The Multi-Function Annunciator Display shows the elapsed time during prepurge, ignition trials, and post-purge sequences. As an additional service aid it provides the time in sequence if a safety shutdown occurs during a timed period (the hold/fault code and time are alternately displayed).

Self-Diagnostics add to the first-out annunciation by allowing the CB70 Computerized Burner Control to distinguish between field (external device) and internal (system related) problems. Faults associated with either the flame detection subsystem, plug-in Program Module, or the system chassis are isolated and reported by the Multi-Function Annunciator Display (see the CB70 Annunciation and Diagnostic Codes, pages 17-19).

Sequence Status Lights (LED's) provide positive visual indication of the program sequence: STANDBY (power on), PREPURGE, HOLD, IGN TRIAL, FLAME ON, RUN, POSTPURGE, and, through the illuminated reset switch, Safety Shutdown (lockout).

ENERGY CONSERVATION

Unnecessary and wasteful purge-related heat losses are significantly reduced by the programmed intelligence of the CB70 Computerized Burner Control.

Energy-Saving Prepurge (ESP). This field-selectable feature prevents blower operation at start-up until the damper reaches the purge position (high fire purge switch closed). This prepurge sequence change saves approximatley 300,000 Btuh per boiler horsepower annually on cycling boilers in typical heating applications. To utilize the Energy Saving Prepurge, the high fire purge switch must be wired between terminals L1 and 15 and terminals 4 and 18 must be jumpered.

Energy-Saving Intelligence terminates burner/blower operation and energizes the alarm circuit whenever the high fire purge switch or the low fire start switch fails to close after a sufficient time delay.

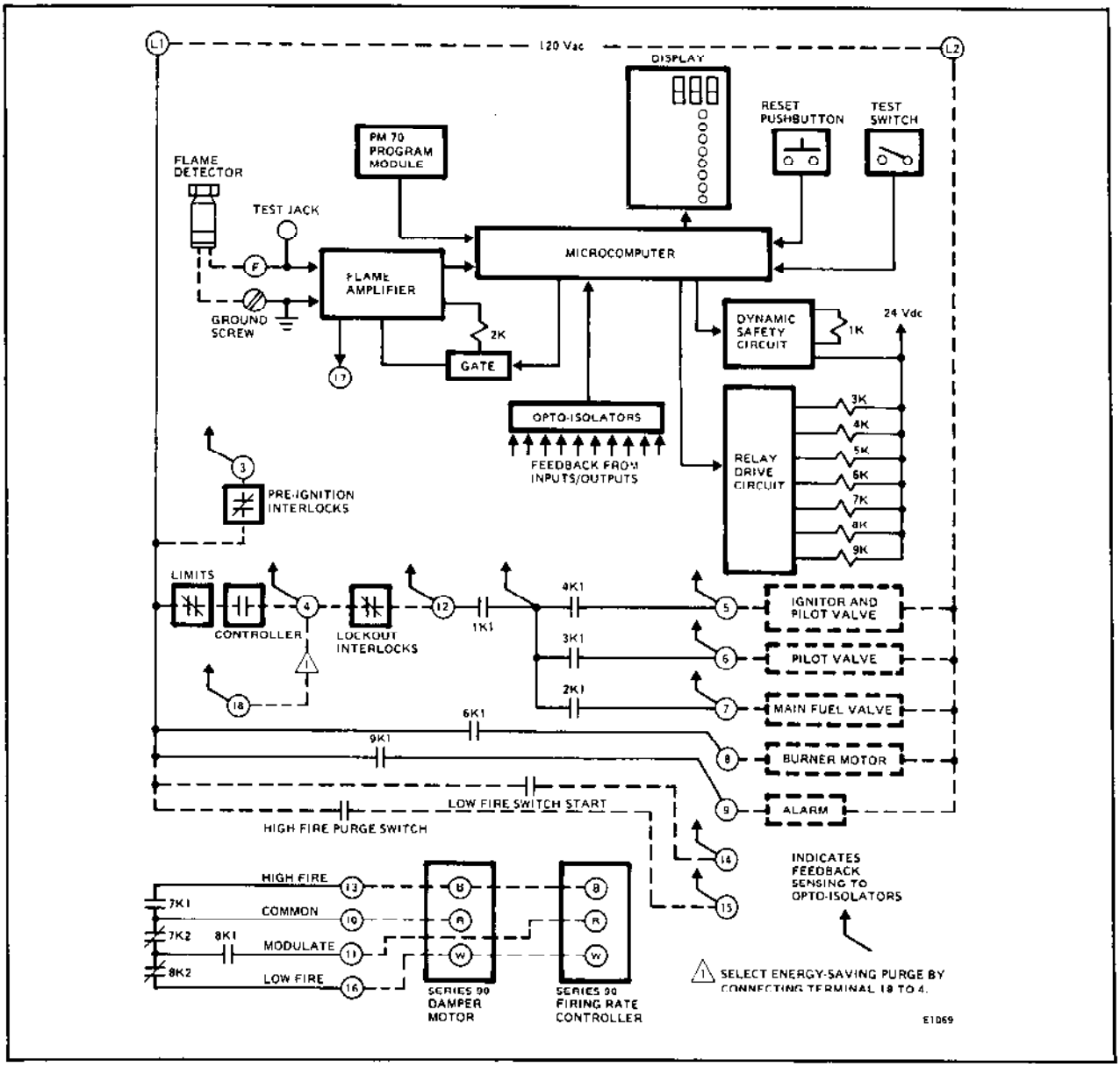
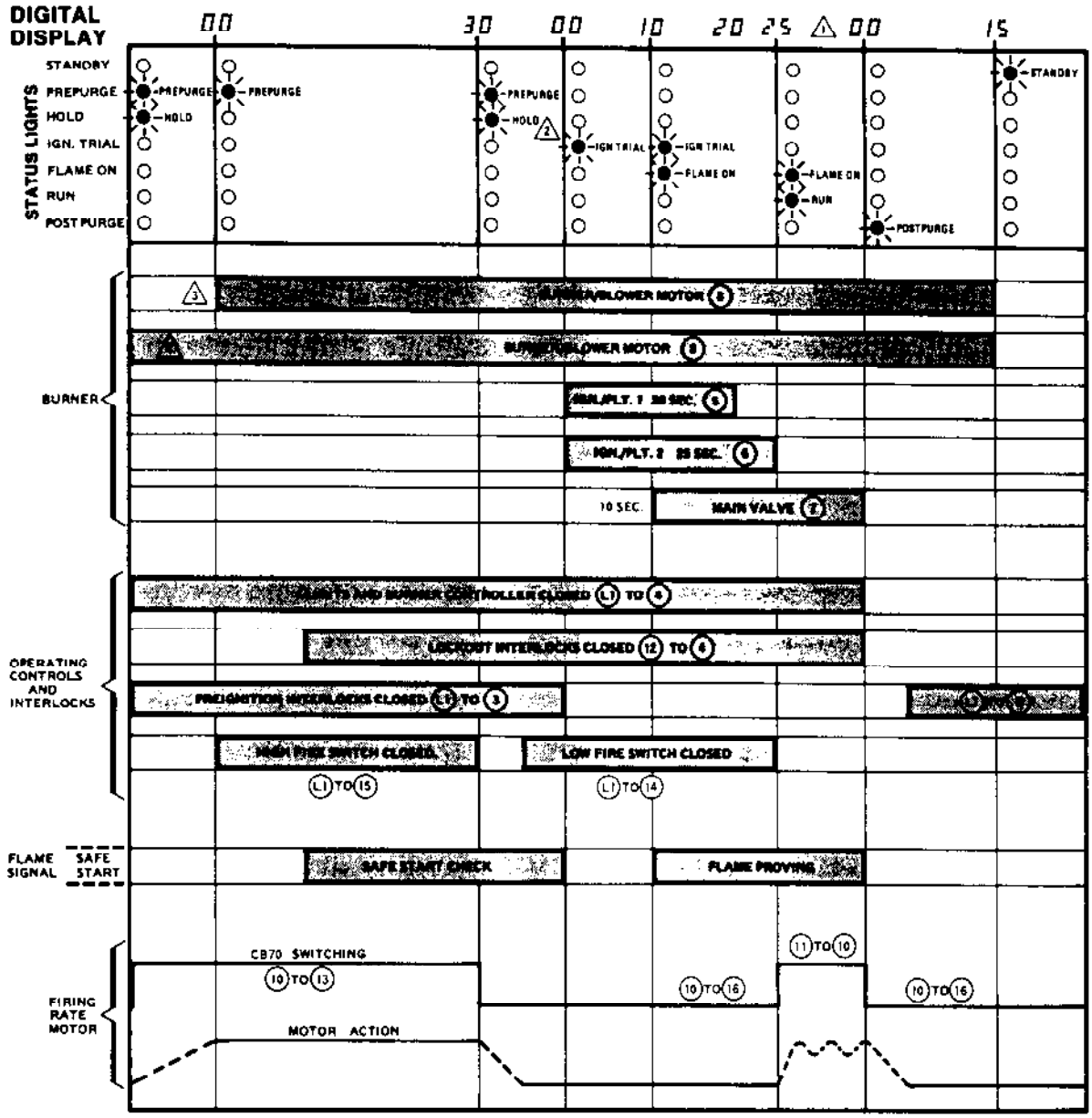


FIG. 5—SIMPLIFIED INTERNAL BLOCK DIAGRAM OF THE CB70.

CB70/PM70



△1 THE DISPLAY IS BLANK DURING THE RUN PERIOD. SYSTEM REMAINS IN RUN AS LONG AS BURNER CONTROLLER CONTACTS ARE CLOSED.

△2 AS SOON AS LOW FIRE START SWITCH CLOSES HOLD LIGHT TURNS OFF. SEQUENCE ENTERS IGN. TRIAL. AFTER 5 SEC. DELAY.

△3 ENERGY SAVING PURGE—JUMPER 4 TO 18.

△4 NO ENERGY SAVINGS PURGE.

E1075A

The CB70/PM70 provides the following operating sequence when used with a flame detection amplifier and detector.

STANDBY—

The CB70 Computerized Burner Control is ready to start the operating sequence when the burner controller closes. All other controls, limits, and interlocks are in the correct operating state. The STANDBY sequence status light is on and the Multi-Function Annunciator Display is blank.

