



Model “B_G” Series Gas-Fired Copper Fin Water Boilers

Operating and Maintenance Manual

*Designed and Manufactured in
Accordance with
ASME Code Section IV,
Heating Boilers*

*E.T.L. Listed
ASME Code Construction and
Stamped.*



Photo shown may vary from actual model.



E.T.L. Listed



**E.T.L.
Canadian Listed**

**Ace Heating
Solutions, LLC**



**Ace Heating
Solutions, LLC**

**INSTALLATION and MAINTENANCE
INSTRUCTIONS for
SERIES "E" and "G"
COPPER FIN COIL HEATERS**

**FOR YOUR SAFETY
IF YOU SMELL GAS**

- 1. OPEN WINDOWS**
- 2. DON'T TOUCH
ELECTRICAL
SWITCHES**
- 3. EXTINGUISH ANY
OPEN FLAME**
- 4. IMMEDIATELY
CALL YOUR GAS
SUPPLIER**

FOR YOUR SAFETY

**DO NOT STORE
GASOLINE OR OTHER
FLAMMABLE VAPORS
AND LIQUIDS IN THE
VICINITY OF THIS OR
ANY OTHER
APPLIANCE**



**RECEIVING INSPECTION AND INITIAL
START UP PROCEDURES**

(1) Inspect the heater for shipping damage. Make sure that you open the box and visually inspect the heater. An undamaged container does not guarantee undamaged contents.

(2) If the heater is damaged when received, a claim must be filed by you with the shipping company.

Ace Heating Solutions, LLC is not responsible for any damage that the heater receives while in shipping. Although each shipping company has its own procedure for filing a claim, the information contained below should provide a guideline for filing a freight claim.

(3) Check and tighten the following as required: plumbing, gas supply, and electrical connections. Lift the fire shield and inspect the burners. Tighten as required.



E.T.L. Listed

Ace Heating Solutions, LLC

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PHONE: (714) 540-2230 • FAX: (714) 540-2239

www.aceheatingllc.com

INSTRUCTIONS

For Ace Gas Fired Copper Fin Volume Water Heaters

CAUTION

Should over heating occur, or the gas supply fail to shut off, turn off the manual gas valve to the appliance immediately.

A. INSTALLATION

- (1) THIS SECTION ADDRESSES THE INSTALLATION OF Ace Heating Solutions, LLC WATER HEATERS WITHIN MECHANICAL SYSTEMS, AND IS INTENDED TO PROVIDE SOME EXPLANATION OF NORMAL SYSTEM HOOK-UP AND OPERATION AS WELL AS DESCRIPTIONS OF SOME COMMONLY ENCOUNTERED SYSTEM PROBLEMS AND SOLUTIONS.
- (2) Install the heater in accordance with the following instructions. A qualified installation company should always be used.
- (3) The heater must be installed in accordance with all state and local codes, and all national codes, including, but not limited to:
 - ANSI Z21.10.2, GAS WATER HEATERS
 - ANSI Z223.1, NATIONAL FUEL GAS CODE
 - ANSI / NFPA 70, NATIONAL ELECTRIC CODE.
- (4) Install per heater-tank diagram located on page 4.
- (5) Connect the piping to draw cool water from the lower portion of the tank through the circulating pump to the bottom inlet heater connection. If a flow switch is used it should be connected near the pump outlet.
- (6) Connect the hot water return line from the heater to the tank as shown in the hook-up diagram.
- (7) Connect the cold water inlet supply directly into the tank as shown in the hook-up diagram. Do not use a check valve on the cold water inlet line. If a check valve is installed in the cold inlet line then a properly sized expansion tank should be added to the system to prevent the relief valve from popping.
- (8) The hot water outlet line should be connected at the highest part of the tank to avoid air entrapment, which can cause rapid corrosion at the top of the tank.
- (9) Install a thermometer, a drain valve, and a relief valve (anode if required) on the tank as shown in the hook-up diagram.
- (10) Page 4 illustrates a normal installation for a single heater with a storage tank. Cold water is supplied to the storage tank while system hot water is drawn from the top of the storage tank. Water is supplied to the water heater by a circulating pump which is normally wired to operate on a continuous basis. **Return Water temperature must be above 140 degrees F to avoid condensation damage.**

Note: Page 4 depicts piping schematics for multiple heater installations with vertical and horizontal storage tanks.

B. IDENTIFICATION

- (1) Your Ace Water Heater carries two identification plates. The coil plate, which carries the ASME Code Stamping and Registration Number (when applicable) is attached to the coil just inside the upper manifold assembly. The boiler nameplate lists information concerning the input and output of the unit, electrical and gas ratings, working pressure and clearance to adjacent construction figures. In addition the model and serial numbers are on the plate. You will need these to order replacement parts from the manufacturing representative in your area or from the factory.
- (2) The information on the National Board plate is the same as on the name plate with the exception of the National Board registration number, which is required in most states for installation of the unit.

Do not remove either of these plates from the unit for any reason.

