

## R4140G,L and M Flame Safeguard Programming Controls

### INSTALLATION INSTRUCTIONS

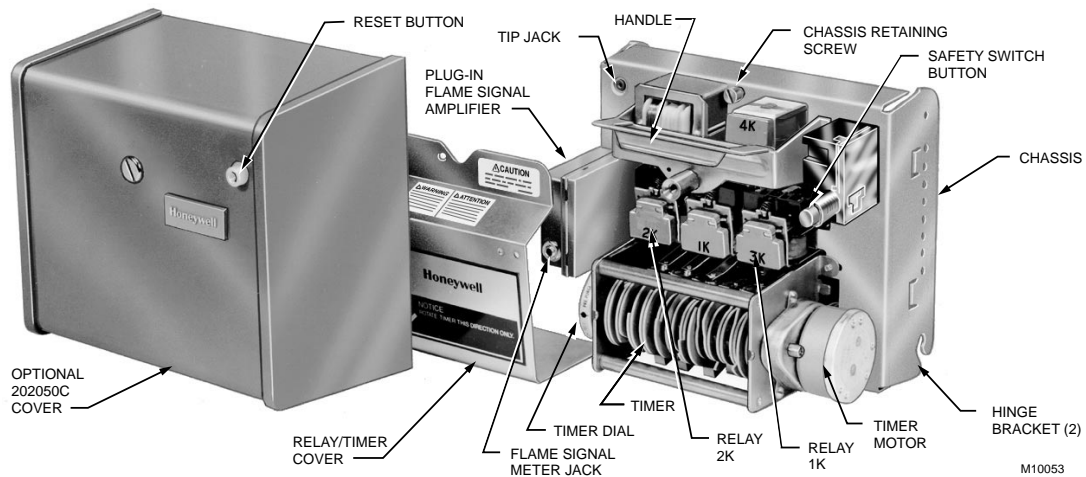


Fig. 1. Components of R4140G and R4140M Programmers.

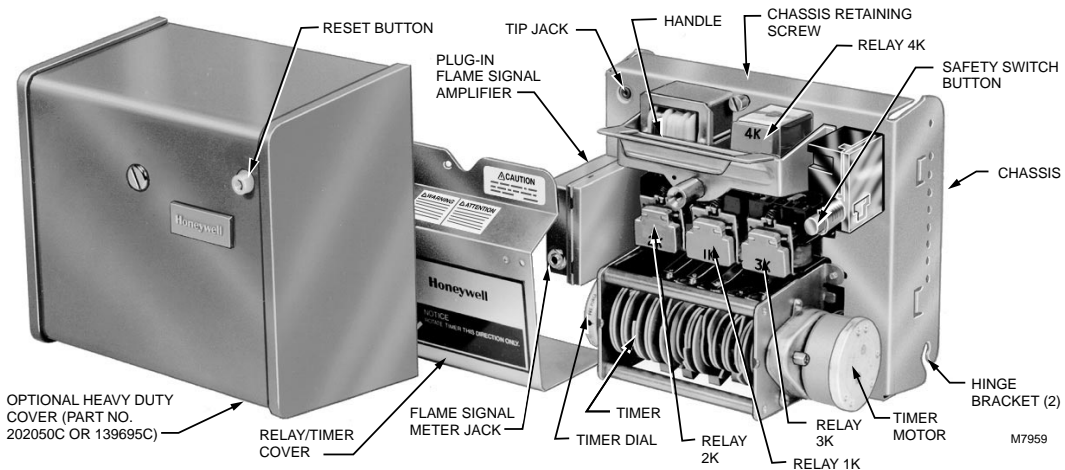


Fig. 2. Components of R4140L Programmers.

#### IMPORTANT

Applications, Features, Specifications (including dimension drawings), Operation (including schematics and bar charts), and Wiring Diagrams are included in these Specifications for models of the R4140G, L, and M: R4140G—60-2337; R4140L—60-2339; R4140M—60-2340.

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## INSTALLATION

### When Installing this Product...

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

### CAUTION

1. Disconnect power supply before beginning installation to prevent electrical shock and equipment damage.
2. All wiring must be NEC Class 1 (line voltage).
3. Loads connected to the control terminals must not exceed those listed on the R4140 label or in the Specifications section of the Specifications for the R4140G,L or M.
4. Limits and interlocks must be rated to carry and break current to the ignition transformer, pilot valve, and main fuel valve(s) simultaneously.
5. All external timers must be listed or component recognized by authorities having jurisdiction for the specific purpose for which they are used.

### 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. *Do not connect more than two C7012E,F or C7076A Ultraviolet Flame Detectors (with self-checking shutter) in parallel to the same terminals.*

Use applicable installation instructions provided by the burner manufacturer in addition to the corresponding instructions given here. Before putting the system into service, check out the installation using the procedures in the Checkout section and any other procedures stipulated by the burner manufacturer.

### Location Temperature

Install the R4140 where the surrounding temperatures remain within the Ambient Operating Temperature Ratings in the Specifications section of the Specifications for the R4140G,L or M.

### Humidity

Install the R4140 where the relative humidity never reaches the saturation point. Condensation of moisture on the R4140 can cause enough leakage to short the flame signal to ground and thus prevent the burner from starting.

### Vibration

Do not install the R4140 where it could be subjected to excessive vibration. Vibration shortens the life of the electronic components.

### Weather

The R4140 is not designed to be weather tight. If it is installed outdoors, it must be protected.

### Mounting the Wiring Subbase

NOTE: For installation dimensions, see Fig. 1 and 2 in the Specifications for the R4140G,L or M.

- 1 The subbase can be mounted in any position except horizontally with the knife-blade contacts pointing down. The standard vertical position (shown in Fig. 5) is recommended. Any other position decreases the maximum ambient temperature rating.
- 2 Select a location on a wall or instrument panel. (The 0520A Subbase can be mounted directly in the customer's cabinet.) Be sure to allow clearances for servicing and for removal of the R4140.

### IMPORTANT

*Do not mount the wiring subbase horizontally with the knife-blade contacts pointing down.*

- 3 For surface mounting, use the back of the subbase as a template to mark the four screw locations. Drill the pilot holes.
- 4 Insert the mounting screws and tighten them securely.

### Wiring to Subbase

### CAUTION

Make sure the wiring to terminal 7 does not touch any other terminal, especially terminal 8.

- 1 All wiring must comply with all applicable electrical codes, ordinances, and regulations. Use NEC Class 1 (line voltage) wiring.
- 2 For normal installations, use moisture-resistant No. 14 wire suitable for at least 194°F (90°C).
- 3 For high temperature installations, use moisture resistant No. 14 wire, selected for a temperature rating above the maximum operating temperature, for all but the ignition and flame detector F leadwires.
  - a. For the ignition, use Honeywell specification no. R1061012 Ignition Cable or equivalent. This wire is rated at 350°F (177°C) for continuous duty, and up to 500°F (260°C) for intermittent use. It has been tested to 25,000 volts.
  - b. For the flame detector F leadwire, use Honeywell specification no. R1298020 or equivalent. This wire is rated up to 400°F (204°C) 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.*

- 4 For ignition installations in a contaminating environment, use Honeywell specification 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 up to

25,000V rms in a salt bath for one minute without breakdown. It is rated at 200°F (93°C) for continuous duty, and up to 350°F (177°C) for intermittent use.

- 5 Refer to the appropriate wiring diagram in the Specifications for the R4140G,L or M. Follow the burner manufacturer's wiring diagram, if provided.
- 6 Make sure the loads do not exceed the terminal ratings. Refer to the label on the R4140 or to the Terminal Ratings in the Specifications section of the Specifications for the R4140G,L or M.
- 7 Check the power supply circuit. The voltage and frequency must match those of the R4140. Do not connect the R4140 to a circuit that is subjected to line voltage variations, such as would occur with on-off switching of heavy loads. A separate power supply circuit can be required for the flame safeguard control. Add required disconnect means and overload protection.
- 8 Check all wiring circuits and complete the Static Checkout in Table 2 before installing the R4140.

## Installing the Flame Detector

NOTE: Table 1 lists the flame detection systems available for use with R4140 Programmers. 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 burner manufacturer's instructions. Follow the instructions carefully for the best possible flame detector application.

Keep the flame signal lead wires as short as possible from the flame detector to the wiring subbase. 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 flame signal leadwire length is the signal current. Refer to Table 4 in the Checkout section.

Table 1. Flame Detection Systems.

Plug-In Flame Signal Amplifiers					Applicable Flame Detectors		
Type	Color	Self-Checking	Model	Flame Failure Response Time	Fuel	Type	Models
Rectification	Green	No	R7247A	2 to 4 second	Gas	Rectifying Flame Rods	Holder <sup>a</sup> C7004, C7007, C7011. Complete Assemblies: C7005, C7008, C7009, Q179.
			R7247A, R7247B <sup>b</sup>		Oil	Rectifying Photocells <sup>c</sup>	C7003, C7010, C7013, C7014.
					Gas, Oil, Coal	Ultraviolet (Purple Peeper)	C7012A or C.
		Dynamic Self-Check	R7247B <sup>b</sup>		Gas	Rectifying Flame Rods	Holder <sup>a</sup> : C7004, C7007, C7011. Complete Assemblies: C7005, C7008, C7009, Q179.
			R7247C <sup>d</sup>		Gas, Oil, Coal	Ultraviolet (Purple Peeper)	C7012E or F.
Infrared	Red	No	R7248A	2 to 4 second	Gas, Oil, Coal	Infrared (Lead Sulfide)	C7015.
		Dynamic Ampli-Check <sup>®</sup>	R7248B <sup>b</sup>				
Ultraviolet	Purple	No	R7249A	2 to 4 second	Gas, Oil	Ultraviolet (Minipeeper)	C7027, C7035, C7044.
	Blue	Dynamic Self-Check	R7476A <sup>d</sup>		Gas, Oil, Coal	Ultraviolet (Adjustable Sensitivity)	C7076.

<sup>a</sup> Order flame rod separately; see Instructions for the holder.

<sup>b</sup> Circuitry tests the flame signal amplifier at least 150 times a minute during burner operation and shuts down the burner if the amplifier fails.

<sup>c</sup> Use only Honeywell part no. 38316 Photocell.

<sup>d</sup> Circuitry tests all electronic components in the flame detection system (amplifier and detector) 60 to 240 times a minute during burner operation and shuts down the burner if the detection system fails.

### Special Considerations for a C7012E or F

The R4140 provides two sources of power for a C7012E or F Purple Peeper Ultraviolet Flame Detector (with self-checking shutter). The power to the black leadwires of a C7012E can be 120V, 208V, 220V, or 240 Vac, depending on the model of the detector. The C7012F is available only in a 120V model. This voltage must match the power supply of the R4140.

The power to the white leadwires must be 120 Vac; this is the power supply for the operation of the self-checking shutter. The 120V for the shutter is applied automatically at terminal 17 of the R4140 through switching action within the plug-in R7247C Flame Signal Amplifier.

### Using Redundant Parallel C7012E or F Detectors

For a flame that is difficult to sight, using two parallel C7012E or F Flame Detectors reduces nuisance shutdowns. If only one of the parallel detectors loses the flame signal, the other continues to indicate the presence of the flame and keeps the burner running. A flame simulating failure in either detector causes the burner to shut down. Two C7012E detectors can be wired in parallel to the same terminals on any R4140 (if the voltage ratings match). Two C7012F Detectors can be wired in parallel only on 120V models. To avoid exceeding the rating of the solid state shutter switch in the R7247C Flame Signal Amplifier, do not connect more than two C7012E or F Detectors in parallel.

### Static Checkout (See Table 2)

## WARNING

1. Use extreme care while performing these tests; line voltage is present on most subbase terminals when power is on.
2. Open the master switch before installing or removing a test jumper.
3. Be sure to remove the test jumper(s) after completing each test before continuing to the next test.
4. Replace all external devices not operating properly. Do not bypass external devices.
5. Close all manual fuel shutoff valves before starting these tests.

After checking all wiring circuits, perform this checkout before installing the programmer on the subbase. These tests ensure that the Q520A Wiring Subbase is wired correctly, and that the external controllers, limits, interlocks, actuators, valves, transformers, motors, and other devices are operating properly.


### Equipment Required

1. Voltmeter (W136A or equivalent) set on 0 to 300 Vac scale.
2. Jumper wires (2) of No. 14 wire, insulated, 12 in. (304.8 mm) long, with alligator clips at both ends.

### General Instructions



- 1 Perform all applicable tests in Table 2, in the order listed.
- 2 Make sure all manual fuel shutoff valves are closed.
- 3 Perform only those tests designated for the specific programmer model being tested.
- 4 Raise the setpoint of the burner controller to simulate a call for heat.
- 5 For each test, open the master switch and install the jumper wire(s) between the subbase wiring terminals listed in the Test Jumpers column.
- 6 Close the master switch before observing operation.
- 7 Read the voltage between the subbase wiring terminals listed in the Voltmeter column.
- 8 If there is no voltage or if operation is abnormal, check the circuits and external devices as described in the last column.
- 9 Check all wiring in the circuits for correct connections, tight terminal screws, correct wire, and proper wiring techniques. Replace all worn or incorrectly sized wires.
- 10 Replace faulty controllers, limits, interlocks, actuators, valves, transformers, motors, and other devices, as required.
- 11 Normal operation must be obtained for each required test before continuing the checkout.
- 12 Be sure to remove the test jumper(s) after completing each test before continuing on to the next test.