NORMAL START-UP—

1. With power applied (the limits, controller, preignition interlocks closed, and no flame signal present) the firing rate motor drives to the high fire (open damper) position. The Multi-Function Annunciator Display shows "00," the STANDBY status light turns off, and the PREPURGE and HOLD status lights turn on.

NOTE: If the energy-saving purge is utilized (terminal 18 jumpered to 4) the blower motor (terminal 8) remains de-energized until the high fire purge switch closes. As soon as the high fire purge switch closes, the blower motor (terminal 8) becomes energized. Blower motor (terminal 8) is energized at this time if Energy Saving Prepurge is not selected (18 to 4 not jumpered).

2. When the firing rate motor reaches the high fire position, the high fire purge switch closes. The HOLD status light turns off and the 30-second proven open damper prepurge starts. The Multi-Function Annunciator Display starts counting from "00" to "30."

3. The lockout interlocks must close by 10 seconds into the prepurge (proven presence of airflow) or safety shutdown will occur.

4. At the completion of the 30-second prepurge the sequence is stopped and the firing rate motor drives to the low fire position. The HOLD status light comes on and the Multi-Function Annunciator Display stops counting.

NOTE: If the low fire start switch is prematurely closed (jumpered or welded) the system locks out. The Multi-Function Annunciator Display shows "F11."

5. When the firing rate motor reaches the low fire position, the low fire start switch makes and allows the sequence to continue. The HOLD status light turns off and (after a 5-second delay to allow for complete motor travel) the sequence enters the ignition trial period.

6. With the low fire start switch closed (and the RUN/TEST switch in the RUN position) the ignition tranformer and pilot valve (terminals 5 and 6) are energized. The PREPURGE status light turns off and the IGN TRIAL status light comes on. The Multi-Function Annunciator Display starts counting from "00" to "25" seconds.

7. As soon as the presence of flame is detected, the FLAME ON status light comes on.

8. 10 seconds into the ignition trial period and with presence of flame detector (FLAME ON status light on) the main fuel valve (terminal 7) is energized.

NOTE: If presence of flame is not detected at this time, safety shutdown will occur.

9. 20 seconds into the ignition trial period the ignition transformer and pilot valve (terminal 5) are de-energized. This completes the 10-second main flame establishing period.

10. 25 seconds into the ignition trial period the pilot valve (terminal 6) is de-energized. This completes the 15-second main flame establishing period. Control of the firing rate motor is released to the modulating controller. The IGN TRIAL status light and the Multi-Function Annunciator Display turn off and the RUN status light comes on.

The CB70 Computerized Burner Control is now in the normal burner run mode of operation and will remain so until an external command directs it to do otherwise.

NORMAL SHUTDOWN

1. When the burner controller opens, the main fuel valve (terminal 7) is immediately de-energized, and the firing rate motor drives to the low fire position. The RUN status light turns off and the POSTPURGE status light comes on. The Multi-Function Annunciator Display starts counting from "00" to "15" seconds. After the flame is out the flame relay drops out and the FLAME ON status light turns off.

2. Following the 15-second postpurge, the burner/blower motor (terminal 8) is de-energized. The POSTPURGE status light and the Multi-Function Annunciator Display turn off. The STANDBY status light comes on, ending the operating cycle.

INSTALLATION

WHEN INSTALLING THIS PRODUCT . . .

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

CAUTION

1. Disconnect power supply before beginning installation to prevent electrical shock and equipment damage.
2. Wiring must comply with all applicable local codes, ordinances, and regulations.
3. All wiring must be NEC Class 1 (line voltage).
4. Wiring connections for the CB70 differ from those of other controls that mount on the same subbase. Refer to Fig. 6 for proper subbase wiring.

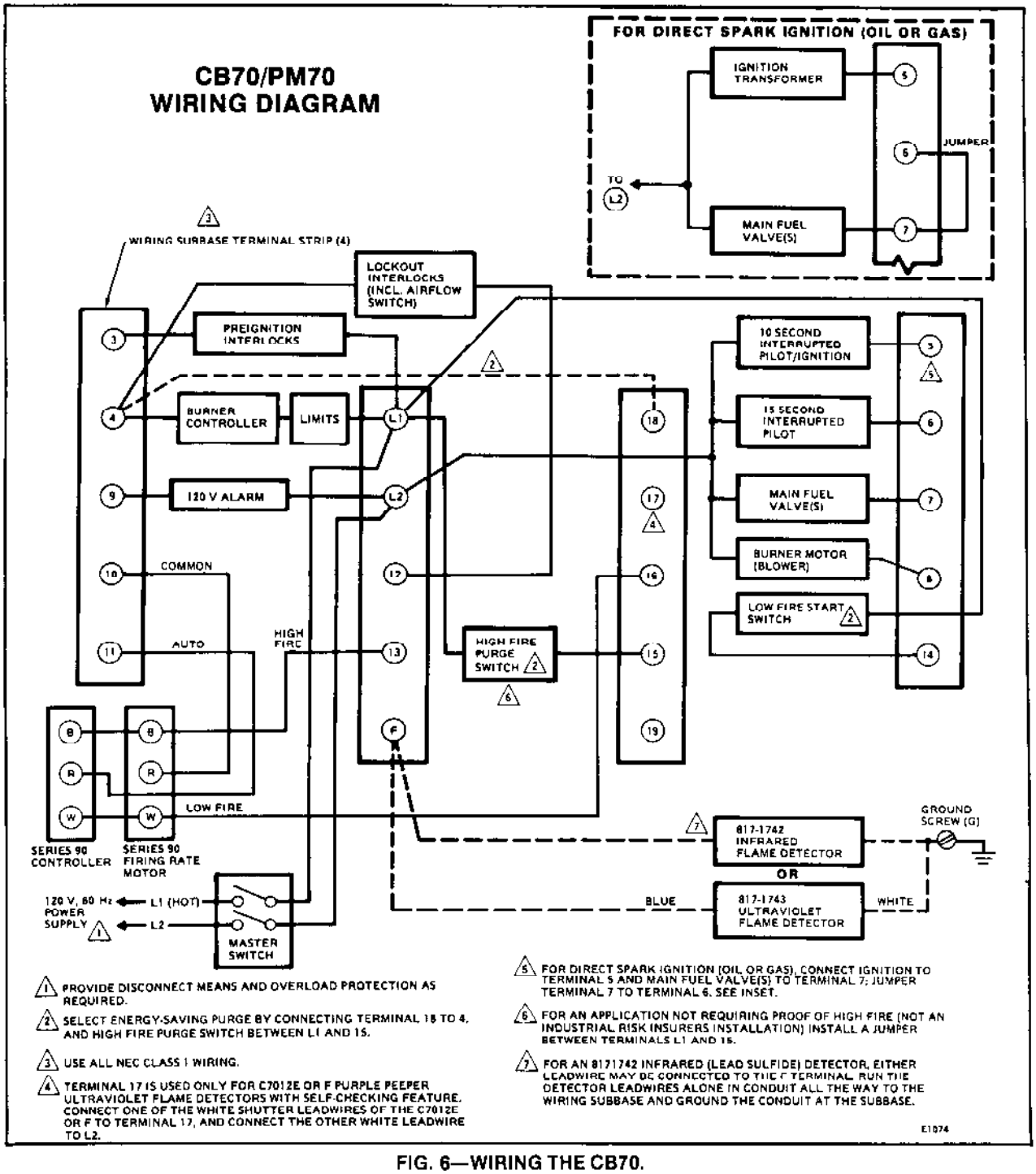


FIG. 6—WIRING THE CB70.

IMPORTANT

1. For on-off gas-fired systems, some authorities having jurisdiction prohibit the wiring of any limit or operating contacts in series between the flame safeguard control and the main fuel valve(s).
2. This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pertinent to sub part 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 may cause interference; in which case, the user at his own expense may be required to take whatever measures that are required to correct the interference.

HUMIDITY

Install the CB70 where the relative humidity never reaches the saturation point. Condensation of moisture on the CB70 may cause false flame readings and cause safety shutdown (lockout) or prevent the burner from starting.

VIBRATION

Do not install the CB70 where it coutd be subject to excessive vibration.

WEATHER

The CB70 is not designed to be weathertight. If it is installed outdoors, it must be protected.

MOUNTING THE WIRING SUBBASE

NOTE: For installation dimensions, see Figs. 3 and 4 in this specification sheet.

1. Do not mount the wiring subbase horizontally with the knife-blade contacts pointing down. This allows the accumulation of moisture. The standard vertical position is preferred. Any other position decreases the maximum ambient temperature rating.
2. Select the location on a wall or instrument panel. Be sure to allow clearances for servicing and removal of the CB70.
3. For surface mounting, use the back of the subbase as a template to mark the 4 screw locations. Drill the pilot holes.
4. Insert the mounting screws and tighten them securely.

WIRING TO SUBBASE

1. Wiring connections for the CB70 differ from those of other controls that mount on the same subbase. Refer to Fig. 6 for proper subbase wiring.
2. All wiring must comply with all applicable electrical codes, ordinances, and regulations. Use NEC Class 1 (line voltage) wiring.
3. For normal installations, use moisture-resistant No. 16 wire suitable for at least 194 F [90 C].
4. For high temperature installations, use wire selected for a temperature rating above the maximum operating temperature. All but the ignition and flame detector "F" leadwires should be moisture resistant.

   For the ignition, use Honeywell Spec No. R1061012 Ignition Cable or equivalent. (This wire is rated at 350F (177C) for continuous duty. It has been tested to 20,000 volts).

   For the Flame Detector "F" leadwire, use Honeywell Spec No. R1298020 or equivalent. (This wire is rated up to 400F (204C) for continuous duty. It is tested for operation up to 600 volts and breakdown up to 7500 volts.)