C. LOCATION

- (1) Set the heater on a non-combustible floor. If the floor is combustible, a special "Combustible Floor Base" (CFB) must be used. Locate the heater so that leakage from tank or connections will be directed to a floor drain and will not damage adjacent area or lower level floors.
- (2) The minimum clearance between a heater and a storage tank is 6". For multiple heater installations a minimum of 6" clearance between heaters shall be maintained. For alcove installation, the minimum clearance to combustible construction is 24" to side and rear walls and 36" from the top of the heater to the ceiling. The front of the alcove shall remain open. Local and state codes may require greater clearances.
- (3) Allow sufficient space in front of heater for cleaning and removal of burners, replacement of the draft hood and controls, and the adjustment of all parts requiring such attention. Keep the area around the heaters free from combustibles and flammable liquids.
- (4) Minimum ventilation and combustible air openings to the room in which the heater is located must be provided in accordance with NATIONAL FUEL GAS CODE ANSI Z21.13.

D. COMBUSTION AND VENTILATION AIR

CAUTION

The lack of adequate combustion air is the single biggest problem encountered with gas fired water heaters.

- (1) Ace recommends that two permanent openings to outside air be provided, one 6" from the floor and the other 6" from the ceiling. The combined area of the two openings should not be less than 200 sq. in. for the first 100,00 BTUH heater input, and 100 sq. in. for each additional 100,000 BTUH heater input.
- (2) All additional gas fired equipment should be considered when calculating the necessary air supply.
- (3) The openings should have permanent, non-adjustable louvers properly designed so that they provide a baffling effect under wind conditions. Wood louvers may be considered to have 20-25% free area, and metal louvers may be considered to have 60-75% free area.
- (4) It is important to locate the heaters so that they are not adversely affected by wind, draft or freezing conditions that may exist in the room.
- (5) Air may be supplied by the use of ducting, fans, etc. It is extremely important, however, that any system be designed and installed by a qualified professional in such a manner that no positive or negative air pressure exists in the room in which the heaters are installed. Such a problem will result in improper combustion and sooting problems.
- (6) Required draft at the outlet stack must be within the range of -.02 to -.04 inches water column.

E. ELECTRICAL CONNECTIONS

- (1) A junction box is provided on the heater jacket for the electrical service connection.
- (2) For multiple heater installations, each heater is to be wired in parallel with all the other heaters so that each heater will operate independently.
- (3) The circulating pump (and the return pump if used) should be wired in parallel with the heater(s) to run continuously.
- (4) The heater(s) when installed, must be electrically grounded in accordance with state and local codes and in accordance with the NATIONAL ELECTRICAL CODE ANSI / NFPA 70-1984.
- (5) If any of the original wiring as supplied with the heater/boiler is replaced, it must be replaced with 18" AWG TFF wire or its equivalent.

F. RELIEF VALVES

- (1) The storage tank should be protected with a pressure (or combination temperature and pressure) relief valve set so as not to exceed the maximum tank operating pressure. The relief valve should be located within 6" of the top of the tank. Refer to local codes for the type of relief valve required.
- (2) Each heater should be protected with its own pressure relief valve. The relief valve should be rated for the BTU/hr or LBS/hr of heater output.
- (3) The pressure relief valves and pressure relief elements of combination valves, when supplied, shall comply with applicable performance provisions of the American National Standard for Relief Valves and Automatic Shutoff Devices for Hot Water Supply Systems, ANSI Z21.22-1979.
- (4) Manually operate relief valves at least once a year.
- (5) If the temperature and pressure relief valve(s) on the appliance(s) discharge periodically, a problem exists and service to the water system is required. Periodic discharge may be due to thermal expansion in a closed water system.

CAUTION!!!

To prevent scalding and/or personal injury, pipe outlet of relief valve(s) to a floor drain with NO intervening valves or restrictions.

G. AIR ELIMINATION

- (A) All of the air must be removed from the water piping in the system before the system will function properly. Therefore, all high points in the system must be vented or purged. Relief valves may be used to purge air when they are at the high point.
- (B) If a water heater is installed in a closed water system, contact the water heater supplier or local plumbing inspector on methods to allow proper system expansion. A weeping pressure or temperature relief valve may be due to thermal expansion (i.e. expansion tanks) in a closed water system. Do not plug the temperature and pressure relief valve.

H. VENTING SYSTEM (FLUE GASES)

- (1) Vents for the heater(s) may be run individually or manifolded. Two or more heaters may be vented through a common vent connector or manifold. The common vent connector or manifold shall be located at the highest level consistent with available head room or clearance to combustible material, and shall be sized in accordance with approved engineering methods. The area of the common vent connector or manifold shall not be less than the combined area of the individual draft hood outlets or the individual vent connectors.

See the NATIONAL FUEL GAS CODE ANSI Z21.13-1984 Section 1.5 "Venting of Appliances" for more detailed information.

- (2) Only locally approved code type venting should be installed.
- (3) The draft hood furnished with each heater/boiler must be installed as shown on the hook-up diagram.
- (4) The sheet metal collar included with the heater must be installed between the heater & the draft hood.