Table 2. Static Tests of External Devices.

Test No.	R4140 Models	Test Jumpers	Voltmeter	Normal Operation	If Operation is Abnormal, Check the Items Listed Below
 <b>WARNING</b> Make sure all manual fuel shutoff valves are closed.					
1	All models	None	L1-L2	Line voltage at terminal L1.	1. Master switch is closed. 2. Power is connected to the master switch. 3. Overload protection (fuse, circuit breaker etc.) has not opened the power line.
2	Models with Preignition Interlocks	None	4-L2	Line voltage at terminal 4.	<b>IMPORTANT</b> <i>Low fuel pressure limits, if used, could be open. Bypass them with jumpers for the remaining Static Tests (if required).</i>
	Models with Start Interlocks	None	16-L2	Line voltage at terminal 16.	1. Limits are closed. If open, determine cause(s) and correct the condition(s). 2. Burner controller contacts are closed (call for heat).


(Continued)

Table 2. Static Tests of External Devices (Continued).

Test No.	R4140 Models	Test Jumpers	Voltmeter	Normal Operation	If Operation is Abnormal, Check the Items Listed Below
3	Models with Preignition Interlocks	None	16-L2	Line voltage at terminal 16.	1. Preignition interlocks are closed. If open, determine cause(s) and correct the condition(s).
	Models with Start Interlocks	None	4-L2	Line voltage at terminal 4.	1. Start interlock(s), if used, is closed. If open, determine cause(s) and correct the condition(s). 2. If start interlock(s) is not used, jumper is installed between terminals 4 and 16.
4	All models	L1-8	3-L2	1. Burner motor (fan or blower) starts. 2. Line voltage at terminal 3 within 12 seconds.	1. Burner motor circuit: a. Manual switch of burner motor is closed. b. Burner motor power supply, overload protection, and starter are OK. c. Burner motor is OK. 2. Running or lockout interlocks (including the Airflow switch) are closed.
 <b>WARNING</b> Make sure all manual fuel shutoff valves are closed.					
5	Models with 5 second ignition	L1-18	—	Ignition spark (if ignition transformer is connected to terminal 18).	1. Watch for spark or listen for buzz. a. Ignition electrodes are clean. b. Ignition transformer is OK.
6	All models	L1-5	—	1. Ignition spark (if ignition transformer is connected to terminal 5). 2. Automatic pilot valve opens (if connected to terminal 5). NOTE: Refer to wiring diagram of the programmer being tested.	1. Watch for spark or listen for buzz: a. Ignition electrodes are clean. b. Ignition transformer is OK. 2. Listen for click or feel head of valve for activation. a. Actuator (if used) is OK. b. Pilot valve is OK.
7	All models	L1-6	—	Same as test no. 6 for connections to terminal 6. (If using direct spark ignition, check the first stage fuel valve(s) instead of the pilot valve.)	Same as test no. 6. (If using direct spark ignition, check the first stage fuel valve(s) instead of the pilot valve.)
 <b>WARNING</b> Make sure all manual shutoff valves are closed.					
8	All models	L1-7	—	Automatic main fuel valve(s) opens. (If using direct spark ignition on a model with intermittent pilot/ignition on terminal 6, check the optional second stage fuel valve, if used.)	1. Listen for and observe operation of the main fuel valve(s) and actuator(s). 2. Valve(s) and actuator(s) are OK.
9	All models	L1-9	—	Alarm (if used) turns on.	1. Alarm is OK.
10	All R4140L models	L1-8 and 10-11	13-L2	Firing rate motor drives open; zero volts at terminal 13 after motor starts driving open.	1. Low Fire switch is open. 2. Firing rate motor and transformer are OK.
11	All R4140G models	L18 and 14-11	13-L2	Firing rate motor drives closed; line voltage at terminal 13 after motor closes.	1. Low Fire switch is closed. 2. Firing rate motor and transformer are OK.
12	All R4140L models	L1-8 and 14-11	15-L2	Firing rate motor drives open; line voltage at terminal 15 after motor opens.	1. High Fire switch is closed. 2. Firing rate motor and transformer are OK.

(Continued)

Table 2. Static Tests of External Devices (Continued).

Test No.	R4140 Models	Test Jumpers	Voltmeter	Normal Operation	If Operation is Abnormal, Check the Items Listed Below
13	All R4140L models	L18 and 14-11	13-L2	Firing rate motor drives closed; line voltage at terminal 13 after motor closes.	1. Low Fire switch is connected between terminals 8 and 13. If not, proceed to test no. 14. 2. Low Fire switch is closed. 3. Firing rate motor and transformer are OK.
14	All R4140L models	L1-15 and 14-11	13-L2	Firing rate motor drives closed; line voltage at terminal 13 after motor closes.	1. Low Fire switch is connected between terminals 15 and 13. If not, proceed to test no. 15. 2. Low Fire switch is closed. 3. Firing rate motor and transformer are OK.
15	All R4140G and R4140L models	12-11	—	1. Raise setpoint of Series 90 Controller—firing rate motor should drive toward open. 2. Lower setpoint of Series 90 Controller—firing rate motor should drive toward closed.	1. Series 90 Controller is OK. 2. Firing rate motor and transformer are OK.
16	R4140M models with open damper contacts	L1-10	—	If damper control is used, actuator drives damper open.	1. Jumper wire is installed between terminals 11 and 12. 2. Damper actuator is OK.
17	R4140M models with open damper contacts	L1-8	13-L2	If damper control is used, spring return drives actuator and damper closed; line voltage at terminal 13 after actuator closes.	1. Low Fire switch is closed. 2. Damper actuator is OK.
Final	All models	 <b>CAUTION</b> After completing these tests, open the master switch and remove all test jumpers from the subbase terminals. Also remove bypass jumpers from the low fuel pressure limits (if used).			

### Installing the Programmer (Fig. 3)

- 1 Open the master switch.
- 2 Make sure no subbase wiring is projecting out beyond the terminal blocks. Tuck in wiring against the back of the subbase so it does not interfere with the contacts.
- 3 Grasp the handle of the programmer chassis and 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 in until the contacts are fully engaged.
- 5 Tighten the chassis retaining screw securely.

### Removing the Programmer

- 1 Open the master switch.
- 2 Loosen the chassis retaining screw.
- 3 Pull outward on the handle.
- 4 Disengage the chassis hinge brackets from the subbase pivot pins.

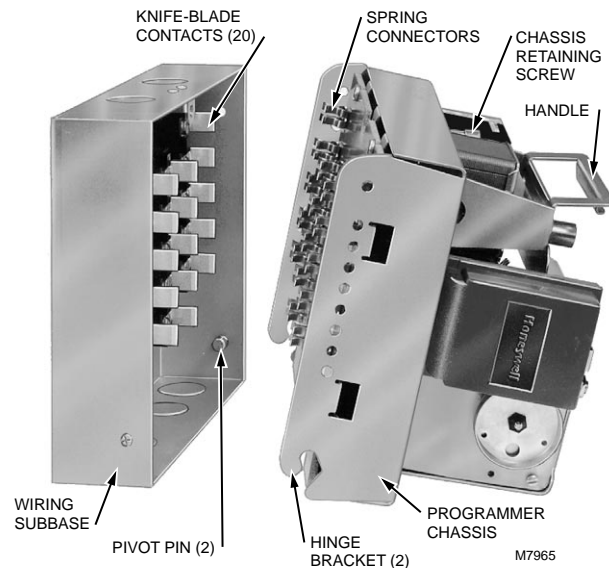


Fig. 3. Mounting the programmer on the subbase.

## Removing and Replacing the Relay/Timer Cover (Fig. 4)

### ⚠ CAUTION

If the programmer is mounted on the subbase, open the master switch before removing or replacing the relay/timer cover.

The relay/timer cover must be removed to install a plug-in flame signal amplifier, to observe relay and timer operation, or to inspect the contacts.

### Removing the Cover

- ❶ Grasp the relay/timer cover and squeeze until the V-notch on the cover slides free of the stud on the handle.
- ❷ Rotate the cover down and out to disengage the two tabs from the slot in the bottom of the programmer chassis.
- ❸ Pull out the cover.

### Replacing the Cover

- ❶ Insert the two tabs on the bottom of the cover between the timer and the programmer chassis and engage them with the slot in the bottom of the chassis.
- ❷ Rotate the cover up and in so the V-notch slides along the stud on the handle. If the cover does not rotate easily, the tabs are jammed.
- ❸ Make sure the spring clip on the cover fits over the plug-in amplifier.
- ❹ Push in on the cover until the V-notch snaps into place on the stud.

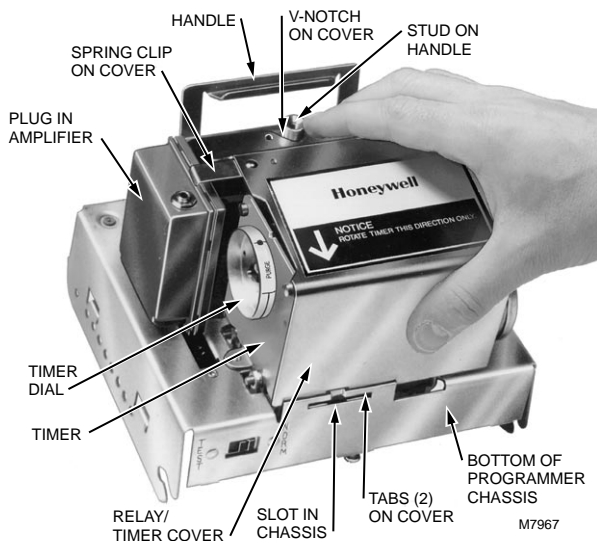


Fig. 4. Removing and replacing the relay/timer cover.

## Installing a Plug-in Flame Signal Amplifier (Fig. 5)

- ❶ Remove the relay/timer cover.
- ❷ Make sure the Honeywell monogram is on the outside, then align the circuit board with the keyed receptacle on the programmer.

NOTE: If installing a small amplifier, align its ends with the two scribe marks alongside the receptacle on the programmer.

- ❸ Push in the amplifier until the circuit board is fully inserted into the receptacle.
- ❹ Make sure the amplifier is firmly in place, then replace the relay/timer cover. Make sure the spring clip on the cover fits over the amplifier.

NOTE: For further information about a self-checking amplifier, refer to the Instructions packed with the amplifier (form 60-2358 for an R7247B or C, form 60-2357 for an R7248B, or form 95-8270 for an R7476A).

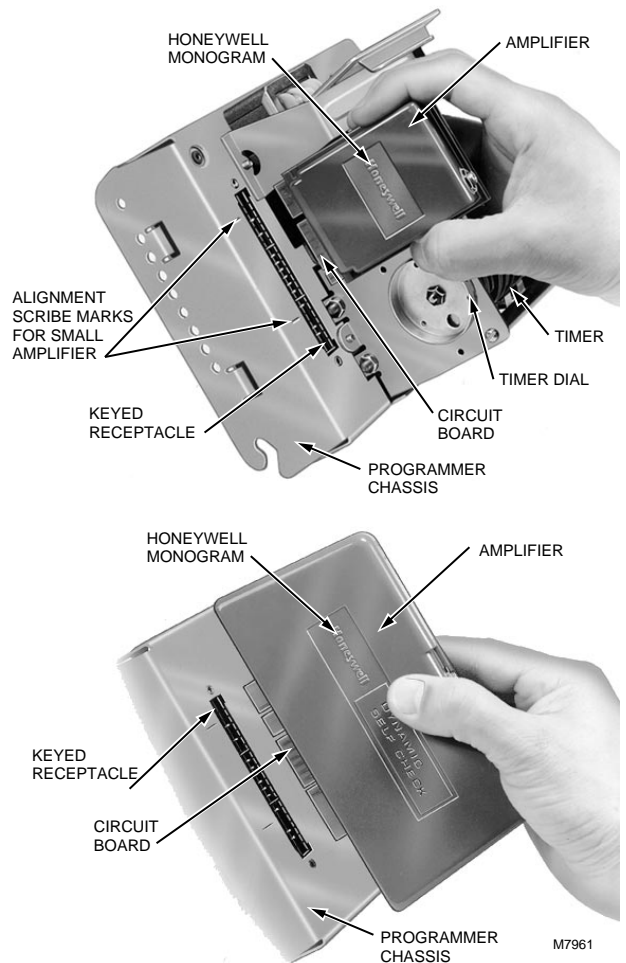


Fig. 5. Installing a plug-in flame signal amplifier.