IMPORTANT

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

5. For ignition installations in a contaminating environment, use Honeywell Spec. No. R1239001 High Tension Ignition Cable or equivalent. (This wire is very resistant to severe conditions of oil, heat, and corona, and is tested to withstand high voltages of up to 25,000 volts RMS in a salt bath for 1 minute without breakdown. It is rated at 200 F [93 C] for continuous duty, and up to 350 F [177 C] for intermittent use.) If the ignition cable is run through a metal shield, be sure that BOTH ends of the shield are grounded to the metal burner. Keep the grounding strap length to a minimum.
6. Make sure the loads do not exceed the terminal ratings. Refer to the label on the CB70 or to the ratings in the SPECIFICATION section of this sheet.
7. Check the power supply circuit. The voltage and frequency tolerances must match those of the CB70 and PM70. Do not connect the CB70 to a power supply circuit that is subject to line voltage variations, such as would occur with ON-OFF switching of heavy loads. A separate power supply circuit may be required for the flame safeguard control. Add the required disconnect means and overload protection.
8. Check all wiring against Fig. 6 before installing the CB70 on the subbase.

INSTALLING THE FLAME DETECTOR

NOTE: The Ordering Information (page 3) lists the flame detection systems available for use with the CB70 Computerized Burner Control. Make sure you are using the correct combination of amplifier and flame detector(s).

Proper flame detector installation is the basis of a safe and reliable flame safeguard installation. Refer to the instructions packed with the flame detector and the Cleaver Brooks instructions. Follow the instructions carefully to make the best possible application of the flame detector.

Keep the flame signal leadwires from the flame detector to the wiring subbase as short as possible. Capacitance increases with leadwire length, reducing the signal strength. The maximum permissible leadwire length depends on the type of flame detector, leadwire, and conduit. The ultimate limiting factor in the flame signal leadwire length is the flame current (see Table I, page 12).

INSTALLING THE CB70 (Fig. 7)

1. Open the master switch.
2. Make sure no subbase wiring is projecting beyond the terminal blocks. Tuck wiring in against the back of the subbase so it does not interfere with the contacts.
3. Engage the chassis hinge brackets with the pivot pins at the bottom of the subbase.
4. Swing the chassis inward until the spring connectors engage the knife-blade contacts. Push until the contacts are fully engaged.
5. Tighten the chassis retaining screw securely.

INSTALLING THE PM70 PROGRAM MODULE (Fig. 8)

1. Remove the amplifier compartment cover.
2. Remove the flame signal amplifier, if present.
3. Insert the program module into the opening in the side of the amplifier compartment (see Fig. 8). NOTE THAT THE MODULE IS KEYED.
4. Reinstall the flame signal amplifier.
5. Reinstall the amplifier compartment cover.

INSTALLING THE PLUG-IN FLAME SIGNAL AMPLIFIER (Fig. 9)

1. Remove the amplifier compartment cover.
2. Grasp the flame signal amplifier with the monogram toward the outside of the amplifier compartment. Align the circuit board with the keyed receptacle in the CB70 chassis. NOTE: If you are installing a small amplifier, align its ends with the 2 lines alongside the receptacle on the CB70 chassis.
3. Push the flame signal amplifier into the keyed receptacle until the circuit board is fully inserted and slide it under the holddown clip. Make sure the amplifier is securely in place.
4. Replace the amplifier cover.

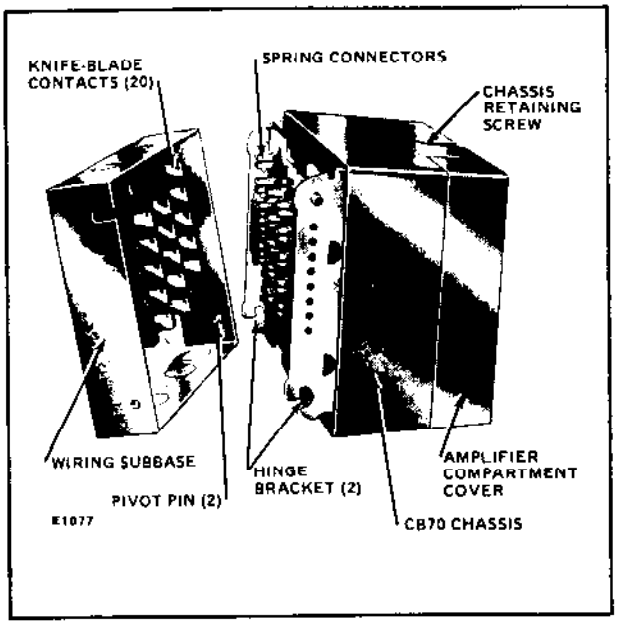


FIG. 7—MOUNTING THE CB70 COMPUTERIZED BURNER CONTROL ON THE SUBBASE.

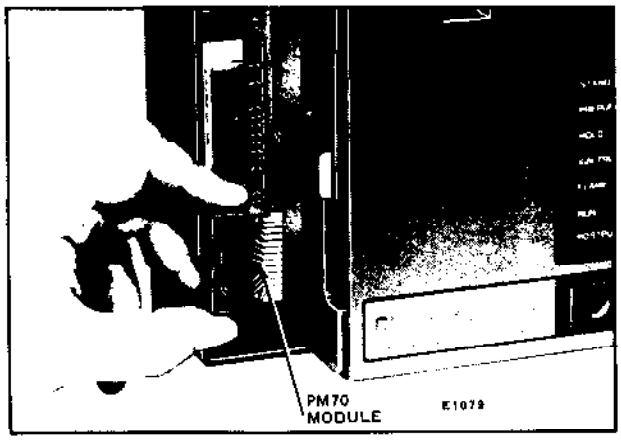


FIG. 8—INSTALLING THE PM70 PROGRAM MODULE IN THE CB70 COMPUTERIZED BURNER CONTROL.

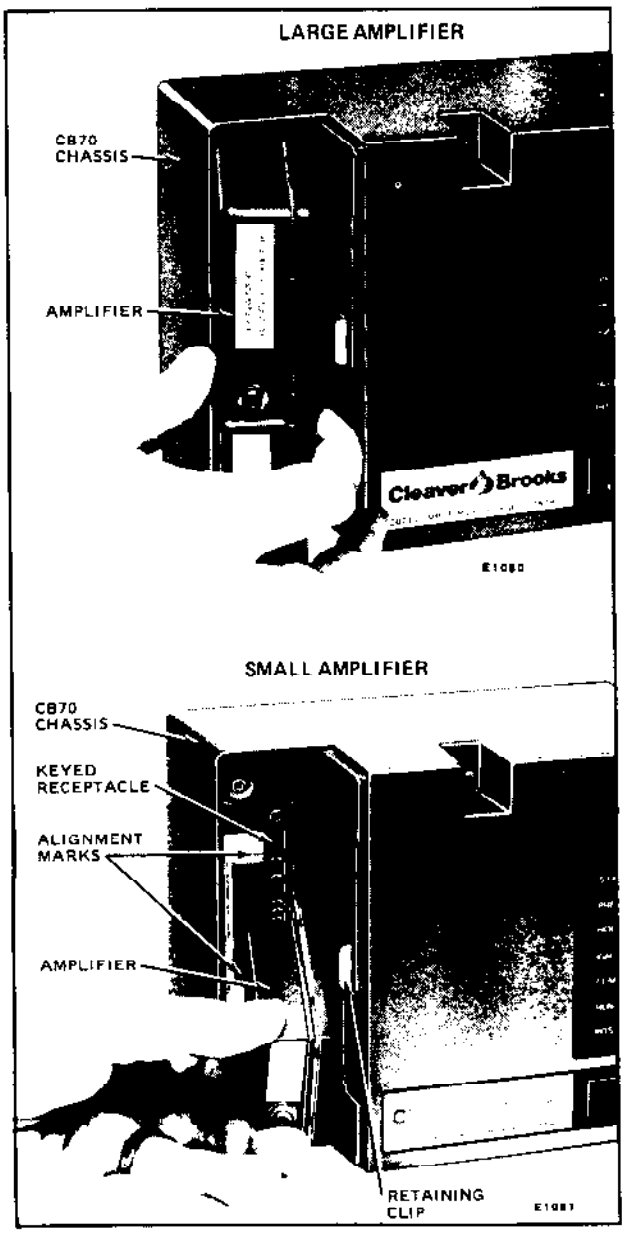


FIG. 9—INSTALLING THE PLUG-IN FLAME SIGNAL AMPLIFIER.

USE OF THE RUN/TEST SWITCH

The RUN/TEST switch is located on the side of the CB70 Computerized Burner Control chassis.

The RUN/TEST switch performs the following functions in the operating cycle:

1. The RUN/TEST switch will stop the sequence at low fire in the PREPURGE, just before ignition trials (if it is in the TEST position prior to this point). Stopping the system at this point allows adjustment of the firing rate motor and damper linkages.

2. The RUN/TEST switch will stop the sequence during the first 8 seconds of the PILOT IGNITION trial. This allows testing for spark pick up when the system is used with an ultraviolet sensor. When stopped in this position it is possible to perform the pilot turndown test. A flame out timer internal to the CB70 is activated that will cause a safety shutdown if the pilot flame signal is lost for 30 seconds.

3. If the RUN/TEST switch is thrown to the TEST position during the BURNER RUN period of the cycle, the CB70 commands the firing rate motor to drive to the low fire position.

NOTE: When the CB70 is switched to the TEST mode, it will stop and hold at the next RUN/TEST switch test point in the operating sequence until the RUN/TEST switch is returned to the RUN position. MAKE SURE THAT THIS SWITCH IS IN THE RUN POSITION BEFORE LEAVING THE INSTALLATION.

CHECKOUT

WARNING

Do not allow fuel to accumulate in the combustion chamber. If fuel is allowed to enter the chamber for longer than a few seconds without igniting, an explosive mixture could result. It is recommended that you limit the trial for pilot to 10 seconds, and limit the attempt to light the main burner to 2 seconds from the time the fuel has reached the burner nozzle. In any case, do not exceed the normal lightoff time specified by Cleaver Brooks; close the manual fuel shutoff valves if the flame is not burning at the end of the specified time.

CAUTION

1. Use utmost care while testing the system. Line voltage is present on most subbase contacts when power is on.
2. Open the master switch before removing the CB70 from the subbase, before reinstalling the CB70, before installing or removing any jumpers, and before making any adjustments.
3. Make sure all manual fuel shutoff valves are closed before starting the Initial Lightoff Check and the Pilot Turndown Test.
4. If low fuel pressure limits are bypassed for any of the tests, make sure you remove the jumpers from these limits before putting the system into service.
5. Do not put the system into service until you have satisfactorily completed all applicable tests described in this section and any others required by Cleaver Brooks.