I. GAS CONNECTION

- (1) The gas line should be a separate line running directly from the gas meter to the heater, unless the existing gas line is of ample capacity. Verify the capacity of the existing gas piping if it is to be used.
- (2) Install a union at the connection to the heater manifold.
- (3) Refer to the rating plate on the shell of the heater for proper gas manifold pressure. The manifold pressure is measured downstream of the gas pressure regulator. Do not exceed the maximum gas pressure specified on the rating plate.
- (4) A trap (drip leg) must be installed upstream of the gas pressure regulator.
- (5) The heater must be disconnected from the gas supply piping system during any pressure testing of the gas supply piping.
- (6) Gas connections and heater should be properly tested for leaks before being put into operation.
- (7) Gas supply lines should be purged of air at the heater before startup.
- (8) The flow rate is determined by controls preset at the factory. There is no field adjustment for the minimum input rate.

J. TESTING

- (1) Your heater has been pressure tested in accordance with ASME CODE SECTION IV and fire tested in accordance with U.L. 795.
- (2) It is recommended that the heater and the system into which it is installed be tested before operating the system. The exact nature of the test(s) are determined by the system's component(s), but will generally consist of a water pressure test and a gas leak test. This testing should be completed as part of the normal installation procedure by the installing company.
- (3) Once the entire installation is complete, the unit should have an operation test to insure that the ignition system safety shut off device works properly. Instructions in the manufacturer's literature shall be followed in conducting this test.

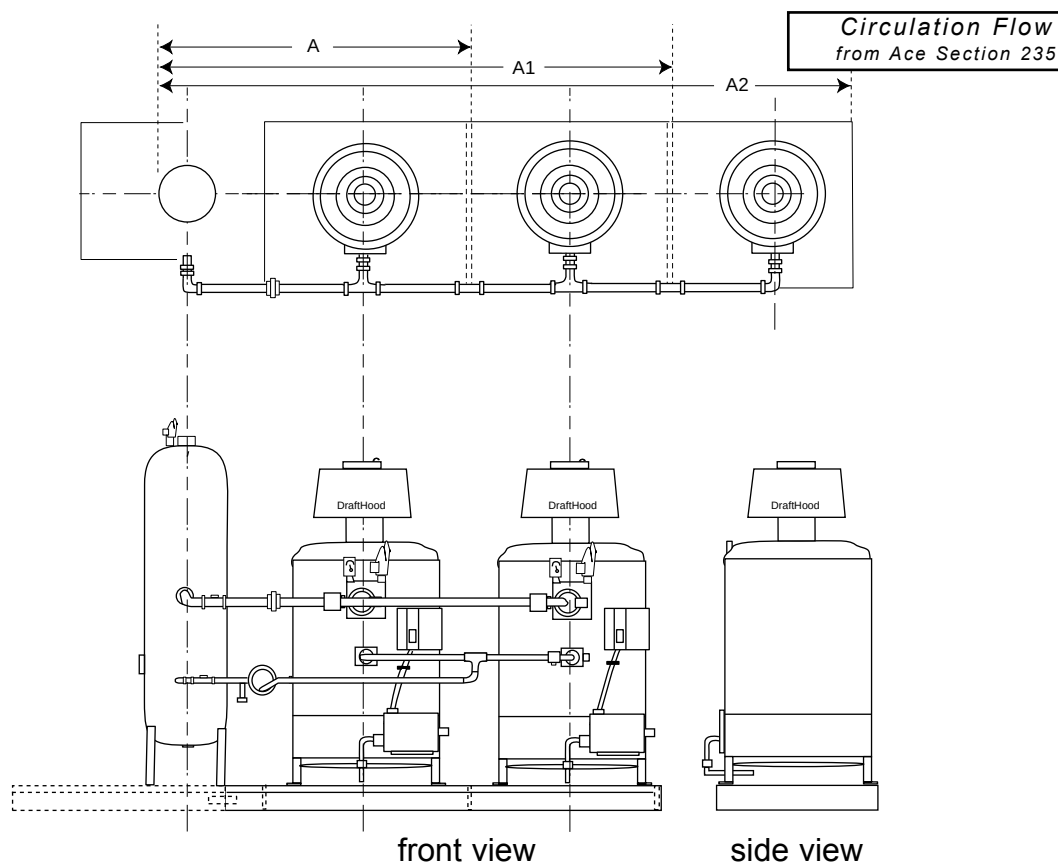
K. MAINTENANCE**CAUTION**

The following inspections and tests should be performed at regular intervals at least every three to six months. Failure to do so may void your warranty.