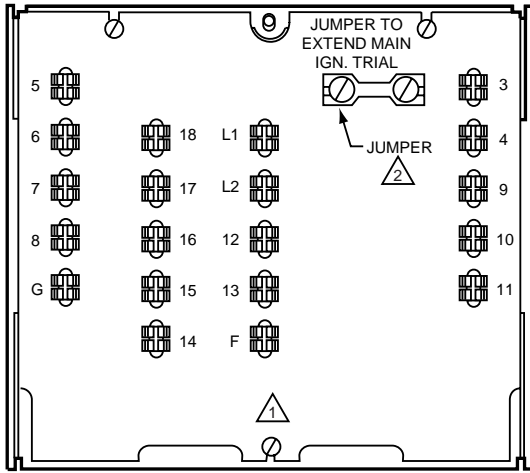
## Installation Instructions for Special Features

Some TRADELINE® models and international models (rated for other than 120V, 60 Hz) can have one (or both) of the following special features.

### Installing Jumper on Back of Programmer (Fig. 6)

Some R4140G, L, and M models have provisions for extending the main burner flame-establishing period (MBFEP) at terminal 6 by installing a jumper on the back of the programmer. If you are installing one of these models, determine the required MBFEP. If you need the longer period provided at terminal 6, install the jumper (included in a bag assembly with the R4140) between the terminals labeled JUMPER TO EXTEND MAIN IGN. TRIAL on the back of the programmer. If you do not need the longer period, leave the jumper off.

NOTE: Some R4140 models for use in Australia have jumper terminals on the back of the programmer for safety shutdown alarm options; these jumpers cannot be used to extend the MBFEP. These R4140 models are shipped with a jumper link between the N.O. screw terminals on the back of the programmer. This results in alarm operation on safety shutdown. N.C. screw terminals are provided for an external auxiliary safety shutdown circuit. Refer to the R4140 Specifications for these models.



⚠ AN R4140L IS SHOWN; R4140G AND R4140M PROGRAMMERS HAVE FEWER SPRING CONNECTORS. TERMINAL NUMBERS ARE NOT ON THE PROGRAMMER, BUT ARE SHOWN FOR REFERENCE.

⚠ INSTALL JUMPER (INCLUDED IN BAG ASSEMBLY) TO OBTAIN THE LONGER MAIN BURNER FLAME-ESTABLISHING PERIOD AVAILABLE AT TERMINAL 6.

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Fig. 6. Installing jumper to extend main burner flame-establishing period.

### Upgrading Systems

Conveniently, the R4140 family was developed in models of varying complexity to allow the user to choose the simplest programmer that meets their application requirements (Table 3).

A system can be upgraded from on-off to modulating by replacing an R4140M with an R4140G (Fig. 7). A system can be upgraded to meet Factory Mutual and Industrial Risk Insurers (formerly FIA) requirements by replacing an R4140M or an R4140G with an R4140L (Fig. 8).

Table 3. R4140 Applications.

Application Requirements	Interlock Circuits	Firing Rate Switching	Applicable R4140
UL On-Off	Start and running	None	R4140M
UL On-Off (with 2-stage firing)	Start, running, and low fire	1-wire <sup>a</sup> (open damper contacts)	Several R4140Ms
UL modulating (with low high-low prepurge)	Start or pre-ignition, running, and low fire	4-wire	R4140G
FM/IRI modulating (with low-high-low prepurge and proven high fire purge)	Preignition, lockout, high fire, and low fire	4-wire	R4140L

<sup>a</sup> Firing rate motor must close by itself (spring-return) when power is removed.

FM Factory Mutual requirements.

IRI Industrial Risk Insurers (formerly FIA) requirements.

UL Underwriters Laboratories Inc. requirements.

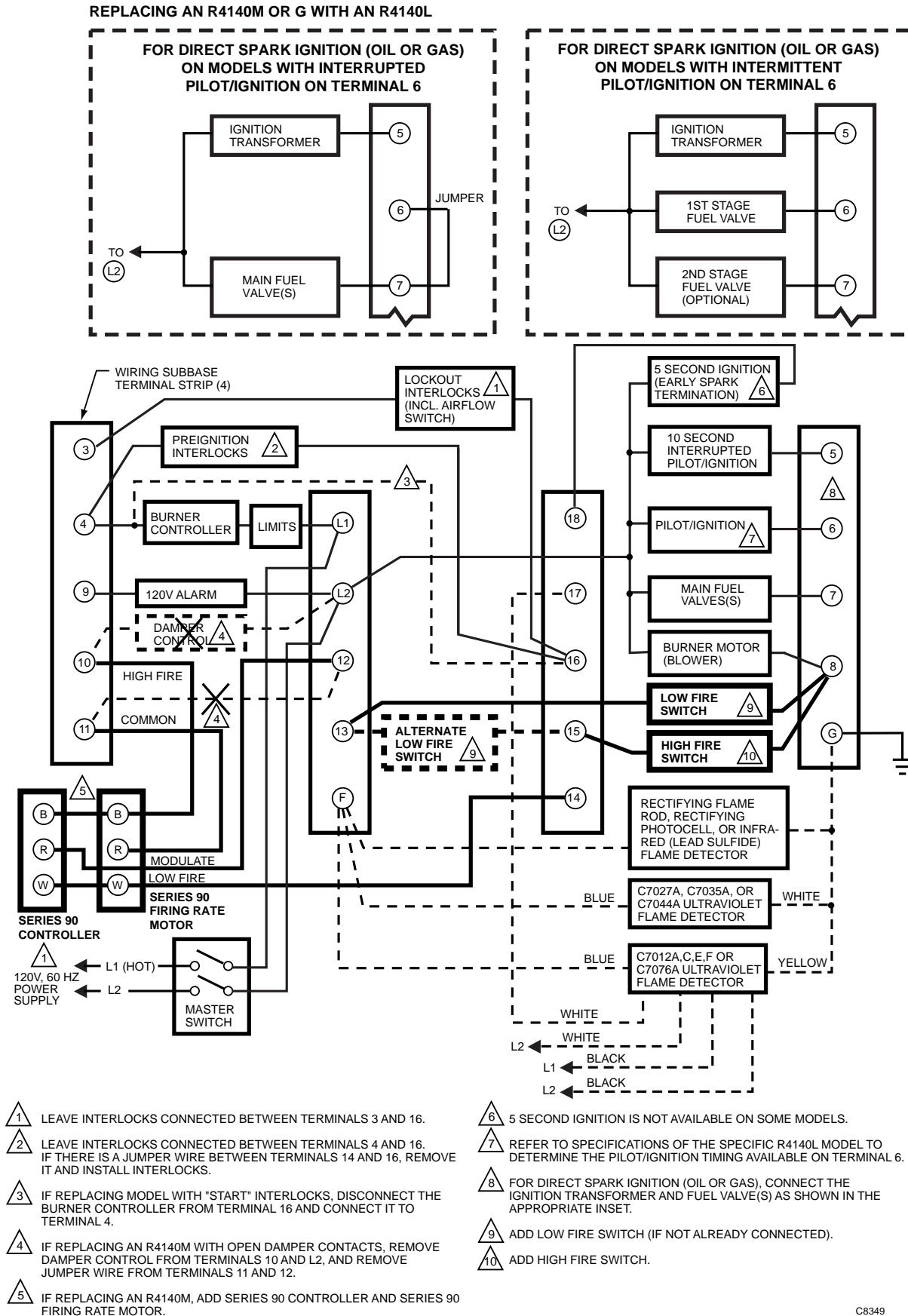
### IMPORTANT

Before replacing an R4140, make sure the replacement model has the required:

- prepurge time.
- pilot/ignition timing on terminal 6.
- 5-second ignition on terminal 18 (if required).
- interlock circuits.
- safety features.
- electrical ratings.
- temperature ratings.
- approvals.







- ⚠️ 1 LEAVE INTERLOCKS CONNECTED BETWEEN TERMINALS 3 AND 16.
- ⚠️ 2 LEAVE INTERLOCKS CONNECTED BETWEEN TERMINALS 4 AND 16. IF THERE IS A JUMPER WIRE BETWEEN TERMINALS 14 AND 16, REMOVE IT AND INSTALL INTERLOCKS.
- ⚠️ 3 IF REPLACING MODEL WITH "START" INTERLOCKS, DISCONNECT THE BURNER CONTROLLER FROM TERMINAL 16 AND CONNECT IT TO TERMINAL 4.
- ⚠️ 4 IF REPLACING AN R4140M WITH OPEN DAMPER CONTACTS, REMOVE DAMPER CONTROL FROM TERMINALS 10 AND L2, AND REMOVE JUMPER WIRE FROM TERMINALS 11 AND 12.
- ⚠️ 5 IF REPLACING AN R4140M, ADD SERIES 90 CONTROLLER AND SERIES 90 FIRING RATE MOTOR.
- ⚠️ 6 5 SECOND IGNITION IS NOT AVAILABLE ON SOME MODELS.
- ⚠️ 7 REFER TO SPECIFICATIONS OF THE SPECIFIC R4140L MODEL TO DETERMINE THE PILOT/IGNITION TIMING AVAILABLE ON TERMINAL 6.
- ⚠️ 8 FOR DIRECT SPARK IGNITION (OIL OR GAS), CONNECT THE IGNITION TRANSFORMER AND FUEL VALVE(S) AS SHOWN IN THE APPROPRIATE INSET.
- ⚠️ 9 ADD LOW FIRE SWITCH (IF NOT ALREADY CONNECTED).
- ⚠️ 10 ADD HIGH FIRE SWITCH.

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## CHECKOUT



### WARNING

**FIRE OR EXPLOSION HAZARD  
CAN CAUSE PROPERTY DAMAGE,  
SEVERE INJURY OR DEATH.**

Do not manually operate relays.



### 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 limiting the trial for pilot to ten seconds, and limiting the attempt to light the main burner to five seconds. In any case, do not exceed the normal lightoff time specified by the burner manufacturer; close the manual fuel shutoff valves if the flame is not burning at the end of the specified time.



### CAUTION

1. Use extreme care while testing the programmer; line voltage is present on most contacts when power is on.
2. Open the master switch before removing the programmer from the subbase, before reinstalling the programmer, 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 Checkout section and any others required by the burner manufacturer.

#### IMPORTANT

- a. If the system fails to perform properly, note the point at which trouble occurs and refer to the Troubleshooting section.
- b. Before you reset the lockout switch, wait at least one minute to allow the heater to cool.
- c. Repeat ALL required Checkout tests after all adjustments are made. ALL tests must be satisfied with the flame detector(s) in its FINAL position.

#### Equipment Required

1. Voltmeter (Honeywell W136A or equivalent) with 0 to 300 Vac scale.
2. Microammeter (Honeywell W136A or equivalent) with 0 to 25 microampere range and SPL scale with damping.
3. Part no. 196146 Meter Connector Plug or equivalent.
4. Jumper wires (2) of No. 14 wire, insulated, 12 in. (304.8 mm) long, with alligator clips at both ends.
5. Watch or clock with second hand.

6. Manometer (or pressure gauge) to measure pilot gas pressure.
7. Thermometer or thermocouple to measure temperature at the flame detector(s).
8. Orifice plates (aperture disks) 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 rectifying photocells or 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.

Refer to Fig. 1 or 2 for locations of component parts, and to Fig. 7 or 8 for terminal locations.

#### 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. Voltage rating of the flame detector(s) matches the voltage rating of the R4140.
3. Flame detector(s) is clean, installed and positioned properly. Consult the appropriate Instructions.
4. Correct combination of amplifier and flame detector(s) is used. Refer to Table 1 in the Installation section.
5. Spring clip on relay/timer cover is holding the plug-in flame signal amplifier securely in the receptacle.
6. Burner is completely installed and ready to fire (consult burner manufacturer's instructions); fuel lines are purged of air.
7. Combustion chamber and flues are clear of fuel and fuel vapor.
8. Power is connected to the system disconnect switch (master switch).
9. Lockout switch is reset (push in lockout switch reset button, see Fig. 1 or 2).
10. Timer switch is in NORM position (Fig. 9).
11. The large dot between PURGE and PREPURGE on the timer dial is at the index notch (Fig. 14). If not, manually rotate the timer dial to the proper position. Rotate the timer only in the direction shown by the arrow on the relay/timer cover.

NOTE: The timer dial on the R4140L1030 cannot be rotated manually, and there is no arrow on its relay/ timer cover.

- 12 All limits and interlocks are reset.
- 13 If you are installing a TRADELINE® model or an international model (rated for other than 120V, 60 Hz) check for one (or both) of these special features.
  - a. If the R4140 has provisions for extending the main burner flame-establishing period (MBFEP) at terminal 6, make sure the jumper is, or is not, installed on the back of the programmer, depending on the MBFEP desired.

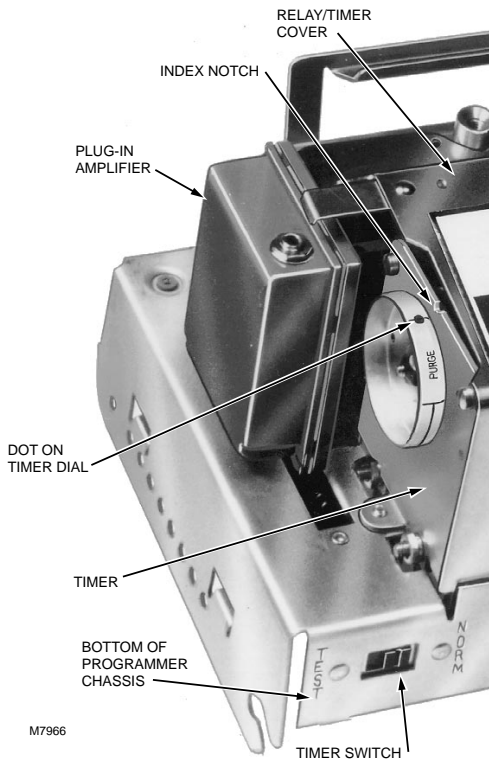


Fig. 9. Location of timer switch and position of timer dial at startup.