IMPORTANT

a. If the system fails to perform properly, note the fault code, status lights, and sequence time on the display. Refer to the troubleshooting section of this sheet.

b. Repeat ALL required Checkout tests after all adjustments have been made. ALL tests must be satisfied with the flame detector(s) in its FINAL position.

EQUIPMENT REQUIRED

1. Voltmeter—with 0 to 300 Vac scale.
2. Microammeter—with 0 to 25 microamp range and SPL scale with damping.
3. Meter connector plug—Part No. 884-72 or equivalent.
4. Jumper wires (2)—No. 14 wire, insulated, 12 inches (304.8 mm) long, with insulated alligator clips at both ends.
5. Manometer (or pressure gauge)—to measure pilot gas pressure.
6. Thermometer or thermocouple—to measure temperature at the flame detector(s).
7. Orifice plates (aperture discs) or filters—as necessary to adjust sensitivity of flame detector(s).

CHECKOUT SUMMARY

The following list summarizes the checkout tests required for each type of installation. Instructions for each test are included in this section; also consult the burner installation instructions.

Preliminary Inspection—all installations.
Flame Signal Measurement—all installations.
Initial Lightoff Check for Proved Pilot—all installations using a pilot.
Initial Lightoff Check for Direct Spark Ignition of Oil—oil burners not using a pilot.
Pilot Turndown Test—all installations using a pilot.
Ignition Interference Test—all installations using flame rods.
Hot Refractory Saturation Test—all installations using infrared (lead sulfide) flame detectors.
Hot Refractory Hold-in Test—all installations using infrared (lead sulfide) flame detectors.
Ultraviolet Response Tests—all installations using ultraviolet flame detectors.
Flame Signal with Hot Combustion Chamber—all installations.
Safety Shutdown Tests—all installations.

PRELIMINARY INSPECTION (All Installations)

Perform this inspection to avoid common problems. Make certain that:

1. Wiring connections are correct and all terminal screws are tight.

2. Flame detector is clean, and it is installed and positioned properly. Consult the appropriate instruction sheet.

3. Correct combination of amplifier and flame detector(s) is used.

4. Retaining clip is holding the plug-in flame signal amplifier securely in the receptacle.

5. Burner is completely installed and ready to fire (consult Cleaver Brooks instructions); fuel lines are purged of air.

6. Combustion chamber and flues are clear of fuel and fuel vapor.

7. Power is connected to the system disconnect switch (master switch).

8. Lockout switch is reset (push in reset button).

NOTE: Do not depress the reset button during the IGNITION TRIAL and burner RUN periods.

9. RUN/TEST switch is in RUN position.

10. System is in the STANDBY condition (STANDBY status light on).

11. All limits and interlocks are reset.

FLAME SIGNAL MEASUREMENT (All Installations)

Measure the flame signal at the appropriate times defined in the following checkout tests. Read the flame signal in microamps at the meter jack on the plug-in flame signal amplifier.

TABLE I—FLAME SIGNAL

FLAME DETECTOR	FLAME SIGNAL AMPLIFIER	MINIMUM ACCEPTABLE CURRENT (MICROAMPERES)	MAXIMUM CURRENT EXPECTED (MICROAMPERES)
817-1742 (C7027A1021 INFRARED, LEAD SULFIDE)	833-2204 (R7248A, RED)	2 1/2	5
	833-2205 (R7248B, RED, DYNAMIC AMPLICHELK)	3-1/2	5
817-1741 (C7027A1021 ULTRAVIOLET)	833-2207 (R7249A, VIOLET)	3 1/2	7 1/2

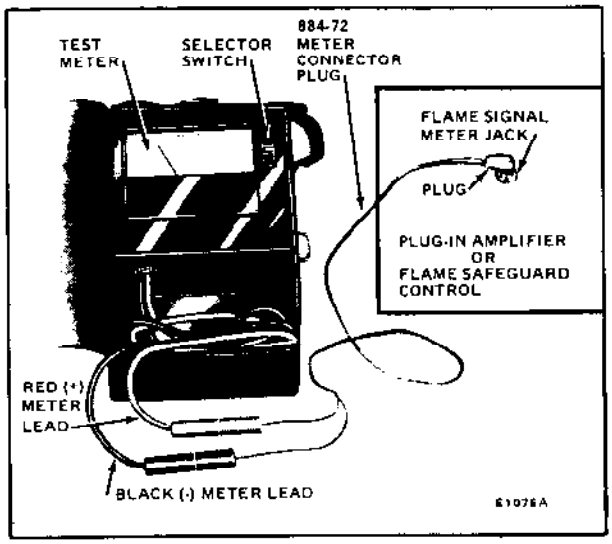


FIG. 10—MEASURING THE FLAME SIGNAL.

1. Use a Test Meter with a 0 to 25 microamp dc range and overload protection to 300 microamps may be used.

2. Set the selector switch on the test meter to 25uA.

3. Use a 884-72 Meter Connector Plug. (It may be ordered separately.) Connect its RED plug-in tip to the RED (+) meter lead and its BLACK plug-in tip to the BLACK (-) meter lead.

4. Insert the grey plug into the flame signal meter jack and allow a few seconds for the meter reading to stabilize.

5. Read the average *stable* current. The red flame-indicating lamp on a self-checking amplifier should blink at the same rate that the flame is flickering (may be as high as 20 times a second). If the lamp is ON or OFF continuously while reading flame signal, check amplifier, flame detector, and flame detector wiring.

6. The meter reading must be as specified in Table I after all tests have been completed and all adjustments have been made.

If the signal is unstable or less than the minimum acceptable current, check the flame detector installation and circuitry.

1. Check the supply voltage at terminals L1-L2 on the wiring subbase. Make sure the master switch is closed, connections are correct, and the power supply is of the correct voltage and frequency.

2. Check the detector wiring for defects, including:
   - —incorrect connections,
   - —wrong type or size of wire,
   - —deteriorated wire,
   - —open circuits,
   - —short circuits,
   - —leakage paths caused by moisture, soot, or accumulated dirt.

3. Clean the detector lens, filter, viewing window, and inside of the sighting pipe (as applicable).

4. With the burner running, check the temperature at the detector. If it exceeds the detector's maximum rated temperature:
   - —add additional insulation between the wall of the combustion chamber and the detector,
   - —add a shield or screen to reflect radiated heat away from the detector, or
   - —add cooling. (Refer to Sighting Pipe Ventilation in the instruction sheet for the detector.)

5. For an 817-1742 Infrared Flame Detector, check that the heat block is in place. Try a new 817-1801 Lead Sulfide Cell. Under unusual circumstances, Cleaver Brooks may advise a change of cell sensitivity.

6. Make sure that the flame adjustment is not too lean.

7. Make sure the detector is sighting the flame properly.

8. If necessary, resight or reposition the detector.

If you cannot obtain proper operation, replace the plug-in amplifier. If you still cannot obtain proper operation, replace the flame detector.

INITIAL LIGHTOFF CHECK FOR PROVED PILOT (All Installations Using a Pilot)

Perform this check on all installations using a pilot. It should immediately follow the preliminary inspection.

NOTE: Low fuel pressure limits, if used, could be open. If so bypass them with jumpers during this check.

1. Open the master switch.

2. Make sure the manual main fuel shutoff valve(s) is closed. Open the manual pilot shutoff valve. (If the pilot takeoff is downstream from the manual main fuel shutoff valve, make sure the main fuel is shut off just upstream from the burner inlet, or disconnect power from the automatic main fuel valve[s].)

3. Close the master switch and start the system with a call for heat (raise the set point of the burner controller). The program sequence should start.

4. Let the sequence advance through PREPURGE. When the IGN TRIAL light comes on, spark should occur and the pilot should ignite. If it ignites, proceed to step 7.

5. If the pilot flame is not established in 10 seconds, safety shutdown will occur. Let the sequence complete its cycle.

6. Reset the lockout switch, and let the system recycle once. If the pilot still does not ignite, make the following ignition/pilot adjustments:

a. Open the master switch and remove the CB70 from the subbase.
b. On the subbase, jumper terminal L1 to the ignition terminal (5 or 6). Refer to the diagram to determine the proper terminal. Disconnect the leadwire to the pilot valve if it is connected to the same terminal.
c. Close the master switch to energize the ignition transformer only.
d. If the ignition spark is not strong and continuous, open the master switch and adjust the ignition electrode spark gap setting to the manufacturer's recommendation.
e. Make sure the ignition electrodes are clean.
f. Close the master switch and observe the spark.
g. Once a continuous spark is obtained, open the master switch and add a jumper on the subbase from terminal L1 to the pilot terminal (5 or 6). Reconnect the leadwire from the pilot valve if it was disconnected in b.
h. Close the master switch to energize both the ignition transformer and the pilot valve.
i. If the pilot does not ignite and if the ignition spark is still continuous, adjust the pilot gas pressure regulator until a pilot is established.
j. When the pilot ignites properly and stays ignited, open the master switch and remove the jumper(s) from terminals L1-5 or L1-6 of the subbase.
k. Check for adequate bleeding of the fuel line.
l. Reinstall the CB70 on the subbase and close the master switch.

7. When the pilot ignites, measure the flame signal (page 12). If necessary, adjust the flame or detector to give a proper flame signal.

8. Recycle the system to recheck lightoff and the pilot flame signal.

9. When the RUN light comes on make sure the automatic main fuel valve(s) are open; then smoothly open the manual main fuel shutoff valve (and manually opened safety shutoff valve, if used) and watch for main burner flame ignition. When the main burner flame is established, proceed to step 14.

NOTE: This step requires 2 people—one to open the manual valve(s) and one to watch for ignition.

10. If the main burner flame is not established within the normal lightoff time specified by Cleaver Brooks, close the manual main fuel shutoff valve(s) and open the master switch.

11. Wait about 3 minutes. Close the master switch, and let the CB70 recycle to the main flame ignition trial period. Smoothly open the manual fuel shutoff valve(s) and try lightoff again. The first attempt may have been required to purge the lines and bring sufficient fuel to the burner.

NOTE: This step requires 2 people—one to open the manual valve(s) and one to watch for ignition.

12. If the main burner flame is not established within the normal lightoff time specified by Cleaver Brooks, close the manual main fuel shutoff valve(s) and open the master switch. Check all burner adjustments.