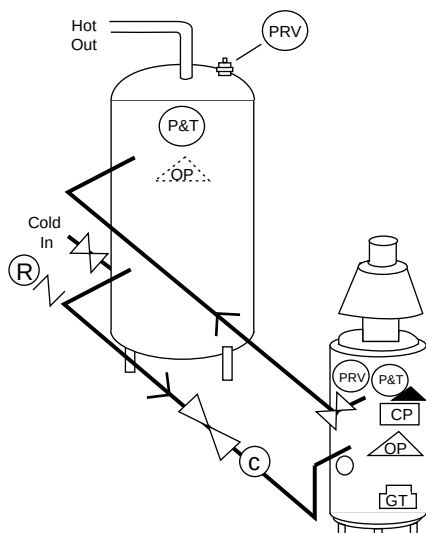
- (1) Turn the Operating Thermostat and High Limit Aquastat down, then up until heater turns off and on to verify that the controls are operating satisfactorily.
- (2) Check the High Limit Aquastat Well for lime. If 1/16" lime is deposited on the outside of the well, the coil needs to be delimed.
- (3) Inspect the coil and burner assembly to make sure that they are free from dust, lint, dirt, etc. If they are dirty, remove all foreign material by washing, flushing, or air cleaning, etc.
- (4) Inspect venting system to make sure that it is free of dirt and corrosion.
- (5) Make periodic visual checks of burners and pilot flames.
- (6) Check combustion air inlets in the room to see that they are clear of obstructions.

L. AQUASTAT INFORMATION

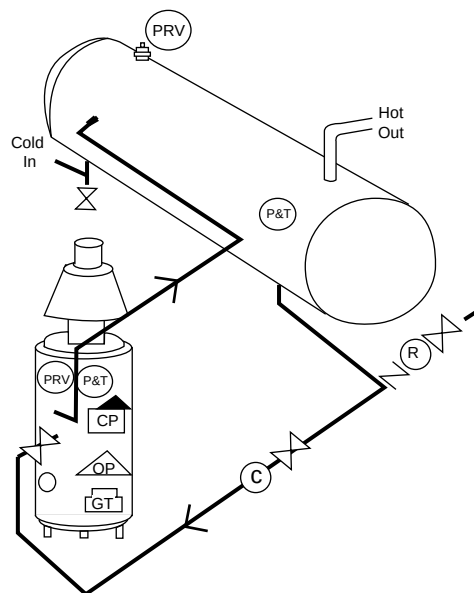
- (1) The Heater is equipped with two aquastats - a high limit safety aquastat in the upper (hot out) manifold and an operating aquastat (Thermostat) in the lower (tank water in) manifold. The operating aquastat "Thermostat" should be set approximately 10°F lower than the desired tank temperature setting. **The HI limit aquastat should be set at least 60°F higher than the thermostat setting.** For example: if desired water temperature in tank is 140°F set the thermostat at 130° F and Hi limit at 200°F; for 150°F tank water temperature set the thermostat at 140°F and the Hi limit at 210°F, etc. When 2 or more heaters are operated together, set the 2nd heater thermostat 3° to 5° lower than the first heater thermostat and the third heater thermostat 3° to 5° lower than the 2nd heater thermostat, etc. Check the tank thermometer and correct thermostat so that the heater shuts off at desired tank water temperature. Note: tank aquastat may be used interchangeably with the heater operating aquastat.
- (2) Water entering heater below 140 °F will cause the heater to condense, limiting its service life.