## Flame Signal Measurement (Fig. 10 and Table 4) for 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.

- 1 Use a Honeywell W136A Test Meter. (If a W136A is not available, a microammeter with a 0 to 25 uA dc range can be used.)
- 2 Set the selector switch on the test meter to:
  - 25 uA for all standard amplifiers (R7247A, R7248A, and R7249A) or for an R7248B Dynamic Amplifier or
  - SPL for an R7247B or C or an R7476A Dynamic Self-Check Amplifier. (If the test meter is not a W136A, shunt the 0 to 25 uA dc range with a 50 microfarad capacitor.)
- 3 Use a part no. 196146 Meter Connector Plug, ordered separately. Connect the red spade tip to the red (+) meter lead and the black spade tip to the black (-) meter lead.
- 4 Insert the plug into the flame signal meter jack and allow a few seconds for the meter reading to stabilize.

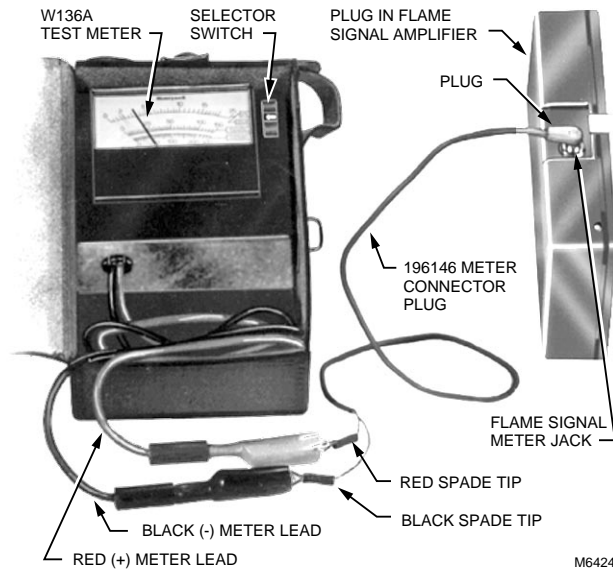


Fig. 10. Measuring the flame signal.

- 5 Read the average stable current. For an R7247B or C or an R7476A Dynamic Self-Check Amplifier, disregard the peaks due to self-checking operation. The red flame-indicating lamp on a self-checking amplifier should blink:
  - about 2-1/2 to 4 times a second on an R7247B.
  - about 1 to 2 times a second on an R7247C or R7476A.
  - at the same rate that the flame is flickering (can be as high as 20 times a second) on an R7248B.

If the lamp is on or off continuously while reading the flame signal, replace the amplifier.

- 6 The meter reading must be as specified in Table 4 after all tests are complete and all adjustments are 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 For a flame rod, make sure:
  - there is enough ground area.
  - the flame rod is properly located in the flame.
  - temperature at the flame rod insulator is no greater than 500°F (260°C).
  - ignition interference is not present (see Ignition Interference Test section).

- 4 For all other detectors, clean the detector lens, filter, viewing window, and inside of the sight pipe, as applicable.
- 5 For a C7012A,C,E or F Purple Peeper Ultraviolet Flame Detector, replace the 113236 and 115330 Electron Tubes, unless the detector is a solid state model.
- 6 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 Sight Pipe Ventilation in the Instructions for the detector.)
- 7 Make sure that the flame adjustment is not too lean.
- 8 Make sure the detector is properly sighting the flame.
- 9 If necessary, resight or reposition the detector.

If you cannot obtain proper operation, replace the plug-in amplifier. If you continue to be unable to 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 setpoint of the burner controller). The burner motor (blower) should run, the programmer timer should start, and prepurge should begin.
- 4 Let the timer dial advance through PREPURGE. When the IGN part of the dial is opposite the index notch, spark should occur and the pilot should ignite. If it ignites, proceed to step 7.
- 5 If the pilot flame is not established in ten seconds, safety shutdown occurs in about one-half minute. Let the timer complete its revolution and stop.
- 6 Wait about one minute, 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 programmer from the subbase.

Table 4. Flame Signal.

Flame Detector	Flame Signal Amplifier	Minimum Acceptable Steady Current <sup>a</sup> (uA)	Maximum Current Expected (uA)
Rectifying Flame Rod	R7247A (Green)	2	5
	R7247B (Green Self Check) <sup>b</sup>	1-1/4	2-12
Rectifying Photocell	R7247A Green	2	5 <sup>c</sup>
	R7247B Green Self Check <sup>b</sup>	1-1/4	2-12
C7012A,C Ultraviolet (Purple Peeper)	R7247A (Green)	2	6
	R7247B (Green Self Check) <sup>b</sup>	2	4
C7012E,F Ultraviolet (Purple Peeper) <sup>e</sup>	R7247C (Green Self Check) <sup>d</sup>	2 <sup>e</sup>	7
C7015A Infrared (Lead Sulfide Cell)	R7248A (Red)	2-1/4 <sup>f</sup>	5
	R7248B (Red Ampli-Check) <sup>b</sup>	3-1/2 <sup>f</sup>	5
C7027A, C7035A, or C7044A Ultraviolet (Minipeeper)	R7249A (Purple)	3-1/2	7-1/2
C7076A Ultraviolet (Adjustable Sensitivity) <sup>e</sup>	R7476A (Blue Self Check) <sup>d</sup>	2-1/2 <sup>e</sup>	5-112

<sup>a</sup> This minimum or stronger signal is easily obtained when the detector is correctly installed and positioned to sense flame properly. *This current must be obtained before completing checkout.*

<sup>b</sup> When using an R7247B or an R7248B, circuitry tests the flame signal amplifier at least 150 times a minute during burner operation and shuts down the burner if the *amplifier* fails.

<sup>c</sup> Do not permit signal to exceed five microamperes because it shortens the photocell life. Reduce the signal by using orifice plates (aperture disks) or filters, as necessary.

<sup>d</sup> If using an R7247C or an R7476A, circuitry tests all electronic components in the flame detection system (amplifier and detector) 60 to 240 times a minute during burner operation and shuts down the burner if the detection system fails.

<sup>e</sup> Shutter operation of the C7012E or F or C7076A causes fluctuations in the current reading. Read the average stable current, disregarding the peaks.

<sup>f</sup> The lead sulfide cells are available in two ranges of sensitivity: 104662B is lowest and 104662D is highest sensitivity. If a sufficiently strong signal cannot otherwise be obtained, try a different cell of the same range. If necessary, substitute a cell of higher sensitivity.

- b. On the subbase, jumper terminal L1 to the ignition terminal (5, 6, or 18). Refer to the appropriate wiring 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 only to energize the ignition transformer.
  - 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 step 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, L1-6, or L1-18 of the subbase.
  - k. Check for adequate fuel line bleeding.
  - l. Reinstall the programmer on the subbase, reset the lockout switch, and close the master switch.
- 7 When the pilot ignites, measure the flame signal. 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 MAIN part of the timer dial is opposite the index notch, 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 flame ignition. When the main burner flame is established, proceed to step 15.

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

- 10 If the main burner flame is not established within five seconds, or within the normal lightoff time specified by the burner manufacturer, 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 three minutes. Reset the lockout switch, close the master switch, and let the programmer recycle to MAIN. 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 two people—one to open the manual valve(s) and one to watch for ignition.

- 13 If the main burner flame is not established within five seconds, or within the normal lightoff time specified by the burner manufacturer, close the manual main fuel shutoff valve(s) and open the master switch. Check all burner adjustments.
- 14 Repeat steps 11 through 13 to establish the main burner flame.
- 15 When the main burner flame is established, the timer dial advances to the end of MAIN and stops. Make burner adjustments for flame stability and input rating.
- 16 Shut down the system by lowering the setpoint of the burner controller. Make sure the main burner flame goes out. If using an intermittent pilot, make sure the pilot flame goes out. Make sure all automatic fuel valves close.
- 17 If used, remove the bypass jumpers from the low fuel pressure limits.
- 18 Restart the system by raising the setpoint of the burner controller. Observe that the pilot is established during IGN and the main burner flame during MAIN, within the normal lightoff time specified by the burner manufacturer.
- 19 Measure the flame signal. Continue to check for the proper signal (Table 4) through the MAIN part of the timer dial, and into the Run period after the timer stops. Check the signal at both high and low firing rate positions and while modulating, if applicable.
- 20 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 (unless monitoring an intermittent pilot).
 Also observe the time to light the main burner.

**IMPORTANT**

*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 appropriate sample block diagram of field wiring in the R4140 Specifications for the ignition transformer and fuel valve(s) hookup.

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 the burner manufacturer.
- 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 setpoint of the burner controller). The burner motor (blower) should run, the programmer timer should start, and prepurge should begin.

- 5 Let the timer dial advance through PREPURGE. When the IGN part of the dial is opposite the index notch, watch for ignition spark and listen for the click of the first stage oil solenoid. (If spark does not occur or the first stage oil valve does not open, refer to Symptom E in Table 5 in the Troubleshooting section.)
- 6 Let the programmer complete its revolution and stop.
- 7 Open the manual first stage oil valve.
- 8 Reset the lockout switch and recycle the programmer through PREPURGE.
- 9 When the IGN part of the timer dial is opposite the index notch, watch for the first stage burner flame to be established. If it is, proceed to step 15.
- 10 If the first stage burner flame is not established within five seconds, or within the normal lightoff time specified by the burner manufacturer, close the manual first stage oil valve and open the master switch.
- 11 Purge the combustion chamber to remove any unburned oil; then check all burner adjustments.
- 12 Wait about three minutes. Close the master switch, open the manual first stage oil valve, 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 first stage burner flame is not established within five seconds, or within the normal lightoff time specified by the burner manufacturer, close the manual first stage oil valve and open the master switch.
- 14 If necessary, repeat steps 11 through 13 to establish the first stage burner flame. Then proceed to step 15.
- 15 When the first stage burner flame is established, the timer dial advances to the end of MAIN and stops. Make burner adjustments for flame stability and input rating. If a second stage is used, make sure the automatic second stage oil valve opened.
- 16 Shut down the system by lowering the setpoint 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 If a second stage is used, check the lightoff as follows; otherwise, proceed to step 19.
  - a. Open the manual second stage oil valve.
  - b. Restart the system by raising the setpoint of the burner controller.
  - c. When the first stage burner flame is established, watch for the automatic second stage oil valve to open. Observe that the second stage lights off properly.
  - d. Make burner adjustments for flame stability and input rating.
  - e. Shut down the system by lowering the setpoint of the burner controller. Make sure the burner flames go out and all automatic oil valves close.
  - f. Proceed to step 19.
- 19 Restart the system by raising the setpoint of the burner controller. Observe that the burner flame is established during IGN, within the normal lightoff time specified by the burner manufacturer.
- 20 Measure the flame signal. Continue to check for the proper signal (Table 4) through the MAIN part of the timer dial and into the Run period after the timer stops. Check the signal at both the high and the low firing rate positions and while modulating, if applicable. Any pulsating or unsteady readings require further adjustments.

**IMPORTANT**

*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. It should immediately follow the initial lightoff check. The purpose of this test is to ensure that the main burner can be lighted by the smallest pilot flame that can hold in the 2K (flame) relay. Clean the flame detector(s) to ensure it can 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 Close the manual main fuel shutoff valve(s).
- 3 Connect a manometer (or pressure gauge) to measure pilot gas pressure during the turndown test.
- 4 Open the manual pilot shutoff valve.
- 5 Close the master switch and start the system with a call for heat (raise the setpoint of the burner controller). The burner motor (blower) should run, the programmer timer should start, and prepurge should begin.
- 6 When the IGN area of the timer dial is opposite the index notch, set the timer switch to the TEST position to stop the timer. Relay 2K should pull in when the pilot ignites.

NOTE: If the timer does not stop, recycle the programmer and set the timer switch as soon as the beginning of the IGN area of the timer dial reaches the index notch.

**IMPORTANT**

*You have only six seconds to stop the timer after the ignition starts.*

- 7 Turn down the pilot pressure very slowly, reading the manometer (or gauge) as it drops. Stop instantly when relay 2K drops out. Note the pressure at the dropout point. The pilot is at the turndown position. Immediately, turn up the pilot pressure until relay 2K pulls in again.

NOTE: With the timer stopped in this position, the lockout switch heats when 2K is not pulled in. If 2K is out for a total of about one-half minute, safety shutdown occurs.

- 8 Repeat step 7 to verify the pilot gas pressure reading at the exact point of relay 2K dropout.
- 9 Increase the pilot pressure immediately to pull in 2K, and then turn it down slowly to obtain a pressure reading just above the dropout point.
- 10 Set the timer switch to the NORM position and let the timer proceed. When the MAIN area of the timer dial reaches the index notch, 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 two people—one to open the manual valve(s) and one to watch for ignition.