13. Repeat steps 11 through 13 to establish the main burner flame. Then proceed to step 14.

14. When the main burner flame is established, the sequence will stay in RUN. Make burner adjustments for flame stability and input rating.

15. Shut down the system by lowering the set point of the burner controller. Make sure the main burner flame goes out. Make sure all automatic fuel valves close.

16. If used, remove the bypass jumpers from the low fuel pressure limits.

17. Restart the system by raising the set point of the burner controller. Observe that the pilot is established during IGN TRIAL, and the main burner flame during IGN TRIAL, within the normal lightoff time.

18. Measure the flame signal. Continue to check for the proper signal (Table I) through the RUN period. Check the signal at both high and low firing rate positions and while modulating, if applicable.

19. Run the burner through another sequence, observing the flame signal for:

—pilot alone (unless using direct spark ignition),
—pilot and main burner flame together, and
—main burner flame alone.

Also, observe the time to light the main burner.

20. Make sure all readings are in the required ranges before proceeding.

INITIAL LIGHTOFF CHECK FOR DIRECT SPARK IGNITION OF OIL (Oil Burners Not Using a Pilot)

This check applies for oil burners not using a pilot. It should immediately follow the preliminary inspection. Refer to the sample block diagram of field wiring in this specification sheet for the hookup of the ignition transformer and fuel valve(s).

NOTE: Low fuel pressure limits, if used, could be open. If so, bypass them with jumpers during this check.

1. Open the master switch.

2. Complete the normal "ready-to-fire" checkout of the oil supply and equipment as recommended by Cleaver Brooks.

3. Close all manual fuel shutoff valves. Check that the automatic fuel valves are closed. Make sure oil is not entering the combustion chamber.

4. Close the master switch and start the system with a call for heat (raise the set point of the burner controller). The program sequence should start.

5. Let the sequence advance through PREPURGE. When the IGN TRIAL light comes on, watch for ignition spark and listen for the click of the oil solenoid valve.

6. Let the program sequence complete its cycle.

7. Open the manual fuel shutoff valves.

8. Depress the reset switch and recycle the program through PREPURGE.

9. When the IGN TRIAL light comes on, watch for the burner flame to be established. If it is, proceed to step 15.

10. If the burner flame is not established within 5 seconds, or within the normal lightoff time specified by Cleaver Brooks, *close the manual fuel shutoff valves, and open the master switch.*

11. Purge the combustion chamber to remove any unburned oil; then check all burner adjustments.

12. Wait about 3 minutes. Close the master switch, open the manual fuel shutoff valves, and try lightoff again. The first attempt may have been required to purge the lines and bring sufficient oil to the burner.

13. If the burner flame is not established within 5 seconds, or within the normal lightoff time specified by Cleaver Brooks, *close the manual fuel shutoff valve.*

14. If necessary, repeat steps 11 through 13 to establish the 1st stage burner flame. Then proceed to step 15.

15. When the burner flame is established, the sequence will advance to RUN. Make burner adjustments for flame stability and input rating.

16. Shut down the system by lowering the set point of the burner controller. Make sure the burner flame goes out and all automatic oil valves close.

17. If used, remove the bypass jumpers from the low fuel pressure limits.

18. Restart the system by raising the set point of the burner controller. Observe that the burner flame is established during IGN TRIAL within the normal lightoff time specified by Cleaver Brooks.

19. Measure the flame signal. Continue to check for the proper signal (Table I) into the RUN period. Check the signal at both high and low firing rate positions and while modulating. Any pulsating or unsteady readings will require further adjustments.

20. Make sure all readings are in the required ranges before proceeding.

PILOT TURNDOWN TEST (All Installations Using a Pilot)

Perform this check on all installations using a pilot. The purpose of this test is to ensure that the main burner can be lit by the smallest pilot flame that will hold in the 2K (flame) relay (FLAME ON light on). Clean the flame detector(s) to ensure that it will detect the smallest acceptable pilot flame.

NOTE: Low fuel pressure limits, if used, could be open. If so, bypass them with jumpers during this test.

1. Open the master switch.

2. Connect a manometer (or pressure gauge) to measure pilot gas pressure during the turndown test.

3. Open the manual pilot shutoff valve.

4. Close the master switch and start the system with a call for heat (raise the set point of the burner controller). The program sequence should start, and prepurge should begin.

5. When the IGN TRIAL light comes on, set the RUN/TEST switch to TEST position to stop the sequence. The FLAME ON light will come on when the pilot ignites.

NOTE: If the sequence does not stop, reset the system and make sure you set the RUN/TEST switch as soon as the beginning of the IGN. TRIAL light comes on.

IMPORTANT

You have 8 seconds to stop the sequence after the start of ignition.

6. Turn the pilot pressure down very slowly, reading the manometer (or gauge) as it drops. Stop instantly when the FLAME ON light goes out. Note the pressure at the dropout point. The pilot is at the turndown position. Immediately, turn up the pilot pressure until the FLAME ON light comes on again.

NOTE: With the sequence stopped at this point, the CR70 will lockout and flash F35 if there is no flame for 30 seconds.

7. Repeat step 6 to verify the pilot gas pressure reading at the exact point the FLAME ON light goes out.

8. Increase the pilot pressure immediately until the FLAME ON light comes on, and then turn it down slowly to obtain a pressure reading just above the dropout point.

9. Set the RUN/TEST switch in the RUN position and let the sequence proceed. At 10 seconds into the ignition trial period (display shows 10), make sure the automatic main fuel valve(s) opens; then smoothly open the manual main fuel shutoff valve (and manually opened safety shutoff valve, if used) and watch for main burner ignition. If the main burner flame is established, proceed to step 17.

NOTE: This step requires 2 people—one to open the manual valve(s) and one to watch for ignition.

10. If the main burner flame is not established within the normal lightoff time specified by Cleaver Brooks, *close the manual main fuel shutoff valve(s) and open the master switch.*

11. Purge the combustion chamber to remove any unburned fuel; check all burner adjustments.

12. Wait about 3 minutes. Close the master switch, and let the program sequence go through PREPURGE. Repeat steps 9 and 10 (try lightoff once more).

13. If the second attempt is unsuccessful, adjust the flame detector position so that a larger pilot is required to cause the FLAME ON light to come on. This may require relocating the flame detector to sense farther out on the pilot flame, or adding an orifice plate.

14. Measure the pilot flame signal after adjusting the flame detector to make sure it is stable and above the minimum.

15. Repeat steps 4 through 15 until the main burner positively lights with the pilot flame just causing the FLAME ON light to remain on.

16. Repeat the lightoff of the main burner several times (steps 4 through 9) with the pilot at turndown.

17. When the main burner lights reliably with the pilot at turndown, disconnect the manometer (or gauge) and turn the pilot up to normal.

18. If used, remove the bypass jumpers from the low fuel pressure limits.

19. Run the system through another cycle to check for normal operation.

HOT REFRACTORY SATURATION TEST (All Infrared Detectors)

Test to make certain that radiation from hot refractory does not mask the flickering radiation of the flame itself.

Start the burner and monitor the flame signal during the warmup period. A decrease in signal strength as the refractory heats up indicates hot refractory saturation. If saturation is extreme, the FLAME ON light will go out and the system will shut down as though a flame failure has occurred.

If hot refractory saturation occurs, the condition must be corrected. Add an orifice plate ahead of the cell to restrict the viewing area. If this doesn't work, resight the detector at a cooler, more distant background. You can also try lengthening the sighting pipe or decreasing the pipe size (diameter). Continue adjustments until hot refractory saturation is eliminated.

HOT REFRACTORY HOLD-IN TEST (All Infrared Detectors)

Test to make certain that hot refractory will not cause the FLAME ON light to remain on after the burner flame goes out. This condition would delay response to flame failure and also would prevent a system restart as long as hot refractory is detected.

First check the plug-in flame signal amplifier by starting a burner cycle. As soon as the CB70 stops in the RUN period, lower the set point of the burner controller to shut down the burner while the refractory is still at a low temperature. Measure the time it takes for the FLAME ON light to go out after the flame goes out. If this takes more than 4 seconds, open the master switch and replace the amplifier.

Infrared (lead sulfide) detectors can respond to infrared rays emitted by a hot refractory, even when the refractory has visibly ceased to glow. Infrared radiation from a hot refractory is steady, whereas radiation from a flame has a flickering characteristic. The infrared detection system responds only to a flickering infrared radiation; it can reject a steady signal from hot refractory. The refractory's steady signal can be made to fluctuate if it is reflected, bent, or blocked by smoke or fuel mist within the combustion chamber. Care must be taken when applying an infrared system to ensure its response to flame only.

To check infrared (lead sulfide) detectors for hot refractory hold-in, operate the burner until the refractory reaches its maximum temperature. If the installation has a multifuel burner, burn the heavier fuel, which is most likely to reflect, bend, or obscure the hot refractory's steady infrared radiation. When the maximum refractory temperature is reached, close all manual fuel shutoff valves, or open the electrical circuits of all automatic fuel valves. Visually observe when the burner flame goes out. After the flame goes out, measure the time it takes for the FLAME ON light to go out. If this takes more than 4 seconds, the infrared detector is sensing hot refractory. Immediately terminate the firing cycle. (Lower the set point of the burner controller, or set the fuel selector switch to OFF. Do not open the master switch.)

NOTE: Some burners continue to purge the oil line although the fuel valve(s) is closed. Termination of the firing cycle (instead of opening the master switch) will allow purging of the combustion chamber. This will reduce a buildup of fuel vapors in the combustion chamber caused by oil line purging.

If the detector is sensing hot refractory, the condition must be corrected. Add an orifice plate ahead of the cell to restrict the viewing area of the detector. If this doesn't work, resight the detector at a cooler, more distant part of the combustion chamber. While resighting the detector, keep in mind that it must also sight the flame properly. For an infrared detector, you can also try lengthening the sighting pipe or decreasing the pipe size (diameter). For details, refer to the detector instruction sheet. Continue adjustments until hot refractory hold-in is eliminated.

ULTRAVIOLET RESPONSE TESTS (All Ultraviolet Detectors)

IGNITION SPARK RESPONSE TEST

Test to make certain that ignition spark is not actuating the FLAME ON light.

1. Close the pilot and main burner manual fuel shutoff valves.

2. Start the burner and run through the ignition period. Ignition spark should occur, but the FLAME ON light must not come on. The flame signal should not be more than 1/4 microamp.