Hook-Up with Vertical Tank



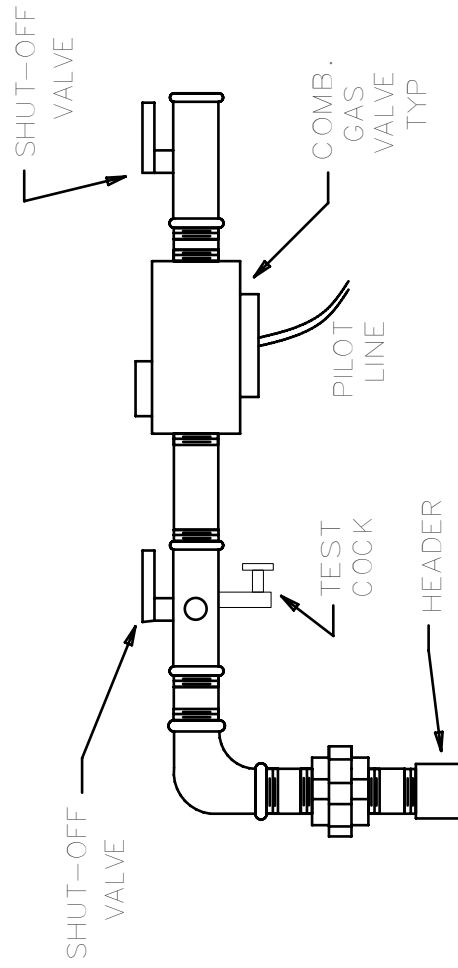
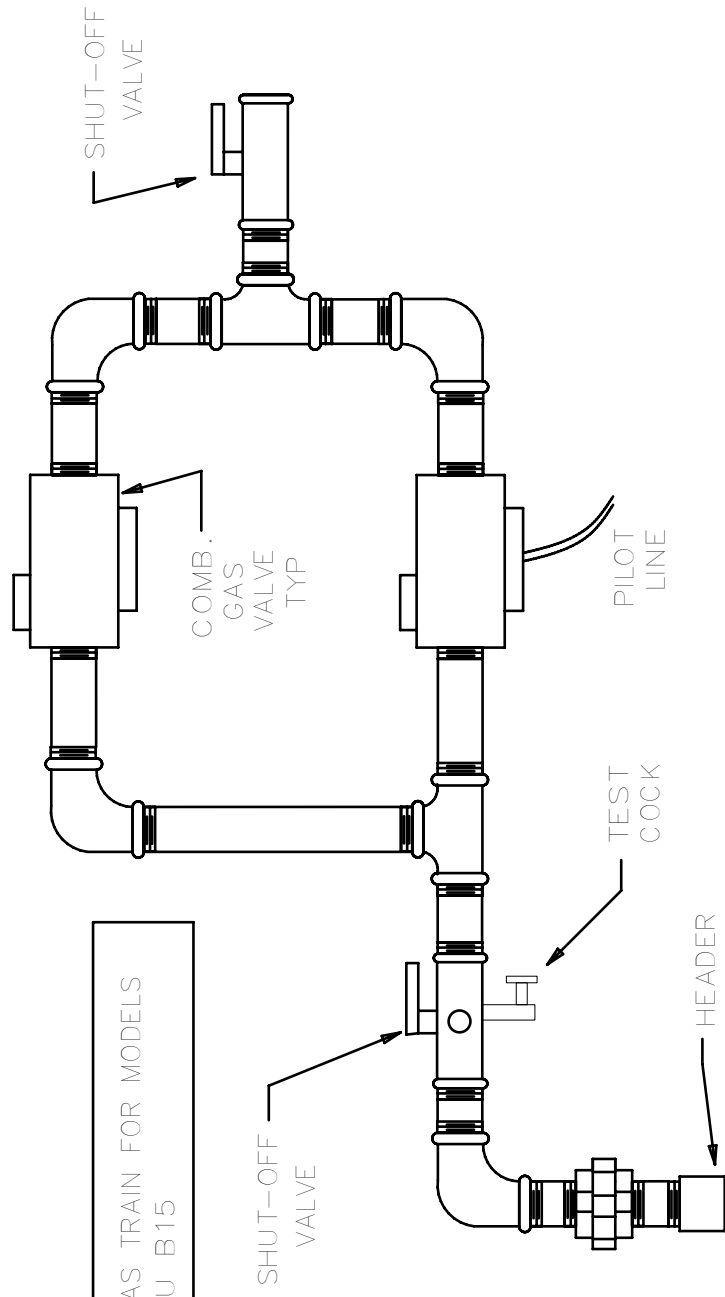
Hook-Up with Horizontal Tank



These are factory recommended hook-ups. They have been tested and proved over the years and should be followed exactly
EVEN THOUGH YOU ARE USED TO DOING THINGS DIFFERENTLY.

Z	Check Valve	C	Unit Circulation Pump	OP	Primary Operational Aquastat
PRV	Pressure Relief Valve	R	System Recirculation Pump	OP	Optional Tank Aquastat
P&T	Pressure & Temp. Gauge		Pilot Safety Relay	▲	Hi Limit Aquastat
⌵	Check Valve		Ground	CP	Control Panel
GT	Gas Train				