- 11 If the main burner flame is not established within five seconds, or within the normal lightoff time specified by the burner manufacturer, close the manual main fuel shutoff valve(s) and open the master switch.
- 12 Purge the combustion chamber to remove any unburned fuel. Check all burner adjustments.
- 13 Wait about three minutes. Reset the lockout switch (if tripped), close the master switch, and let the programmer recycle to MAIN. Repeat steps 10 and 11 (try lightoff again).
- 14 If the second attempt is unsuccessful, adjust the flame detector position so that a larger pilot is required to hold in flame relay 2K. This may require relocating the flame detector to sense farther out on the pilot flame, or adding an orifice plate.
- 15 Measure the pilot flame signal after adjusting the flame detector to make sure it is stable and above the minimum (see Table 4).
- 16 Repeat steps 5 through 15 until the main burner positively lights with the pilot flame just holding in flame relay 2K.
- 17 Repeat the lightoff of the main burner several times (steps 5 through 10) with the pilot at turndown.
- 18 When the main burner lights reliably with the pilot at turndown, disconnect the manometer (or gauge) and turn up the pilot to normal.
- 19 If used, remove the bypass jumpers from the low fuel pressure limits.
- 20 Run the system through another cycle to check for normal operation.

## Ignition Interference Test (All Flame Rods)

Test to make certain that a false signal from a spark ignition system is not superimposed on the flame signal.

Ignition interference can subtract from (decrease) or add to (increase) the flame signal. If it decreases the flame signal enough, it causes safety shutdown (relay 2K does not pull in and the programmer acts as though the pilot or main burner, if using direct spark ignition, was not ignited). If it increases the flame signal, it could cause relay 2K to pull in when the true flame signal is below the minimum acceptable value.

### To Test for Interference

Start the burner and measure the flame signal with both ignition and pilot (or main burner) on, and then with only the pilot (or main burner) on. Any significant difference (greater than 1/2 uA) indicates ignition interference.

### To Eliminate Ignition Interference

- 1 Make sure there is enough ground area.
- 2 Be sure the ignition electrode and the flame rod are on opposite sides of the ground area.
- 3 Check for correct spacing on the ignition electrode:
  - 6,000 volt systems—1/16 to 3/32 in. (1.6 to 2.4 mm).
  - 10,000 volt systems—1/8 in. (3.2 mm).
- 4 Make sure the leadwires from the flame rod and ignition electrode are not too close together anywhere.
- 5 Replace any deteriorated leadwires.
- 6 If the problem cannot be eliminated, change to an ultraviolet flame detection system.

## 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 relay 2K drops out and the system shuts down as though a flame failure 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 does not work, resight the detector at a cooler, more distant background. You can also try lengthening the sight pipe or decreasing the pipe size (diameter). Continue adjustments until hot refractory saturation is eliminated.

## Hot Refractory Hold-In Test (Rectifying Photocells or Infrared Detectors)

Test to make certain that hot refractory does not cause flame relay 2K to stay pulled-in after the burner flame goes out. This condition delays response to flame failure and also prevents 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 programmer stops for the run period, lower the setpoint 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 relay 2K to drop out after the flame goes out. (Watch or listen to the flame relay to determine when it drops out.) If the flame relay fails to drop out within four seconds, open the master switch and replace the amplifier.

To check rectifying photocells for hot refractory hold-in, operate the burner until the refractory reaches its maximum temperature. Then terminate the firing cycle. (Lower the setpoint of the burner controller, or set the fuel selector switch to OFF. Do not open the master switch.) Visually observe when the burner flame goes out. After the flame goes out, measure the time it takes for the flame relay 2K to drop out. (Watch or listen to the flame relay to determine when it drops out.) If the flame relay fails to dropout within four seconds, the photocell is sensing hot refractory. This condition must be corrected as described in the last paragraph of this test

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, but 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. Take care 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.



(Burn a solid instead of a liquid, or a liquid instead of a gas.) 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 relay 2K to drop out. (Watch or listen to the flame relay to determine when it drops out.) If the flame relay fails to drop out within four seconds, the infrared detector is sensing hot refractory. Immediately terminate the firing cycle. (Lower the setpoint of the burner controller, or set the fuel selector switch to OFF. Do not open the master switch.)

**NOTE:** Some burners continue to purge their oil lines between the valve(s) and nozzle(s) even though the fuel valve(s) is closed. Terminating the firing cycle (instead of opening the master switch) allows purging the combustion chamber, if available. This reduces 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 does not work, resight the detector at a cooler, more distant part of the combustion chamber. While resighting the detector, remember that it must also properly sight the flame. For an infrared detector, you can also try lengthening the sight pipe or decreasing the pipe size (diameter). For details, refer to the C7015A Instructions, form 60-2306. Continue adjustments until hot refractory hold-in is eliminated.

## Ultraviolet Response Tests (All Ultraviolet Detectors) Ignition Spark Response Test

Test to be sure that ignition spark is not actuating flame relay 2K.

- ① Close the pilot and main burner manual fuel shut-off valves.
- ② Start the burner and run through the ignition period. Ignition spark should occur, but relay 2K must not pull in. The flame signal should not be more than 1/4 microamp.
- ③ If relay 2K does pull in, 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.

**NOTE:** Honeywell Q624A Solid State Spark Generator prevents detection of ignition spark when properly applied with flame detection systems using C7027, C7035, or C7044 Minipeeper Ultraviolet Flame Detectors. The Q624A is for use only with gas pilots.

## Response to Other Ultraviolet Sources

Some sources of artificial light produce small amounts of ultraviolet radiation. Under certain conditions, an ultraviolet detector responds to them as if sensing a flame. Do not use an artificial light source to check the response of an ultraviolet detector. To check for proper detector operation, conduct flame failure response tests (Safety Shutdown Tests 1, 2, and 3) under all operating conditions.

## Flame Signal with Hot Combustion Chamber (All Installations)

With all initial startup tests and burner adjustments completed, operate the burner until the combustion chamber is at maximum expected temperature. (Observe the burner manufacturer warmup 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 pilot flame when using an intermittent pilot, or only the main burner flame when using direct spark ignition). Check the signal at both the high and the low firing rate positions and while modulating, if applicable.

Also check the flame failure response time. Lower the setpoint of the burner controller and observe the time it takes flame relay 2K to drop out after the burner flame goes out (2K should drop out within four 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 continues to be too slow, replace the plug-in flame signal amplifier. If the detector is relocated or resighted, or the amplifier is replaced, repeat all required checkout tests.

### **IMPORTANT**

*Repeat all required Checkout tests after all adjustments are complete. All tests must be satisfied with the flame detector(s) in its FINAL position.*

## Safety Shutdown Tests (All Installations)

Perform these tests at the end of Checkout after all other tests are complete.

For all R4140 Programmers, safety shutdown should occur on: (1) failure to ignite the pilot (or first stage burner when using direct spark ignition), (2) failure to light the main burner (unless monitoring an intermittent pilot), and (3) loss of flame during the Run period. (If a self-checking flame detection system is used, safety shutdown should also occur on a failure in the detection system. However, because the programmer acts the same if a flame failure has occurred, no separate test is necessary.)

For an R4140L, safety shutdown should also occur upon (1) detection of a flame (or a condition simulating a flame) before or during prepurge, (2) opening of a preignition interlock during prepurge, and (3) opening of a lockout interlock after 14 seconds.

On safety shutdown, the lockout switch should trip (pop out) and lock out the programmer. The ignition and fuel valve terminals should be de-energized. If used, the external alarm should turn on. The timer should complete its revolution and lock up at the start position. The lockout switch must be manually reset to restart the system.

- ① Failure to Ignite Pilot (or First Stage Burner if Using Direct Spark Ignition).
  - a. Close all manual fuel shutoff valves; this includes the manual pilot shutoff valve and all manual main burner shutoff valves.
  - b. Make sure all interlocks are closed.

- c. Reset the Lockout switch, if tripped.
  - d. Close the master switch.
  - e. Start the system with a call for heat. (Raise the setpoint of the burner controller.)
  - f. Ignition spark should occur and the automatic pilot valve (or automatic first stage valve) should be energized, but the pilot (or first stage burner) cannot ignite. No flame is detected so relay 2K cannot pull in.
  - g. Safety shutdown should occur about one-half minute after ignition spark occurs.
- ② Failure to Light Main Burner (Unless Flame Detector is Monitoring an Intermittent Pilot).

NOTE: If using direct spark ignition, perform Test ① instead.

- a. Open the manual pilot shutoff valve; leave the manual main fuel shutoff valve(s) closed.
  - b. Reset the Lockout switch.
  - c. Start the system.
  - d. The pilot should ignite and pull in relay 2K, but the main burner cannot light.
  - e. Relay 2K should drop out within four seconds after the pilot goes out.
  - f. Safety shutdown should occur about one-half minute after 2K drops out.
- ③ 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 if a pilot is used.
  - b. Reset the Lockout switch.
  - c. Start the system. Startup should be normal; the pilot (or first stage burner) and the main burner should light normally.
  - d. After the timer stops for the Run period with the burner(s) firing, close all manual fuel shutoff valves to extinguish all burner flames.
  - e. Relay 2K should drop out within four seconds after all burner flames go out.
  - f. Safety shutdown should occur about half a minute after 2K drops out.
- ④ Detection of a Flame (or a Condition Simulating a Flame) Before or During Prepurge (R4140L Only).
- a. Make sure all interlocks are closed.
  - b. Reset the Lockout switch.
  - c. Start the system.
  - d. At about 30 seconds, momentarily simulate a flame to pull in relay 2K. (Actuate the flame detector with a flame, or use a flame simulator—see Flame Signal Check in the Troubleshooting section.)
  - e. When relay 2K pulls in, relay 3K should drop out, and there should be no ignition.
  - f. Safety shutdown should occur about one-half minute after 3K drops out.
- ⑤ Opening of a Preignition Interlock During Prepurge (R4140L Only).
- a. Make sure all interlocks are closed.
  - b. Reset the Lockout switch.
  - c. Start the system.
  - d. After about 30 seconds, open a preignition interlock.
  - e. Relay 3K should drop out, and there should be no ignition.
  - f. Safety shutdown should occur about one-half minute after 3K drops out.

- ⑥ Opening of a Lockout Interlock (R4140L Only).
- a. Make sure all manual fuel shutoff valves are open; this includes the manual pilot shutoff valve if using a pilot, and all manual main burner shutoff valves.
- b. Make sure all interlocks are closed.
- c. Reset the Lockout switch.
- d. Start the system. Startup should be normal; the pilot (or first stage burner) and the main burner should light normally.
- e. After the timer stops for the Run period with the burner(s) firing, open a lockout interlock. Manually turn off the burner motor (blower) to open the Airflow switch, or gradually turn up (or down) the fuel pressure to open a fuel pressure switch.
- f. Relay 3K should drop out, the automatic fuel valves should close, and the burner flame(s) should go out.
- g. Safety shutdown should occur about one-half minute after 3K drops out.

#### IMPORTANT

1. If the Lockout switch fails to trip and shut down the system on any of these tests, replace the programmer and rerun all Checkout tests from the beginning.
2. When all Checkout tests are complete, reset all controller setpoints to the desired values.



### CAUTION

If low fuel pressure limits were 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



### CAUTION

1. Close *all* manual fuel shut off valves as soon as trouble occurs.
2. Use extreme care while troubleshooting the programmer; line voltage is present on most contacts when power is on.
3. Open the master switch before removing or replacing the relay/timer cover, before removing the programmer from the subbase, before reinstalling the programmer, before installing or removing any test jumpers, before making any adjustments, and before replacing any devices.
4. Replace all external devices not operating properly. Do not bypass external devices.
5. Make sure you remove all test jumpers from the subbase when troubleshooting is complete.
6. Replace the relay/timer cover on completion of troubleshooting.

### Equipment Required

1. Honeywell W136A Voltmeter or equivalent with 0 to 300 Vac scale.
2. Honeywell W136A Microammeter or equivalent with 0 to 25 microamp range and SPL scale with damping.

3. Part no. 196146 Meter Connector Plug or equivalent.
4. 123514A Flame Simulator—for use with R7247A Rectification Flame Signal Amplifiers (green).
5. 123514B Flame Simulator for use with R7249A Ultraviolet Flame Signal Amplifiers (purple).
6. Jumper wires (2) of No. 14 wire, insulated, 12 in. (304.8 mm) long, with alligator clips at both ends.
7. Shorting wire 10 in. (254.0 mm) long, insulated, with 3/4 in. (19.1 mm) of insulation removed from each end; for simulating flame with an R7248A Infrared Flame Signal Amplifier (red).
8. Watch or clock with second hand.
9. Manometer (or pressure gauge) to measure pilot gas pressure.
10. Thermometer or thermocouple to measure temperature at the flame detector.
11. Orifice plates (aperture disks) or filters, as necessary, to adjust sensitivity of flame detector(s).

### Preliminary Check (Fig. 11)

Open the master switch before performing this check. Eliminate the possibility of trouble being caused by poor contact of the spring connectors on the back of the programmer. Ensure that they are properly aligned and have the proper tension. They should be tight enough so that it is necessary to force a dime between the contacts. If a dime slips through, gently press the connector together with your finger tips—do not use pliers.