3. If the FLAME ON light does come on, resight the detector farther out from the spark, or away from possible reflection. It may be necessary to construct a barrier to block the ignition spark from the detector's view. Continue adjustments until the flame signal due to ignition spark is less than 1/4 microamp.

RESPONSE TO OTHER ULTRAVIOLET SOURCES

Some sources of artificial light produce small amounts of ultraviolet radiation. Under certain conditions, an ultraviolet detector will respond to them as if it is sensing a flame. DO NOT USE AN ARTIFICIAL LIGHT SOURCE TO CHECK THE RESPONSE OF AN ULTRAVIOLET DETECTOR. To check for proper detector operation, flame failure response tests (Safety Shutdown Tests 1, 2, and 3) should be conducted under all operating conditions.

FLAME SIGNAL WITH HOT COMBUSTION CHAMBER (All Installations)

With all initial start-up tests and burner adjustments completed, operate the burner until the combustion chamber is at maximum expected temperature. (Observe the Cleaver Brooks warm-up instructions.) Recycle the burner under these hot conditions and measure the flame signal. Check the pilot alone, the main burner flame alone, and both together (unless monitoring only the main burner flame when using direct spark ignition). Check the signal at both high and low firing rate positions and while modulating, if applicable.

Also check the flame failure response time. Lower the set point of the burner controller and observe the time it takes for the FLAME ON light to go out (this should be within 4 seconds).

If the flame signal is too low or unsteady, check the flame detector temperature. Relocate the detector if the temperature is too high. If necessary, realign the sighting to obtain the proper signal and response time. If the response time is still too slow, replace the plug-in flame signal amplifier. If the detector is relocated or resighted, or the amplifier is replaced, repeat all required check out tests.

SAFETY SHUTDOWN TESTS (All Installations)

Perform these tests at the end of Checkout after all other tests have been completed.

Safety shutdown should occur on: (1) opening of a preignition (valve closed) interlock during prepurge, postpurge and standby, (2) opening of a lockout interlock, (3) detection of flame (or a flame simulating condition) before or during prepurge, (4) failure to ignite the pilot, (5) failure to light the main burner, and (6) loss of flame during the run period.

On safety shutdown the CB70 will lock out. If used, the external alarm should turn on. The lockout switch must be manually reset to restart the system.

1. Opening of a Preignition (valve closed) Interlock During Prepurge
   a. Close the master switch.
   b. Start the system with a call for heat (raise the set point of the burner controller).
   c. After 10 seconds, open a preignition interlock.
   d. The fault code "F03" should appear and there should be no ignition.
   e. Safety shutdown should occur.
2. Opening of a Lockout Interlock
   a. Make sure all interlocks are closed.
   b. Depress the reset button.
   c. Start the system. Start-up should be normal and the main burner should light normally.
   d. After the sequence stops in "RUN" position with the burner firing, open a lockout interlock (airflow switch or fuel pressure switch).
   e. The fault code "F54" should appear, the automatic fuel valves should close, and the burner flame should go out.
   f. Safety shutdown should occur.
3. Detection of Flame Before or During Prepurge
   a. Make sure all interlocks are closed.
   b. Depress the reset button.
   c. Start the system.
   d. At about 30 seconds, momentarily simulate flame to cause the "FLAME ON" indicator to light. (Actuate the flame detector with a flame, or use a flame simulator.)
   e. The fault code "F00" or "F10" should appear and there should be no ignition.
   f. Safety shutdown should occur.
4. Failure to Ignite Pilot
   a. Close the pilot and main fuel manual shutoff valves.
   b. Depress the reset button.
   c. Start the system.
   d. The automatic pilot valve should be energized, but the pilot cannot ignite.
   e. The fault code "F30" should appear 10 seconds after the pilot valve is energized.
   f. Safety shutdown should occur.
5. Failure to Light Main Burner
   a. Open the manual pilot shutoff valve; leave the manual main fuel shutoff valve(s) closed.
   b. Depress the reset button.
   c. Start the system.
   d. The pilot should ignite and the "FLAME ON" indicator should light but the main burner cannot light.
   e. The "FLAME ON" indicator should turn off within 4 seconds after the pilot goes out.
   f. The fault code "F40" should appear immediately after the "FLAME ON" indicator goes out.
   g. Safety shutdown should occur.
6. Loss of Flame During the Run Period
   a. Open the manual main fuel shutoff valve(s); the manual pilot shutoff valve must also be open.
   b. Depress the reset button.
   c. Start the system. Start-up should be normal and the main burner should light normally.
   d. After the sequence stops in the normal "RUN" position with the burner firing, close the manual main fuel shutoff valve(s) to extinguish the main burner flame.
   e. The "FLAME ON" indicator should go out within 4 seconds after the main flame goes out.
   f. The fault code "F50" should appear immediately after the "FLAME ON" indicator goes out.
   g. Safety shutdown should occur.

IMPORTANT

1. If CB70 fails to shut down on any of these tests, replace it and rerun all Checkout tests from the beginning.
2. When all Checkout tests have been completed, reset all controller set points to the desired values.

CAUTION

If low fuel pressure limits have been bypassed for any of the tests in this CHECKOUT section, make sure you remove the jumpers from these limits before putting the system into service.

TROUBLESHOOTING

CB70 SYSTEM ANNUNCIATION AND DIAGNOSTIC CODES

Troubleshooting of control and burner system problems is made easier through the CB70 Computerized Burner Control self-diagnostic and first-out anunciation functions. In addition to a line voltage alarm terminal (audible annunciation), the CB70 Computerized Burner Control provides visual annunciation by displaying a 3-digit alphanumeric code and 1 or 2 sequence status lights.

SELF-DIAGNOSTICS of the CB70 detect and annunciate both external and internal CB70 system problems. External faults such as interlock failure, flame failure, false flame signal, and damper motor problems; and internal faults associated with the CB70 chassis, the PM70 Program Module, or the flame amplifier are all reported through the Multi-Function Annunciator Display.

FIRST-OUT ANNUNCIATION is achieved through the 3-digit alphanumeric Multi-Function Annunciator Display that reports the cause of a safety shutdown, failure to start, or a failure to continue in the burner sequence. The cause of a safety shutdown is displayed as an "F"(fault), followed by a 2-digit number. The cause of a failure to continue with the burner sequence is displayed as an "H"(hold), followed by a 2-digit number. Sequence status lights (LEDs) provide positive visual indication of the program sequence: STANDBY (power on), PREPURGE, HOLD, IGN TRIAL, FLAME ON, RUN, POSTPURGE, and safety shutdown (illuminated reset button). Safety shutdown (lockout) is indicated by the illuminated reset button and an "F"(fault) code followed by a 2-digit number. Safety shutdown (lockout) de-energizes all loads and requires a reset. With this information, most problems can be diagnosed without extensive trial and error testing.

See the CB70 Annunciation and Diagnostic Code Summary (Table II) for the meaning of Fault and Hold Codes, their interpretations, and possible remedies.

TABLE II—CB70 ANNUNCIATION AND DIAGNOSTIC CODE SUMMARY

ANNUNCIATION/ DIAGNOSTIC CODE	SYSTEM FAILURE	RECOMMENDED TROUBLESHOOTING
H70	FLAME SIGNAL DURING STANDBY	1. CHECK THAT FLAME IS NOT PRESENT IN THE COMBUSTION CHAMBER 2. TEST FLAME SIGNAL AMPLIFIER 3. TEST FLAME DETECTOR 4. CHECK FLAME DETECTOR WIRING
F00	FALSE FLAME SIGNAL DURING PREPURGE	1. CHECK THAT FLAME IS NOT PRESENT IN THE COMBUSTION CHAMBER 2. TEST FLAME SIGNAL AMPLIFIER 3. TEST FLAME DETECTOR 4. CHECK FLAME DETECTOR WIRING
F01	HIGH FIRE PURGE SWITCH FAULT	1. CHECK HIGH FIRE SWITCH, ADJUSTMENT AND WIRING 2. CHECK FIRING RATE MOTOR, LINKAGE AND WIRING
F03	PREIGNITION INTERLOCK OPENED DURING PREPURGE	1. CHECK PREIGNITION INTERLOCKS AND WIRING 2. CHECK FOR FAULTY FUEL SHUTOFF VALVE OR VALVE WIRING
F04	LOCKOUT INTERLOCK OPENED DURING PREPURGE	1. CHECK LOCKOUT/RUNNING INTERLOCKS AND WIRING 2. CHECK AIRFLOW, FUEL PRESSURE, WATER LEVEL, etc.
F10	FALSE FLAME SIGNAL DURING THE LOW FIRE HOLD AT THE END OF PREPURGE	1. CHECK THAT FLAME IS NOT PRESENT IN THE COMBUSTION CHAMBER 2. TEST FLAME SIGNAL AMPLIFIER 3. TEST FLAME DETECTOR 4. CHECK FLAME DETECTOR WIRING

(continued)

(Table II continued)