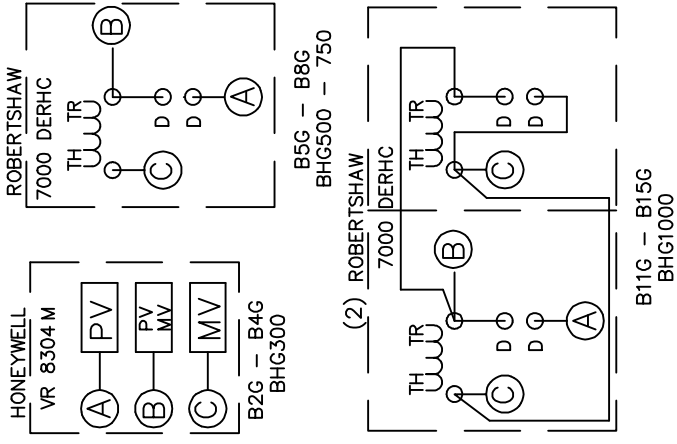
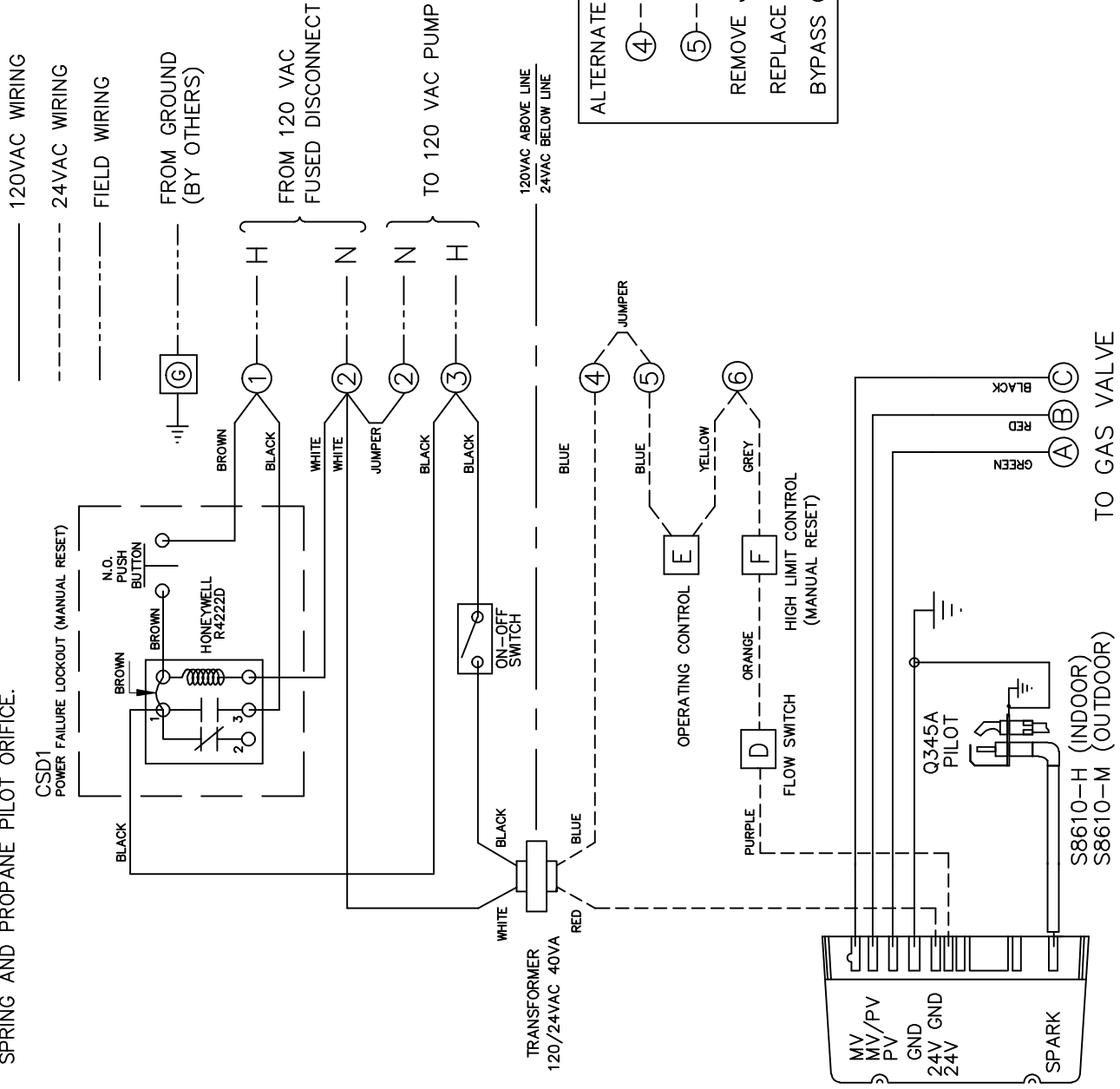
CSD-1 GAS TRAIN FOR MODELS
B11 THRU B15



CSD-1 GAS TRAIN FOR MODELS
B2 THRU B8 INDOOR/OUTDOOR

NOTE: FOR PROPANE USE BLUE SPRING

NOTE: FOR PROPANE USE BLUE REGULATOR
SPRING AND PROPANE PILOT ORIFICE.



ALTERNATE WIRING FOR UNITS WITH TANK AQUASTAT.