### Troubleshooting Procedures

Refer to the Step-By-Step Operation for the appropriate R4140 model in the Operation section of the R4140G,L or M Specifications. Observe the operation carefully to determine the point where the trouble occurs. Then refer to Table 5 and follow the troubleshooting procedure(s) outlined.

Refer to Fig. 15, 16, and 17 for location of relay and timer contacts. Access to the contacts can be gained by removing the relay/timer cover (Fig. 4).

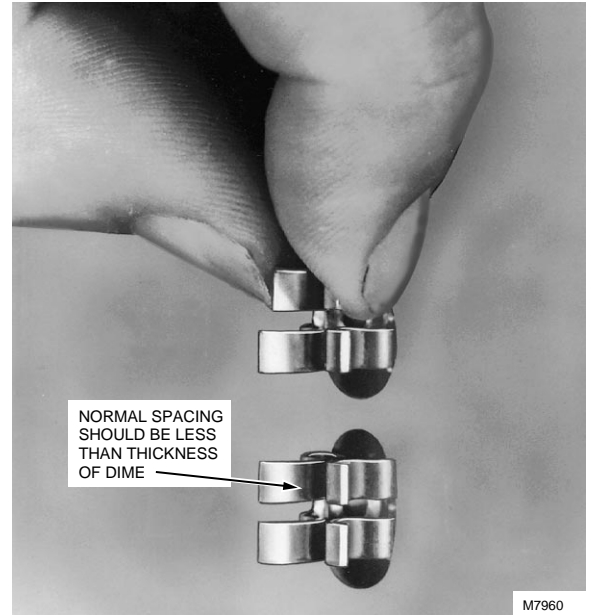


Fig. 11. Adjusting spring connectors.

#### IMPORTANT


- a. Blackened M4A, M6B, M8B, M9B, or M11B timer contacts are due to normal deposits of impurities caused by breaking an inductive load (ignition transformer). Tests on returned programmers have shown that the deposits are not heavy enough to cause ignition failure. Determine exactly at what point in the operating sequence the trouble occurs and carefully follow the applicable troubleshooting procedure.
- b. Before you reset the lockout switch, wait at least one minute to allow the heater to cool.
- c. If, after completing an applicable troubleshooting procedure, proper operation still cannot be obtained, replace the programmer (except the amplifier, unless noted).
- d. At the completion of troubleshooting, be sure to perform all applicable tests in the Checkout section of these instructions.

Table 5. Troubleshooting Chart.

Symptom	Test	Possible Cause/Correction
A. On a call for heat, programmer will not start. (Relay 1K does not pull in.)	1. Check Lockout switch.	1. If Lockout switch is popped out, reset it.
	2. Check relay 2K.	2. If relay 2K is holding in, perform the Flame Relay (2K) Hold-In Check immediately following this table.
	3. Check the timer dial to make sure the timer is at the START position.	3. If the large dot between PURGE and PREPURGE is not at the index notch (Fig. 9), turn the dial in the direction shown by the arrow on the relay/ timer cover until the dot is at the index notch. (The R4140L1030 timer cannot be rotated manually.)

(Continued)

**Table 5. Troubleshooting Chart (Continued).**



Symptom	Test	Possible Cause/Correction
A. On a call for heat, programmer will not start. (Relay 1K does not pull in.) <i>Continued.</i>	4. Open master switch, remove programmer from subbase, close master switch, and check for line voltage between the following terminals on the subbase: a. L1 to L2. b. (1) Model with preignition interlocks—4 to L2. (2) Model with start interlocks—16-L2 (or connection between burner controller and start interlocks when terminal 16 is not used as a tie point). c. (1) Model with preignition interlocks—16-L2. (2) Model with start interlocks—4-L2.	4. If there is no voltage, check that: a. Line voltage power is connected to master switch; master switch is closed; and overload protection (fuse, circuit breaker, or similar device) has not opened power line. b. Limits and burner controller contacts are closed. If a limit is open, determine cause(s) and correct condition(s) before proceeding. c. Interlocks are closed. If one is open, determine cause(s) and correct condition(s) before proceeding. (On model with start interlocks, if interlocks are not used, jumper must be installed between terminal 4 and the burner controller.)
	 <b>CAUTION</b> Replace all external devices not operating properly. Do not bypass external devices.	
	5. Open master switch, reinstall programmer on subbase, and close master switch.	5. If relay 1K still does not pull in, replace programmer.
B. Relay 1K pulls in, but burner motor does not start.	1. Check manual switch for burner motor.	1. Make sure switch is closed.
	2. Check external burner motor circuits.	2. Make sure circuits are wired correctly; replace deteriorated leadwires.
	3. Check motor power supply, motor overload protection, and motor starter	3. Replace devices if not operating properly.
	4. Check burner motor.	4. Replace burner motor if it is not operating properly.
C. Programmer starts, but system shuts down after a few seconds; ignition does not occur, and programmer recycles to standby position (zero seconds); R41401 locks out.	1. Check relay 2K.	1. If relay 2K has pulled in, perform the Flame Relay (2K) Hold-In Check immediately following this table.
	2. Check that all limits and interlocks are closed. (Start interlocks must stay closed until Airflow switch closes.)	2. If a limit or interlock is open, determine cause(s) and correct condition(s).
	3. Check that the Airflow switch contacts are closed.	3. Make sure that there is airflow; if not: a. Check burner motor; replace if necessary. b. Check Airflow switch; replace if necessary.
D. Programmer stops during prepurge and does not continue sequence.	1. For an R4140G or M, proceed to step 3. On an R4140L only, check that the external High Fire switch is closed; if it is, proceed to step 2.	1. If switch is open: a. Check High Fire switch; replace if necessary. b. Check firing rate motor and transformer; replace if necessary.
	2. On an R4140L only, check purge extender, if provided, otherwise proceed to step 3.	2. Make sure purge extended jumper is plugged in.
	3. Check Timer switch.	3. Make sure Timer switch is in NORM position.

(Continued)

**Table 5. Troubleshooting Chart (Continued).**


Symptom	Test	Possible Cause/Correction
D. Programmer stops during prepurge and does not continue sequence (Continued).	4. If an external Low Fire switch is used, check that it is closed.	4. If switch is open: a. Check Low Fire switch; replace if necessary. b. Check firing rate motor and its transformer; replace if necessary. c. On an R4140M model with open damper contacts. —Check damper actuator; replace if necessary.
E. Pilot (or first stage burner if using direct spark ignition) does not ignite; safety shutdown occurs.	1. Close all manual main fuel shutoff valves immediately, and let programmer complete its revolution.	1. Make sure that: a. Manual pilot shutoff valve (or manual first stage valve) is open. b. Fuel is available. c. Fuel lines are not plugged.
	2. Reset Lockout switch and let programmer run through another cycle.	2. If pilot (or first stage flame) is established, operation is OK; proceed to step 8.
	3. If pilot (or first stage burner) still does not ignite, close all manual fuel shutoff valves, open master switch, and remove programmer from subbase.	3. Make sure that: a. Ignition electrodes are clean. b. External circuits are wired correctly; replace deteriorated leadwires.
	4. Check operation of ignition transformer: Jumper terminals L1-5, L1-6, or L1-18 on subbase. (Refer to appropriate wiring diagram to determine proper terminals.) Close master switch, and watch for spark or listen for buzz.	4. If ignition spark is not strong and continuous, open master switch and adjust ignition electrode spark gap setting to manufacturer's recommendation. If a strong, continuous spark still cannot be obtained, replace ignition transformer.
	5. Check operation of automatic pilot valve (or first stage valve): open master switch, and jumper terminals L1-5 or L1-6 on subbase. (Refer to appropriate wiring diagram to determine proper terminals.) Close master switch, and listen for click or feel head of valve for activation.	5. If valve or actuator is not operating properly, replace it.
	6. Open master switch, remove test jumpers from subbase, and reinstall programmer on subbase.	6. No action.
	7. Open manual pilot shutoff valve (or manual first stage valve), reset lockout switch, close master switch, and recycle programmer.	7. If pilot (or first stage flame) is still not established, replace programmer.
	8. When pilot (or first stage burner) ignites satisfactorily, repeat appropriate Initial Lightoff Check and Pilot Turn-down Test.	8. Follow instructions in the Checkout section.
F. Pilot (or first stage burner if using DSI) ignites, but relay 2K does not pull in; safety shutdown occurs.	1. Close all manual fuel shutoff valves immediately, and let programmer complete its revolution.	1. No action.
	2. Perform the Flame Signal Check following this table.	2. Follow instructions in Flame Signal Check.
G. Pilot (or first stage burner) ignites and relay 2K pulls in, but main burner (or second stage burner) does not light. (Safety shutdown occurs when using an interrupted pilot.)	1. Shut down system (lower burner controller setpoint) and check manual main burner shutoff valve (or manual second stage valve).	1. Make sure that: a. Manual fuel shutoff valve is open. b. Fuel is available. c. Fuel lines are not plugged. d. Air and fuel supplies are adjusted for the correct air-fuel ratio.
	2. Reset Lockout switch (if tripped), raise setpoint, and let programmer run through another cycle.	2. If main burner flame (or second stage flame) is established, operation is OK; proceed to step 8. (Continued)

**Table 5. Troubleshooting Chart (Continued).**

Symptom	Test	Possible Cause/Correction
G. Pilot (or first stage burner) ignites and relay 2K pulls in, but main burner (or second stage burner) does not light. (Safety shutdown occurs when using an interrupted pilot.) <i>Continued.</i>	3. If main burner (or second stage burner) still does not light, close all manual fuel shutoff valves immediately, open master switch, and remove programmer from subbase.	3. Make sure that external circuits are wired correctly; replace deteriorated leadwires.
	4. Check operation of automatic main fuel valve (or second stage fuel valve): open master switch, jumper terminals L1-7 on subbase, and close master switch. Listen for and observe operation of the valve and actuator.	4. If valve or actuator is not operating properly, replace it.
	5. Open master switch, and remove test jumper from subbase.	5. No action.
	 <b>CAUTION</b> Make sure the test jumper has been removed from terminals L1-7 on the subbase before proceeding.	
	6. Reinstall programmer on subbase, and reset Lockout switch (if tripped).	6. No action.
	7. Open all manual fuel shutoff valves, close master switch, and recycle programmer.	7. If main burner flame (or second stage flame) is still not established, replace programmer.
	8. When main burner (or second stage burner) lights satisfactorily, repeat appropriate Initial Lightoff Check and Pilot Turndown Test.	8. Follow instructions in the Checkout section.
	H. Pilot does not go out at end of main burner flame-establishing period. (Applicable only if using an interrupted pilot.)	1. Close all manual fuel shutoff valves, open master switch, and remove programmer from subbase.
2. If programmer has provisions for extending the main burner flame establishing period (MBFEP) at terminal 6, check back of programmer; otherwise, proceed to step 3.		2. Make sure jumper is or is not installed, depending on MBFEP desired.
3. Check operation of automatic pilot valve: make sure master switch is open, and jumper terminals L1-5 or L1-6 on subbase. (Refer to appropriate wiring diagram to determine proper terminals.) Close master switch to actuate valve. After valve opens, open master switch to close valve.		3. If valve does not close properly, replace it.
4. Make sure master switch is open, remove test jumper from subbase, and reinstall programmer on subbase.		4. No action.
5. Close master switch and recycle programmer.		5. If pilot still does not go out, replace programmer.
6. When pilot valve operates satisfactorily, repeat Pilot Turndown Test		6. Follow instructions in Checkout section.
I. Burner cycles on and off continuously; programmer does not stop for Run period.	1. Open master switch; check burner controller, all limits, and all interlocks (including Airflow switch).	1. a. Make sure all circuits are wired correctly; replace deteriorated lead wires. b. If burner controller, limit, or interlock is not operating properly, replace it.
	 <b>CAUTION</b> Replace all external devices not operating properly. Do not bypass external devices.	
	2. Close master switch, and recycle programmer.	2. If programmer still does not stop for Run period, replace it.