ANNUNCIATION/ DIAGNOSTIC CODE	SYSTEM FAILURE	RECOMMENDED TROUBLESHOOTING
F11/HOLD LIGHT BLINKING	LOW FIRE START SWITCH FAULT (FAILED TO CLOSE)	1. CHECK THE LOW FIRE START SWITCH, ADJUSTMENT AND WIRING 2. CHECK FIRING RATE MOTOR, LINKAGE, AND WIRING
F11	LOW FIRE START SWITCH FAULT (JUMPERED OR WELDED	1. CHECK THE LOW FIRE START SWITCH, ADJUSTMENT AND WIRING.
F13	PREIGNITION INTERLOCK OPENED DURING THE LOW FIRE HOLD PERIOD	1. CHECK PREIGNITION INTERLOCKS AND WIRING 2. CHECK FOR FAULTY FUEL SHUTOFF VALVE OR VALVE WIRING
F14	LOCKOUT INTERLOCK OPENED DURING LOW FIRE HOLD AT THE END OF PRE-PURGE	1. CHECK LOCKOUT/RUNNING INTERLOCKS AND WIRING 2. CHECK AIRFLOW, FUEL PRESSURE, WATER LEVEL, etc.
F30	PILOT FLAME FAILURE	1. CHECK PILOT AND VALVE OPERATION 2. CHECK PILOT FUEL SUPPLY 3. CHECK IGNITION TRANSFORMER AND ELECTRODE, FLAME DETECTOR, FLAME DETECTOR SIGHTING, AND FLAME SIGNAL AMPLIFIER
F31	LOW FIRE START SWITCH OPENED DURING PILOT TRIAL	1. CHECK LOW FIRE START SWITCH, ADJUSTMENT, AND WIRING 2. CHECK FIRING RATE MOTOR, LINKAGE, AND WIRING
F34	LOCKOUT/RUNNING INTERLOCK OPENED DURING PILOT TRIAL	1. CHECK LOCKOUT/RUNNING INTERLOCKS AND WIRING 2. CHECK AIRFLOW, FUEL PRESSURE, WATER LEVEL, etc.
F35	PILOT FLAME FAILURE IN TEST MODE	1. INCREASE PILOT FUEL PRESSURE AND REPEAT PILOT TURNDOWN TEST 2. CHECK PILOT WIRING, AND VALVE OPERATION 3. CHECK FUEL SUPPLY 4. CHECK IGNITION TRANSFORMER AND ELECTRODE, FLAME DETECTOR, FLAME DETECTOR SIGHTING, AND FLAME SIGNAL AMPLIFIER
	PILOT FLAME FAILURE AND LOW FIRE START SWITCH FAULT (LOW FIRE START SWITCH OPENED DURING PILOT TRIAL)	1. CHECK THE LOW FIRE START SWITCH, ADJUSTMENT AND WIRING.
F40	MAIN FLAME FAILED TO IGNITE	1. CHECK MAIN FUEL SUPPLY AND WIRING 2. CHECK THAT THE PILOT CAN LIGHT MAIN FLAME (CONDUCT PILOT TURNDOWN TEST) 3. CHECK SENSOR ABILITY TO SENSE AND RESPOND TO THE MAIN FLAME 4. CHECK THE FLAME SIGNAL AMPLIFIER 5. CHECK PILOT OPERATION AS MAIN FUEL VALVE OPENS

(continued)

(Table II continued)

ANNUNCIATION/ DIAGNOSTIC CODE	SYSTEM FAILURE	RECOMMENDED TROUBLESHOOTING
F41	LOW FIRE START SWITCH OPENED DURING MAIN FLAME ESTABLISHING PERIOD	1. CHECK LOW FIRE START SWITCH, ADJUSTMENT AND WIRING
F44	LOCKOUT INTERLOCK OPENED DURING MAIN FLAME TRIAL	1. CHECK LOCKOUT/RUNNING INTERLOCKS AND WIRING 2. CHECK AIRFLOW, FUEL PRESSURE, WATER LEVEL, etc.
F50	FLAME FAILURE IN RUN PERIOD	1. CHECK MAIN FUEL SUPPLY 2. CHECK FLAME DETECTOR AND FLAME SIGNAL AMPLIFIER
F54	LOCKOUT INTERLOCK OPENED DURING RUN PERIOD	1. CHECK LOCKOUT/RUNNING INTERLOCKS AND WIRING 2. CHECK AIRFLOW, FUEL PRESSURE, WATER LEVEL, etc.
F63	PREIGNITION INTERLOCK FAILED TO CLOSE DURING POSTPURGE	1. CHECK THE PREIGNITION INTERLOCKS AND WIRING 2. CHECK FOR FAULTY FUEL SHUTOFF VALVE OR VALVE WIRING.
F70	FALSE FLAME SIGNAL DURING STANDBY	1. CHECK THAT FLAME IS NOT PRESENT IN COMBUSTION CHAMBER 2. TEST FLAME SIGNAL AMPLIFIER 3. TEST FLAME DETECTOR 4. CHECK FLAME DETECTOR WIRING
F73	PREIGNITION INTERLOCK OPENED DURING STANDBY	1. CHECK PREIGNITION INTERLOCKS AND WIRING 2. CHECK FOR FAULTY FUEL SAFETY SHUTOFF VALVE AND VALVE WIRING
F81	INTERMITTENT (BOUNCING) PREIGNITION INTERLOCK	1. CHECK PREIGNITION INTERLOCKS AND WIRING 2. INSPECT PREIGNITION INTERLOCK CONTACTS
F82,F83, F85,F86, F87	INTERMITTENT (BOUNCING) BURNER CONTROLLER/LIMIT	1. CHECK BURNER CONTROLLER/LIMITS AND WIRING 2. INSPECT THE BURNER CONTROLLER AND LIMIT CONTACTS
F84	INTERMITTENT (BOUNCING) LOCKOUT/RUNNING INTERLOCK	1. CHECK LOCKOUT/RUNNING INTERLOCKS AND WIRING 2. INSPECT LOCKOUT/RUNNING INTERLOCK CONTACTS
F90	PROGRAM MODULE FAULT	1. REMOVE AND REINSTALL PROGRAM MODULE (MAKE SURE MODULE IS INSTALLED PROPERLY) AND RESET THE CB70 2. REPLACE PM70 PROGRAM MODULE 3. REPLACE CB70 COMPUTERIZED BURNER CONTROL
F97	SYNCHRONIZATION (LINE FREQUENCY) FAULT	1. RESET CB70 COMPUTERIZED BURNER CONTROL 2. CHECK MAIN AND AUXILLIARY POWER SUPPLY LINE FREQUENCY 3. CHECK THAT THE CORRECT PM70 PROGRAM MODULE IS USED
F99, FA8, FAA, FAb, FAC, FAd, FAE, FAF, Fb8, Fb9, FbA, Fbb, FbC	INTERNAL CIRCUIT FAULT	1. CHECK FOR IMPROPER SUBBASE WIRING 2. ENSURE THAT CRITICAL LOAD TERMINALS (5,6,7) ARE NOT EXTERNALLY POWERED OR SHORTED 3. REMOVE AND REINSTALL THE PM70 PROGRAM MODULE AND RESET THE CB70 4. REPLACE THE PM70 PROGRAM MODULE 5. RESET CB70; IF F99, FA8 FAA, FAb, FAC, FAd, FAE, FAF, Fb8, Fb9, FbA, Fbb, or FbC REAPPEARS, REPLACE CB70

(Table II continued)

ANNUNCIATION/ DIAGNOSTIC CODE	SYSTEM FAILURE	RECOMMENDED TROUBLESHOOTING
F0E	LINE VOLTAGE PRESENT AT VALVE OR IGNITION TERMINALS DURING PREPURGE	1. CHECK FOR IMPROPER SUBBASE WIRING 2. ENSURE THAT CRITICAL LOAD TERMINALS (5,6,7) ARE NOT EXTERNALLY POWERED OR SHORTED 3. REMOVE AND REINSTALL THE PM70 PROGRAM MODULE AND RESET THE CB70 4. REPLACE THE PM70 MODULE 5. RESET THE CB70; IF THE CODE REAPPEARS, REPLACE CB70
F1E	LINE VOLTAGE PRESENT AT VALVE OR IGNITION TERMINALS DURING LOW FIRE HOLD	
F3A	PILOT TERMINAL NOT ENERGIZED DURING PILOT FLAME TRIAL	
F4A	PILOT TERMINAL NOT ENERGIZED DURING MAIN FLAME TRIAL	
F4C	MAIN VALVE TERMINAL NOT ENERGIZED DURING MAIN FLAME TRIAL	
F5C	MAIN VALVE TERMINAL NOT ENERGIZED DURING RUN PERIOD	
F6E	VALVE OR IGNITION TERMINAL ENERGIZED DURING POSTPURGE	
F7E	LINE VOLTAGE PRESENT AT VALVE OR IGNITION TERMINALS DURING STANDBY	
BLANK OR UNDEFINED FAULT CODES. STATUS LIGHTS MAY ALSO HAVE INCORRECT INFORMATION AND BURNER MOTOR MAY BE RUNNING		1. RESET CB70. IF CONDITION REAPPEARS, REPLACE CB70

CB70 RESPONSE ANALYSIS

This table lists the CB70 response to improper input and output conditions at the various sequence positions.

INPUT OUTPUT STATES. / BURNER SEQUENCE POSITION	INPUT CONDITION	
	FLAME SIGNAL (H70, F00, F10, F30, F40, F50, F70)	**BURNER CONTROLLER LIMITS (F82, F83, F85, F86, F87)**
STANDBY	—When a flame signal is present during standby, the STANDBY status light remains on, the FLAME ON status light comes on, and the Multi-Function Annunciator Display (display) reads 'H70'. —The CB70 does not start up if a flame signal is present when the burner controller closes. —If a flame signal remains for more than 30 seconds a safety shutdown occurs. The STANDBY status light blinks and the display alternately flashes "---" and "F70."	—The system remains in standby as long as the controller is open. —The sequence enters prepurge when the controller closes.
PREPURGE	—Presence of flame signal is ignored for the first 10 seconds of prepurge. —From 10 seconds into the prepurge until the sequence is halted for the low fire hold, presence of flame signal causes a safety shutdown. The PREPURGE status light blinks and the display alternately flashes the prepurge time at which the safety shutdown occurred and the fault code "F00." —During the low fire hold period, before the ignition trial period, presence of flame signal causes a safety shutdown. The PREPURGE and HOLD status lights blink and the display alternately flashes "30" and the fault code "F10."	—The burner controller must remain closed or the CB70 returns to standby.
IGNITION TRIAL	—During the 10-second pilot flame establishing period (0 to 10 seconds to the ignition trial period), status of the flame signal is monitored. If the sequence is stopped during the pilot flame establishing period and presence of flame is not proved within 30 seconds, a safety shutdown occurs. The display alternately flashes the ignition time at which the sequence was stopped and the fault code "F35." If the run/test switch is in the test position, the IGN. TRIAL status light blinks. If the low fire start switch has opened, the IGN. TRIAL and hold status lights blink. —Absence of flame signal at 10 seconds into the ignition trials (end of the pilot flame establishing period) causes safety shutdown. The IGN. TRIAL status light blinks and the display alternately flashes 10 and the fault code "F30." —Absence of flame signal during the main flame establishing period (after 10 seconds into the ignition trial and before entering the run period) causes a safety shutdown. The IGN. TRIAL status light blinks and the display alternately flashes the ignition trial time at which the safety shutdown occurred and the fault code "F40."	—The burner controller must remain closed or all ignition and fuel loads are de-energized and the sequence advances to postpurge.
BURNER RUN	—Loss of flame signal during the run period causes safety shutdown. The RUN status light blinks and the display alternately blinks "---" and "F50."	—The burner controller must remain closed or all of the fuel loads are de-energized and the sequence advances to postpurge.
POSTPURGE	—	—