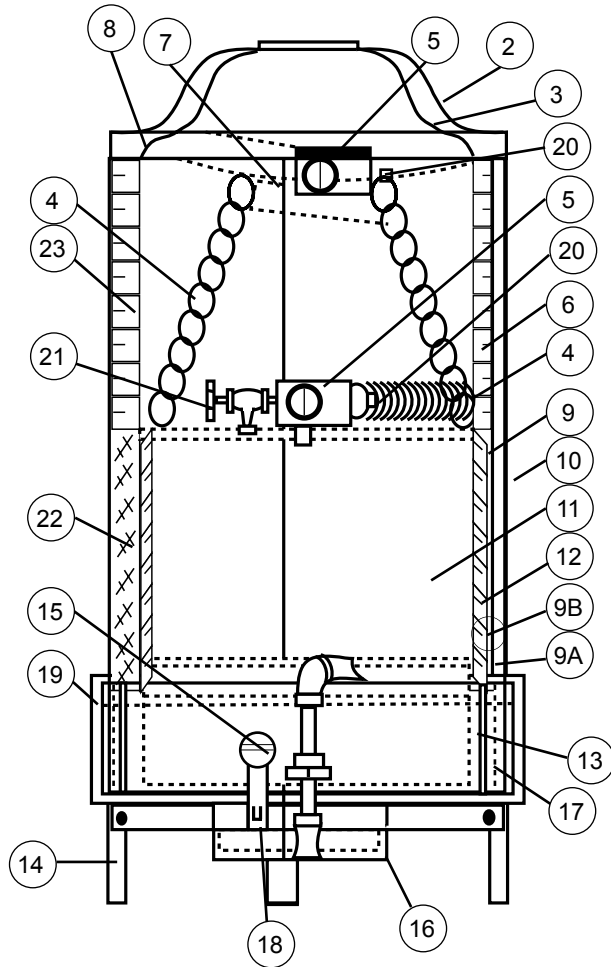
④ ----- } TO TANK AQUASTAT

⑤ ----- }

REMOVE JUMPER BETWEEN TERMINAL 4 AND 5 AND
REPLACE JUMPER BETWEEN TERMINAL 5 AND 6 TO
BYPASS OPERATING CONTROL.



Ace Heating Solutions, LLC



APPLICABLE FOR "D", "E" OR "G" SERIES

PART NO.	PART NAME
1	DRAFT HOOD - NOT SHOWN
2	OUTER LID
3	INNER LID
4	COIL-FINNED COPPER - INCLUDES PARTS NO. 5, 6, 7, 8
5	MANIFOLD PIPE CONNECTION (2 REQ'D.)
6	INNER JACKET - COIL SUPPORT & ENCLOSURE
7	STAINLESS STEEL BAFFLE FOR COIL
8	HOLD DOWN BRACKET - (COIL & BAFFLE) WITH J BOLT
9	STAINLESS STEEL LOWER INNER JACKET
9A	FIRE JACKET ASSEMBLY - PARTS 9, 9B, 12
9B	INSULATION HIGH TEMPERATURE
10	OUTER JACKET - MAIN BODY PORTION
11	FRONT PANEL - OUTER JACKET
12	OUTER FIRE JACKET WRAPPER & COIL JACKET SUPPORT
13	FIRESHIELD - S.S.
14	BASE RING WITH LEGS & REAR SKIRT
15	BURNER TUBES (NUMBER VARIES)
16	BURNER GAS RING & FLOOR SHIELD
17	GAS PIPING SUPPORT BRACKET WITH U BOLT
18	GAS JETS (ORIFICES) MAIN BURNER
19	RADIATION SHIELD - BASE
20	AQUASTAT WELL
21	DRAIN COCK - 3/4"
22	INSULATION HIGH TEMP. BLANKET - 2" (MINIBOND)
23	INSULATION - FIBERGLASS - UPPER BLANKET

"D", "E" OR "G" SERIES ASSEMBLY

- **THIS LIST COVERS PARTS EXCEPT THOSE IN GAS TRAIN OR IN CONTROL ASSEMBLY. CONSULT APPROPRIATE LIST FOR THESE ITEMS**
- **ALL REPAIR WORK SHOULD BE PERFORMED BY A QUALIFIED SERVICE ORGANIZATION.**

NOT INCLUDING CONTROLS AND GAS TRAIN

BOTH MODEL AND SERIAL NUMBERS MUST BE FURNISHED TO OBTAIN CORRECT PARTS

Ace Heating Solutions, LLC maintains a policy of continuous improvements and therefore reserves the right to change specifications without notice.

GAS FIRED COPPER FIN CONE COIL WATER HEATERS • HEAVY DUTY INDUSTRIAL WATER HEATERS • "MINI-PACK" SEMI-INSTANTANEOUS WATER HEATERS • PACKAGED STORAGE WATER HEATERS • CLEAN STEAM BOILERS • ASME HOT WATER STORAGE TANKS



Ace Heating Solutions, LLC
FACTORY LIMITED WARRANTY POLICY

The Ace Factory limited warranty provides assurance that all products are free from manufacturer's defects at the time of shipment and meet specifications and performance described in the product literature.

It is important to understand the difference between a factory warranty and an installed warranty. There are many factors that can occur to the products after they are shipped that the company has no control over and can not fully verify. These include:

1. Hidden damage during the shipping.
2. Handling damage.
3. Damage during storage.
4. Installation conditions.
5. Other unknown variables in the system design: maintenance, pulsation and vibrations.

The installed warranty is the responsibility of the architect, specifying engineer, contractor and/or owner who jointly have control over the application, installation, location, operating and maintenance conditions.

The Ace Heating Solutions, LLC warranty excludes extended liabilities. Extended liability typically occurs when products are installed without proper drainage, flooding containment or when safety devices are not tested and repaired or replaced when needed.

Product problems are often caused by the condition of the water, the lack of water treatment and/or the improper treatment of the water, insufficient combustion air, improper draft conditions, bolts not re-tightened, pipes not flushed and cleaned of oil, metal chips, rags, vibration and pulsation etc. These are installation, operating and/or maintenance conditions that are beyond the seller's responsibility and are not covered by the factory warranty, but may be covered by the installer's warranty.