(Continued)

**Table 5. Troubleshooting Chart (Continued).**

Symptom	Test	Possible Cause/Correction
J. Burner stays at low fire during Run period. (Not applicable for R4140M model without open damper contacts.)	1. For an R4140G or L, check 4-wire firing rate switching circuitry.	1. a. Make sure that external circuits are wired correctly; replace deteriorated leadwires. b. Check firing rate motor and its transformer; replace, if necessary. c. Check Series 90 Controller; replace, if necessary.
	2. For an R4140M with open damper contacts, check one-wire firing rate switching circuitry.	2. a. Make sure that external circuits are wired correctly; replace deteriorated leadwires. b. Make sure jumper wire is installed between terminals 11 and 12 on the subbase. c. Check damper actuator; replace if necessary.
K. Shutdown occurs during Run period.	1. Close all manual fuel shutoff valves immediately, let programmer complete its revolution, open master switch, and check the Lockout switch on the programmer.	1. No action.
	2. If the Lockout switch has not tripped (if the reset button has not popped out): a. Check that all limits are closed. b. For an R4140G or M, check that all running interlocks, including the Airflow switch, are closed.	2. Follow steps a. and b., as applicable. a. If a limit is open, determine cause(s) and correct condition(s). b. If a running interlock is open, determine cause(s) and correct condition(s). Make sure that there is airflow. If not: — check burner motor; replace if necessary. — check Airflow switch; replace if necessary.
	3. If the Lockout switch has tripped (if the reset button has popped out): a. For an R4140L only, check that all lockout interlocks, including the Airflow switch, are closed. b. If using an infrared (lead sulfide) flame detector, perform the Hot Refractory Saturation Test. c. Check the flame detection system. d. If flame detection system is OK, check fuel lines and automatic fuel valves.	3. Follow steps a. through d., as applicable. a. If a lockout interlock is open, determine cause(s) and correct condition(s). Make sure that there is airflow. If not: — check burner motor; replace if necessary. — check Airflow switch; replace if necessary. b. Follow instructions in the Checkout section. c. Perform the Flame Signal Check following this table. d. Clean fuel lines; replace valves and actuators, if defective. (Refer to applicable procedures for Symptoms E and G.)
 <b>CAUTION</b> Replace all external devices not operating properly. Do not bypass external devices.		
L. Timer does not complete its revolution after operating setpoint was reached.	1. Check that the burner controller contacts are open.	1. If burner controller is not operating properly, replace it.
M. Burner motor keeps running at end of cycle.	1. Check burner motor starter.	1. If starter is mechanically stuck, repair it or replace it.
	2. Check external burner motor circuits.	2. Make sure circuits are wired correctly; replace deteriorated leadwires.

(Continued)

Table 5. Troubleshooting Chart (Continued).

Symptom	Test	Possible Cause/Correction
N. Relay 2K stays in at end of cycle. (R4140G, R4140M, and R414011030 cannot start new cycle; for all other R41401 models, safety shutdown occurs after the new cycle starts.)	1. Perform the Flame Relay (2K) Hold-In Check immediately following this table.	1. Follow instructions in the Flame Relay (2K) Hold-In Check.
O. External alarm (if used) does not go on when safety shutdown occurs.	1. Check external alarm circuits.	1. Make sure circuits are wired correctly; replace deteriorated leadwires.
	2. Check the alarm.	2. If alarm is not operating properly, replace it.

### Flame Relay (2K) Hold-In Check

- 1 Make sure all burner flames are extinguished. (If using an intermittent pilot, make sure the pilot flame is extinguished.) If a flame is still burning, check the external wiring and operation of the automatic valves and actuators. (Refer to applicable procedures for Symptoms E and G in Table 5.) Replace if defective.
- 2 If the flame detector is a rectifying photocell or infrared (lead sulfide) detector, perform the Hot Refractory Hold-in Test in the Checkout section.
- 3 If the plug-in flame signal amplifier is an R7248A or B Infrared Amplifier (red), open the master switch and install a new amplifier.
- 4 If the plug-in flame signal amplifier is an R7247A Rectification Amplifier (green) or an R7249A Ultraviolet Amplifier (purple), momentarily short the tip jack to the programmer chassis (Fig. 12). If this does not cause relay 2K to drop out, open the master switch and install a new amplifier.
- 5 Check the external wiring and operation of the flame detector (see step 9 of the Flame Signal Check). Replace if faulty.

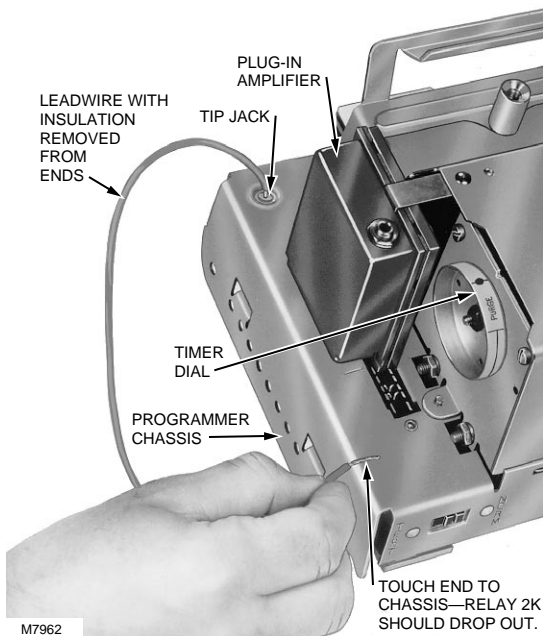


Fig. 12. Checking plug-in flame signal amplifier for 2K hold-in (R7247A or R7249A only).

### Flame Signal Check

#### IMPORTANT

*If the flame relay 2K does not pull in when the pilot (or first stage burner) ignites, or if shutdown occurs during the Run period, perform this check. The flame detector, plug-in flame signal amplifier, and flame relay 2K form a flame detection system, which can be disabled by failure of any of the components.*

- 1 Open the master switch and plug a microammeter into the meter jack on the plug-in amplifier (Fig. 10).
- 2 Make sure all manual fuel shutoff valves are closed. Open the manual pilot shutoff valve (or manual first stage fuel valve if using direct spark ignition).
- 3 Reset the Lockout switch and close the master switch to start the programmer.
- 4 When the pilot (or first stage burner) ignites, measure the flame signal as described in Flame Signal Measurement in the Checkout section. If the signal is unstable or weak, check the flame detector installation and circuitry as instructed.
- 5 Recycle the programmer and measure the flame signal again to obtain a good reading. If the flame signal is unstable or less than the minimum acceptable value listed in Table 4, proceed to step 7. Otherwise, continue with step 6.
- 6 If the flame signal is stable and above the minimum acceptable value listed in Table 4, either the amplifier or the programmer is faulty.
  - a. Let the programmer complete its revolution and open the master switch.
  - b. Replace the plug-in amplifier with a new one of the same part number.
  - c. Reset the Lockout switch, close the master switch, recycle the programmer, and measure the flame signal again.
  - d. If the flame signal is OK and relay 2K pulls in, operation is normal. Omit steps 7 through 9, and perform the Pilot Turndown Test in the Checkout section (unless using direct spark ignition).
  - e. If the flame signal is OK but relay 2K still does not pull in, replace the programmer. (Keep the plug-in amplifiers.) Repeat all required tests in the Checkout section.



7 The procedure in this step depends on the model of the plug-in flame signal amplifier used.

- a. All self-checking models:
  - R7247B Dynamic Self-Check Rectification Amplifier (green)—used with rectifying flame rods, rectifying photocells, or C7012A or C Purple Peeper Ultraviolet Flame Detectors.
  - R7247C Dynamic Self-Check Rectification Amplifier (green)—used with C7012E or F Purple Peeper Ultraviolet Flame Detectors (with self-checking shutter).
  - R7248B Dynamic Ampli-Check Infrared Amplifier (red)—used with C7015A Infrared (lead sulfide) Flame Detectors.
  - R7476A Dynamic Self-Check Ultraviolet Amplifier (blue)—used with C7076A Adjustable Sensitivity Ultraviolet Flame Detectors.
  - (1) Let the programmer complete its revolution and open the master switch.
  - (2) Replace the plug-in amplifier with a new one of the same part number.
  - (3) Wait a minute and reset the Lockout switch.
  - (4) Close the master switch to start the programmer.
  - (5) When the pilot (or first stage burner) is ignited, relay 2K should pull in.
  - (6) If relay 2K pulls in, operation is normal. Omit steps 8 and 9, and perform the Pilot Turndown Test in the Checkout section (unless using direct spark ignition).
  - (7) If relay 2K does not pull in, either the flame detector or the programmer is faulty.
    - Install the original amplifier.
    - Check the flame detector and its circuit as described in step 9.
    - If the problem still exists, replace the programmer.
- b. All standard models (R7247A, R7248A, and R7249A).
  - (1) Let the programmer complete its revolution.
  - (2) Close the manual pilot shutoff valve (or manual first stage fuel valve if using direct spark ignition).
  - (3) Open the master switch and remove the programmer from the subbase.
  - (4) Remove the flame detector leadwire from terminal F on the subbase. Be sure the leadwire does not touch anything after removal.
  - (5) Reinstall the programmer on the subbase and reset the Lockout switch (if popped out).
  - (6) Set the Timer switch to the TEST position.
  - (7) Proceed to the following instructions for the appropriate amplifier.
- c. R7247A Rectification Amplifier (green)—used with rectifying flame rods, rectifying photocells, or C7012A or C Purple Peeper Ultraviolet Flame Detectors.
  - (1) Complete step 7.b. above.
  - (2) Close the master switch to start the programmer. Wait until the timer stops.
  - (3) Plug the probe of a 123514A Flame Simulator into the tip jack on the front of the programmer chassis (Fig. 13).

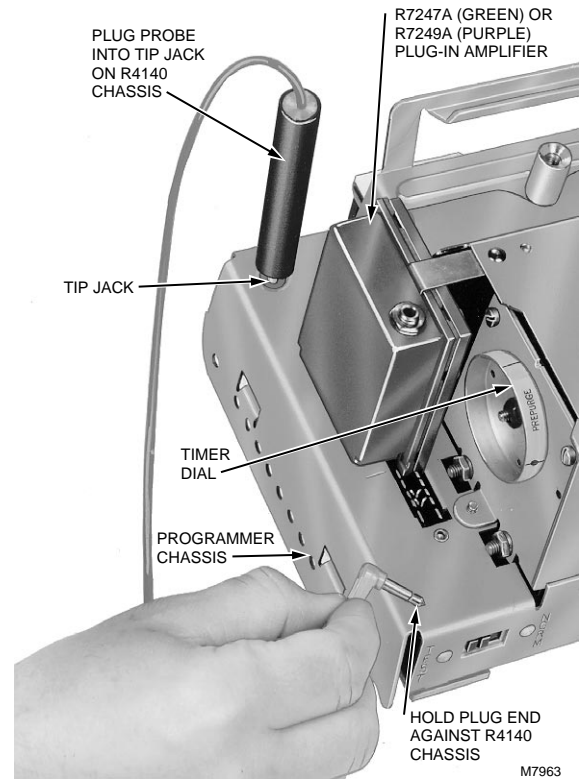


Fig. 13. Using flame simulator.

- (4) Hold the plug (lead end) of the simulator against the programmer chassis. Relay 2K should pull in and stay in while the plug is in contact with the chassis.

NOTE: As soon as 2K pulls in: on an R4140G or M, relay 1K drops out and the timer starts to run. On an R4140L, relay 3K drops out and safety shutdown occurs in about one-half minute.

- (5) If relay 2K pulls in, the trouble is in the flame detector or its circuitry outside the programmer. Proceed to steps 8 and 9.
- (6) If relay 2K does not pull in, set the timer switch to the NORM position, let the timer complete its revolution, and open the master switch.
- (7) Replace the plug-in amplifier with a new one of the same part number.
- (8) Wait a minute and reset the Lockout switch.
- (9) Set the timer switch to the TEST position.
- (10) Close the master switch to start the programmer.
- (11) When the timer stops, repeat step (4).
- (12) If relay 2K pulls in, restore the programmer to operating condition as instructed in step 8, below.
- (13) If relay 2K still does not pull in, replace the programmer.

- d. R7248A Infrared Amplifier (red)—used with C701 5A Infrared (lead sulfide) Flame Detectors.
- (1) Complete step 7b. above.
  - (2) Remove the plug-in infrared amplifier.
  - (3) Remove 3/4 in. (19.1 mm) of insulation from each end of a 10 in. (254.0 mm) length of insulated wire. Plug one end of this wire into the tip jack on the front of the programmer chassis (Fig. 14).
  - (4) Reinstall the plug-in amplifier and close the master switch. Wait until the timer stops.
  - (5) Tap the free end of the wire against the programmer chassis at a rapid frequency (about two times a second) to simulate a flame. Relay 2K should pull in and stay in while a flame is simulated.

NOTE: As soon as 2K pulls in:  
 — On an R4140G or M, relay 1K drops out and the timer starts to run.  
 — On an R4 140L, relay 3K drops out and safety shutdown occurs in about one-half minute.

- (6) If relay 2K pulls in, the trouble is in the flame detector or its circuitry outside the programmer. Proceed to steps 8 and 9.
- (7) If relay 2K does not pull in, set the timer switch to the NORM position, let the timer complete its revolution, and open the master switch.
- (8) Replace the plug-in amplifier with a new one of the same part number.
- (9) Wait a minute and reset the Lockout switch.