INPUT CONDITION		
PREIGNITION INTERLOCKS (F03, F13, F63, F73, F81)	**LOCKOUT INTERLOCKS (F04, F14, F34, F44, F54, F84)**	**HIGH FIRE PURGE SWITCH (F01)**
—If a preignition interlock opens during standby, safety shutdown occurs. The standby status light blinks and the display alternately flashes "---" and fault code "F73."	—	—
—If a preignition interlock opens after startup but before the sequence is halted for the low fire hold, safety shutdown occurs. The PREPURGE status light blinks and the display alternately flashes the prepurge time at which the safety shutdown occurred and the fault code "F03." —If a preignition interlock opens during the low fire hold period, before entering the ignition trial period, safety shutdown occurs. The PREPURGE and HOLD status lights blink and the display alternately flashes "30" and the fault code "F13."	—Status of the lockout interlocks is not monitored during the first 10 seconds of prepurge. —From the first 10 seconds of the prepurge, until the low fire hold, an open lockout interlock causes a safety shutdown. The PREPURGE status light blinks and the display alternately flashes the prepurge time at which the safety shutdown occurred and the fault code "F04." —During the low fire hold, an open lockout interlock causes a safety shutdown. The PREPURGE and HOLD status lights blink and the display alternately flashes "30" and the fault code "F14."	—When the burner controller closes, the sequence enters prepurge and holds with the PREPURGE and HOLD status lights on. If the high fire switch does not close within 3 minutes, a safety shutdown occurs. The PREPURGE and HOLD status lights blink and the display alternately flashes "00" and the fault code "F01." 1. If the energy-saving purge is utilized (terminal 18 jumpered to 4), the burner motor remains de-energized until the high fire purge switch closes. If the high purge switch is jumpered the energy-saving purge is deleted. 2. If the energy-saving purge is not utilized (terminal 18 is not jumpered to 4), the burner motor becomes energized when the operating controller closes. —If the high fire switch opens during the 30-second proven open damper prepurge, the sequence stops and holds with the HOLD status light on and the display shows the prepurge time the hold occurred. If the high fire switch closes within 3 minutes, the sequence continues as normal. If the high fire switch remains open beyond this time, a safety shutdown occurs. The PREPURGE and HOLD status lights blink and the display alternately flashes the prepurge time that the shutdown occurred and the fault code "F01." —Status of the high fire switch is not monitored during the low fire hold period.
	—An open lockout interlock during the ignition trial period causes a safety shutdown. The IGN. TRIAL status light blinks and the display alternately flashes the ignition trial time at which the safety shutdown occurred and 1 of 2 fault codes: 1. "F34" if the shutdown occurred in the pilot flame establishing period (0-10 seconds), or: 2. "F44" if the shutdown occurred in the main flame establishing period (11-25 seconds).	—
	—An open lockout interlock during the run period causes a safety shutdown. The RUN status light blinks and the display alternately flashes "---" and "F54."	—
—If the preignition interlocks are not closed after 5 seconds into the postpurge, safety shutdown occurs. The postpurge status light blinks and the display alternately flashes the postpurge time at which the preignition interlocks opened and the fault code "F63."	—	—

CB70 RESPONSE ANALYSIS

This table lists the CB70 response to improper input and output conditions at the various sequence positions.

INPUT CONDITION		OUTPUT CONDITION
LOW FIRE START SWITCH (F11, F31, F41, F35)	**RUN/TEST SWITCH (F35)**	**TERMINAL 5 (F99, F7E, F0E, F1E, F3A, F4A, F6E)**
—	—	—Presence of line voltage causes a safety shutdown. The STANDBY status light blinks and the display alternately flashes "---" and the fault code "F99" or "F7E."
—Status of the low fire start switch is not monitored until the low fire hold. The low fire start switch must close within 3 minutes after the beginning of the low fire hold to continue the normal operating sequence. If the low fire start switch does not close within this period, a safety shutdown occurs. The PREPURGE status light blinks and the display alternately flashes "30" and the fault code "F11." —If the low fire switch is jumpered, a safety shutdown occurs. The PREPURGE status light blinks and the display alternately flashes "30" and the fault code "F11."	—The RUN/TEST switch is not monitored during prepurge until the low fire hold. If the switch is moved to the TEST position during the low fire hold period the HOLD status light turns off. The sequence and display remain as they were until the switch is reset to the RUN position. The sequence then resumes with the low fire hold.	—The presence of line voltage during prepurge and up to the low fire hold period causes a safety shutdown. The PREPURGE status light blinks and the display alternately flashes the prepurge time at which the safety shutdown occurred and the fault code "F99" or "F0E." —Presence of line voltage during the low fire hold period causes a safety shutdown. The PREPURGE and HOLD status lights blink and the display alternately flashes the prepurge time and the fault code "F99" or "F1E."
—If the low fire start switch opens during the trial for ignition before the pilot flame is sensed the sequence holds (HOLD light on). If this hold exceeds 30 seconds safety shutdown occurs and the display alternately flashes the ignition trial time at which shutdown occurred and the fault code "F35." —If the low fire start switch opens during the ignition trials after the pilot flame is sensed the sequence holds (HOLD light on). If this hold exceeds 3 minutes safety shutdown occurs and the display alternately flashes the ignition trial time at which safety shutdown occurred and the fault code "F31." —If the low fire start switch opens during trial for main flame safety shutdown occurs immediately, the IGN. TRIAL light blinks, and the display alternately flashes the ignition trial time at which shutdown occurred and the fault code "F41."	—If the RUN/TEST switch is moved to the TEST position within the first 8 seconds of the ignition trial period, the sequence is halted and the display stops counting. Presence or absence of flame signal is now monitored by the 30-second flame out timer in the CB70. If flame is not proven within 30 seconds, a safety shutdown occurs. The IGN. TRIAL status light blinks and the display alternately flashes the time at which the RUN/TEST switch was placed in the TEST position and the fault code "F35."	—Absence of line voltage from 0 to 20 seconds into the ignition trial period causes a safety shutdown. The IGN. TRIAL status light blinks and the display alternately flashes the ignition trial time at which the safety shutdown occurred and the fault code "F99," or "F3A" or "F4A."
—	—If the RUN/TEST switch is moved to the TEST position at any time during the run period, the firing rate motor drives to the low fire position. Control is again released to the modulating controller when the switch is returned to the RUN position.	—
—	—	—Presence of line voltage during the postpurge causes a safety shutdown. The POSTPURGE status light blinks and the display alternately flashes the postpurge time at which the safety shutdown occurred and the fault code "F99" or "F6E."

CB70 RESPONSE ANALYSIS

This table lists the CB70 response to improper input and output conditions at the various sequence positions.

INPUT CONDITION		OUTPUT CONDITION
LOW FIRE START SWITCH (F11, F31, F41, F35)	**RUN/TEST SWITCH (F35)**	**TERMINAL 5 (F99, F7E, F0E, F1E, F3A, F4A, F6E)**
—	—	—Presence of line voltage causes a safety shutdown. The STANDBY status light blinks and the display alternately flashes "---" and the fault code "F99" or "F7E."
—Status of the low fire start switch is not monitored until the low fire hold. The low fire start switch must close within 3 minutes after the beginning of the low fire hold to continue the normal operating sequence. If the low fire start switch does not close within this period, a safety shutdown occurs. The PREPURGE status light blinks and the display alternately flashes "30" and the fault code "F11." —If the low fire switch is jumpered, a safety shutdown occurs. The PREPURGE status light blinks and the display alternately flashes "30" and the fault code "F11."	—The RUN/TEST switch is not monitored during prepurge until the low fire hold. If the switch is moved to the TEST position during the low fire hold period the HOLD status light turns off. The sequence and display remain as they were until the switch is reset to the RUN position. The sequence then resumes with the low fire hold.	—The presence of line voltage during prepurge and up to the low fire hold period causes a safety shutdown. The PREPURGE status light blinks and the display alternately flashes the prepurge time at which the safety shutdown occurred and the fault code "F99" or "F0E." —Presence of line voltage during the low fire hold period causes a safety shutdown. The PREPURGE and HOLD status lights blink and the display alternately flashes the prepurge time and the fault code "F99" or "F1E."
—If the low fire start switch opens during the trial for ignition before the pilot flame is sensed the sequence holds (HOLD light on). If this hold exceeds 30 seconds safety shutdown occurs and the display alternately flashes the ignition trial time at which shutdown occurred and the fault code "F35." —If the low fire start switch opens during the ignition trials after the pilot flame is sensed the sequence holds (HOLD light on). If this hold exceeds 3 minutes safety shutdown occurs and the display alternately flashes the ignition trial time at which safety shutdown occurred and the fault code "F31." —If the low fire start switch opens during trial for main flame safety shutdown occurs immediately, the IGN. TRIAL light blinks, and the display alternately flashes the ignition trial time at which shutdown occurred and the fault code "F41."	—If the RUN/TEST switch is moved to the TEST position within the first 8 seconds of the ignition trial period, the sequence is halted and the display stops counting. Presence or absence of flame signal is now monitored by the 30-second flame out timer in the CB70. If flame is not proven within 30 seconds, a safety shutdown occurs. The IGN. TRIAL status light blinks and the display alternately flashes the time at which the RUN/TEST switch was placed in the TEST position and the fault code "F35."	—Absence of line voltage from 0 to 20 seconds into the ignition trial period causes a safety shutdown. The IGN. TRIAL status light blinks and the display alternately flashes the ignition trial time at which the safety shutdown occurred and the fault code "F99," or "F3A" or "F4A."
—	—If the RUN/TEST switch is moved to the TEST position at any time during the run period, the firing rate motor drives to the low fire position. Control is again released to the modulating controller when the switch is returned to the RUN position.	—
—	—	—Presence of line voltage during the postpurge causes a safety shutdown. The POSTPURGE status light blinks and the display alternately flashes the postpurge time at which the safety shutdown occurred and the fault code "F99" or "F6E."