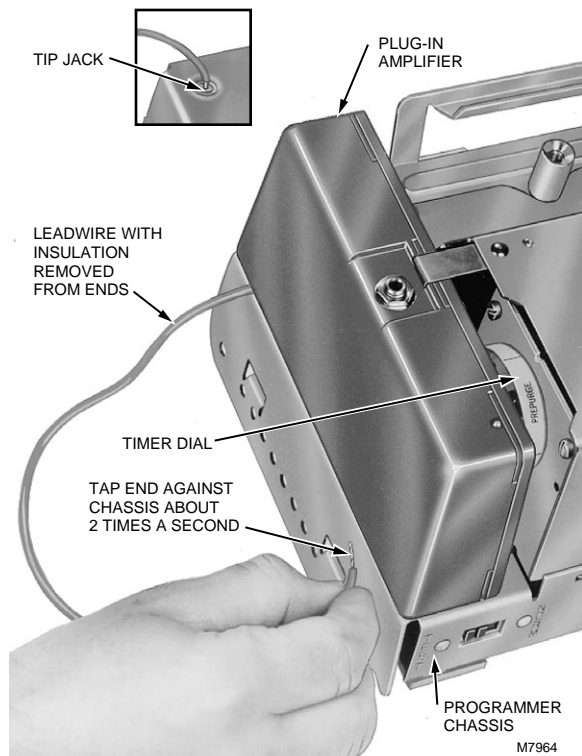


Fig. 14. Simulating flame for an infrared amplifier.

- (10) Set the timer switch to the TEST position.
  - (11) Close the master switch to start the programmer.
  - (12) When the timer stops, repeat step (5).
  - (13) If relay 2K pulls in, restore the programmer to the operating condition as instructed in step 8 below.
  - (14) If relay 2K still does not pull in, replace the programmer.
- e. R7249A Ultraviolet Amplifier (purple)—used with C7027A, C7035A, or C7044A Minipeeper Ultraviolet Flame Detectors. Follow the same procedure as described in 7c, above, for an R7247A Rectification Amplifier, except substitute a 123514B Flame Simulator in step (3).

8 Restore the programmer to operating condition as follows:

- a. Let the timer complete its revolution and set the timer switch to the NORM position.
- b. Open the master switch and remove the programmer from the subbase.
- c. Reconnect the flame detector leadwire to terminal F on the subbase.
- d. Reinstall the programmer on the subbase and reset the Lockout switch.

9 Check the flame detector and its circuitry outside the programmer as follows:

- a. 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.
- b. For a flame rod, make sure:
  - there is enough ground area.
  - the flame rod is properly located in the flame.
  - temperature at the flame rod insulator is no greater than 500°F (260°C).
  - ignition interference is not present (see Ignition Interference Test in the Checkout section).
- c. For all other detectors, clean the detector lens, filter, viewing window, and inside of the sight pipe, as applicable.
- d. For a C7012A,C,E or F Purple Peeper Ultraviolet Flame Detector, replace the 113236 and 115330 Electron Tubes (unless the detector is a solid state model).
- e. 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 Sight Pipe Ventilation in the detector Instructions.)
- f. Make sure that the flame adjustment is not too lean.
- g. Make sure the detector is properly sighting the flame.
- h. If necessary, resight or reposition the detector.

- i. If trouble persists, replace the detector. (Open the master switch before replacing the flame detector.)

**IMPORTANT**

If you make any changes in the flame detection system (including the plug-in amplifier), repeat all required tests in the Checkout section.

**SERVICE INFORMATION**



**CAUTION**

- 1. Only qualified service technicians should attempt to service or repair flame safeguard controls and burner systems.
- 2. Open the master switch before removing the relay/timer cover or before cleaning the contacts. Line voltage can be present on most contacts when power is on. If cleaning is necessary, be sure to replace the relay/timer cover.

**Scheduled Inspection and Maintenance**

A schedule should be set up and followed for periodic inspection and maintenance, for the burner, all other controls, and the programmer. Include the following in that schedule:

- 1 Always keep the burner and fuel mixture adjusted according to the burner manufacturer recommendations.
- 2 Keep the flame detection system adjusted for the smoothest, most reliable operation recommended by the burner manufacturer.
- 3 Clean the flame detector lens, filter, viewing window, and inside of the sight pipe, as applicable.
- 4 Check the flame signal (Table 4) using a Honeywell W136A Test Meter or equivalent (and a 196146 Meter Connector Plug, if needed).
- 5 If using a C7012A,C,E or F Purple Peeper Ultraviolet Flame Detector, replace the 113236 and 115330 Electron Tubes annually (unless the detector is a solid state model). These tubes are tested by Honeywell to ensure reliability and safety. Do not replace these tubes with commercial substitutes.

**Contact Cleaning**

Field cleaning of relay or timer contacts is not recommended.

**IMPORTANT**

- 1. Do not clean contacts.
- 2. Use extreme care to avoid bending the contacts or changing the specifications or configuration in any way.
- 3. Do not use an abrasive or a burnishing tool to clean contacts.
- 4. Do not use hard paper, such as a business card, to clean contacts.

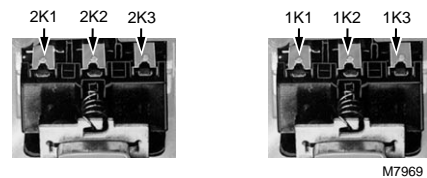
Do not use other types of contact cleaners. Honeywell's chemical analysis laboratory tested other pressurized type contact cleaners but did not approve them for these reasons:

- 1 The solvents could deteriorate plastic parts and wire insulation.

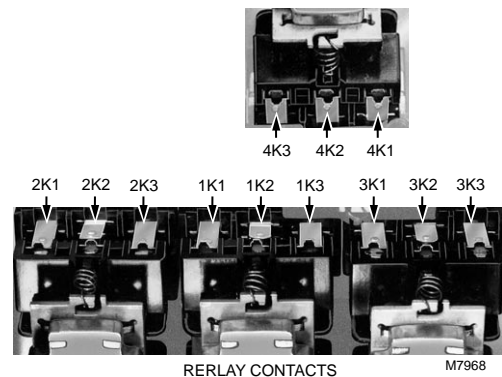
- 2 The cleaners leave an oily residue that collects dust and dirt. The residue also breaks down to form various carbonaceous products. Either result causes early contact failure.

Do not use an abrasive (sandpaper stick, file, etc.) or a burnishing tool to clean contacts. Its use can cause early contact failure for these reasons:

- 1 Some relay and timer contacts are plated with gold for increased reliability. Burnishing can quickly remove the plating.
- 2 The radii or points of the contacts are designed with specific shapes to best serve the intended functions of the contacts. Burnishing can rapidly alter these contact configurations.
- 3 Use of an abrasive loosens fine particles of the contact material that adhere to the surface of the contact, thus increasing its resistance.
- 4 Contact specifications (contact pressures, press back, and gaps) are carefully controlled during manufacturing to ensure maximum contact life. Burnishing can easily change these specifications.



**Fig. 15. Location of R4140G and R4140M relay contact (front view).**



**Fig. 16. Location of R4140L relay contacts (front view).**

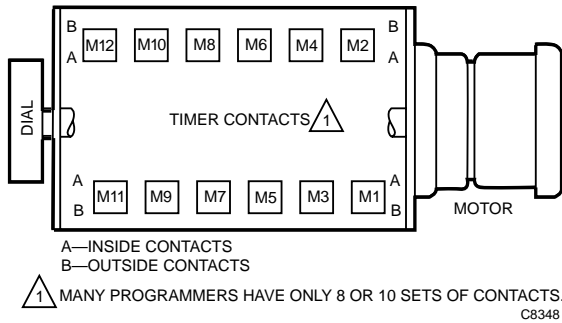


Fig. 17. Location of timer contacts (front view).

## TESTING AND MAINTENANCE

Periodic tests of all boiler controls and safety devices are required to determine that they are operating as designed to provide a measure of safety. Because the operation of all control and safety devices depends on the ability to respond quickly to activating impulses, perform systematic and thorough inspection and maintenance on a scheduled basis to insure the devices are operating as designed at all times. All information needed to comply with this schedule is provided by the boiler and burner manufacturer in the Operating and Maintenance Instructions furnished with the unit.

It is strongly recommended that the owner or user of the automatic boiler system set up a formal system of periodic preventive maintenance and testing. These tests should be conducted on a regular basis and the results recorded in a log book. Table 6 contains a recommended check list. Because of the variety of equipment in use, owners and users should write a detailed check list for the operator's use. This list must be in accordance with the equipment manufacturer's instructions on maintenance and should at least meet the requirements of the following schedule.

- During initial operation of a system inspection, adjustment, cleaning, and testing should be performed more frequently.
- Any defects in the system must be corrected immediately.
- Precautions must be taken while testing is in progress to protect the testing personnel, building occupants, and equipment from injury or damage.
- It is essential that any personnel who make inspections be thoroughly familiar with the operating procedures and equipment functions and be capable of judging when equipment is operating in accordance with the manufacturer's instructions and complies with all governing codes and ordinances.

## Minimum Inspection and Testing Schedule

The following inspection and testing schedule is taken from the ASME safety code, ASME CSD-1.

### CM-102 Minimum Schedule

- ① Daily
  - a. For high pressure boiler, test low water fuel cutoff and alarm.
  - b. Check fire for good combustion.
- ② Weekly
  - a. Check igniter.
  - b. Check flame failure detection system.
  - c. For low pressure steam boilers, test low water fuel cutoff and alarm.
- ③ Monthly
  - a. Test all fan and air pressure interlocks.
  - b. Check main burner safety shutoff valve(s) for leakage.
  - c. Check Low Fire Start switch.
  - d. For oil: test fuel pressure and temperature interlocks.
  - e. For gas: test high and low fuel pressure switches.
- ④ Semiannually
  - a. Inspect burner components
  - b. Check flame failure system components such as vacuum tubes, amplifier, and relays.
  - c. Check piping and wiring of all interlocks and shutoff valves.
  - d. Recalibrate all indicating and recording gauges.
- ⑤ Annually
  - a. Replace vacuum tubes, scanner, or flame rods in the flame failure system in accordance with manufacturer's instructions.
  - b. Check all coils and diaphragms; test other operating parts of all safety shutoff and control valves.
  - c. Conduct a pilot turndown test as shown in Table 6.
- ⑥ As required
  - a. Test safety valves in accordance with ASME Boiler and Pressure Vessel Code, Section VI; see bottom of Table 6.
  - b. Recondition low water fuel cutoff.
- ⑦ As required for oil firing
  - a. Remove and clean atomizers.
  - b. Clean oil strainers
- ⑧ As required for gas firing
  - a. Check drip leg and gas strainer.

### Cm-103 General

The above instructions are for general guidance. In all cases, the manufacturer's detailed instructions must be followed.

Table 6. Periodic Testing Recommended Check List (See Manufacturer's Instructions)

Item	Frequency	Accomplished By	Remarks
Gauges, Monitors, and Indicators	Daily	Operator	Make visual inspection and record readings in log.
Instrument and Equipment Settings	Daily	Operator	Make visual check against factory recommended specifications.
Firing Rate Control	Weekly	Operator	Visually inspect.
	Semi-annual	Service Technician	Verify factory settings—check with combustion test instruments.
Igniter Fuel Valves	Weekly	Operator	Make visual inspection, check flame signal strength if meter is fitted (see Combustion Safety Controls).
1. Pilot Valves			Open limit switch—make audible and visual check; check valve position indicators; check fuel meters.
2. Main Gas Valves	Monthly	Operator	Perform leakage tests—refer to manufacturer's instructions.
3. Main Oil Valves	Annual	Service Technician	
Combustion Safety Controls			
1. Flame Failure	Weekly	Operator	Close manual fuel supply for (1) pilot (2) main fuel cock and/or valve(s)—check safety shutdown timing log.
2. Flame Signal Strength	Weekly	Operator	If flame signal meter is installed, read and log—for both pilot and main flames, notify service organization if readings are very high, very low or fluctuating—refer to manufacturer's instructions.
3. Pilot Turn-Down Tests	As required/ Annual	Service Technician	Required after any adjustments to flame scanner mount or pilot burner—verify annually.
4. Refractory Hold-In	As required/ Annual	Service Technician	See Pilot Turn-Down Test.
Low Water Fuel Cutoff and Alarm	Daily/Weekly	Operator	Refer to manufacturer's instruction.
High Limit Safety Control	Annual	Service Technician	Refer to manufacturer's instructions.
Operating Control	Annual	Service Technician	Refer to manufacturer's instructions.
Low Draft, Fan and Air Pressure Interlocks	Monthly	Operator	Refer to manufacturer's instructions.
Atomizing Air/Steam Interlock	Annual	Service Technician	Refer to manufacturer's instructions.
High and Low Gas Pressure Interlocks	Monthly	Operator	Refer to manufacturer's instructions.
High and Low Oil Pressure Interlocks	Monthly	Operator	Refer to manufacturer's instructions.
High and Low oil Temperature Interlocks	Monthly	Operator	Refer to manufacturer's instructions.
Fuel Valve Interlock Switch	Annual	Service Technician	Refer to manufacturer's instructions.
Purge Switch	Annual	Service Technician	Refer to manufacturer's instructions.
Burner Position Interlock	Annual	Service Technician	Refer to manufacturer's instructions.
Rotary Cup Interlock	Annual	Service Technician	Refer to manufacturer's instructions.
Low Fire Start Interlock	Annual	Service Technician	Refer to manufacturer's instructions.
Automatic Change-over Control (Dual Fuel)	At least Annual	Service Technician	Under supervision of gas utility.
Safety Valves	As required	Operator	In accordance with procedure in Section VI, ASME Boiler Code Recommended Rules for Care and Operation of Heating Boilers.
Inspect Burner Components	Semi-annual	Service Technician	Refer to manufacturer's instructions.





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