The factory warranty covering company products is based upon extensive product development and testing. Combustion products undergo certification testing and approvals to Underwriters Laboratory (UL) standards. Auditing of the production of combustion products is conducted by a nationally recognized testing laboratory.

Pressure vessel products are designed and manufactured to American Society of Mechanical Engineering (ASME) and National Board (NB) Design standards. Design reviews, factory product manufacturing quality inspections and testing are carried out by a third party National Board authorized inspection agency.

Ace Heating Solutions, LLC products have proven themselves in service for over 85 years which indicates that the company products perform exceedingly well when normal installation, operating and maintenance conditions exist.

The following is a review from the terms and conditions of sale. Also included in paragraph two, below, is the Ace Heating Solutions, LLC nonconformance policy.

1. Ace Heating Solutions, LLC warrants its products against defective material and/or workmanship only. The warranty does not apply to operational failures, electrical failures, gasket leaks, and/or other malfunctions caused by improper application, installation and/or maintenance.
2. It is the buyer's responsibility to inspect and accept the product, when received, as conforming to their purchase order, specifications and approved drawings. All claims for non-conformance, errors, shortages, etc. must be made within 10 days after receipt of the shipment.
3. Ace Heating Solutions, LLC do not provide a warranty or guarantee, express or implied, in any manner, form, usage of trade, merchantability or fitness which extend beyond the product description and quotation.
4. Ace Heating Solutions, LLC liability is limited to the factory repair or replacement of warranty failures, or non-conformance, upon the return of the product to the factory.
5. Ace Heating Solutions, LLC is not liable for any direct or consequential damages.
6. Ace Heating Solutions, LLC warranty is based upon section 23161(2) of the uniform commercial code and is printed in the terms and conditions of sale which is referenced in every quotation, on the back of sales order acknowledgements and invoices. It is legally correct and is an industry standard policy.

Ace Heating Solutions, LLC

WARRANTY

LIMITED THERMAL SHOCK

In addition to our standard one (1) year warranty against defective parts and workmanship, Ace Heating Solutions, LLC. provides the following guarantee with all commercial hot water, forced circulation, space heating boilers:

Ace Heating Solutions, LLC guarantees this new boiler pressure vessel for twenty (20) years after date of installation from damage due to thermal shock. Thermal shock occurs when cold makeup water, up to 150°F less than the boiler water outlet temperature, is added directly into the boiler while the boiler is operating within the normal temperature range from 140°F to 250°F with a temperature rise from 20°F to 40°F. This guarantee shall cover damage to the boiler tubes, tube headers, and tube sheets when such damage is attributed to unequal expansion, poor circulation and/or other causes quite often described as "thermal shock". This guarantee does not cover damage or failures that can be attributed to corrosion, condensation, scale, boiler treatment chemicals, dirt accumulation, low water conditions, or any other abnormal operating conditions.

The liability of Ace Heating Solutions, LLC. is limited solely to the replacement of the complete pressure vessel, with tubes, if found by our inspection to be damaged by thermal shock. In no event shall Ace Heating Solutions, LLC. be held liable for replacement labor charges or for freight or handling charges.

Ace Heating Solutions, LLC

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Ace Heating Solutions, LLC
LIMITED
WARRANTY

Ace Heating Solutions, LLC provides a limited warranty on its products against **defective material and/or workmanship only**. This limited warranty is not applicable to operational failures, electrical failures, gasket leaks, wear or malfunctions caused by improper application, installation, and/or maintenance.

Product Period - The following Limited Warranty period are from date of shipment:

Carbon Steel Tank and Heat Exchanger Pressure Vessels: One year.

Stainless Steel Tanks: Three years.

Boiler Copper Fin Coils: Three years.

Single-wall or Double-wall Tank/Exchanger Coils: One year.

Single-wall or Double-wall Mini-Packs™: One year.

Atlas Series Condensing Boiler: One year.

Linings: (Pro-rated Warranty)

In Section VIII Tanks: Glass 30" dia. and above (Five years).

Glass 24" dia. and under (One year).

Cement (Five years).

Pre-Krete (Ten years).

In Section IV Tanks: Glass (One year).

Controls: Components manufactured by other than Ace Heating Solutions, LLC such as controls, instruments, forced draft burner, etc., provided with the boilers and packaged products are not covered by the Ace Heating Solutions, Warranty. However, Ace Heating Solutions, LLC extends to the customer the same warranty provided by the manufacturer to Ace Heating Solutions, LLC. The customer shall receive the full benefits of adjustments made to Ace Heating Solutions, LLC by the manufacturer.

Any claim for adjustment under this limited warranty must be made within the warranty period. Ace Heating Solutions, LLC's liability shall be limited to factory repair or, at Ace Heating Solutions, LLC's option, replacement of all parts which, upon test and examination by Ace Heating Solutions, LLC, prove to be defective material and/or workmanship and within the above limited warranty. If required by Ace Heating Solutions, LLC, parts which are claimed to be defective must be promptly delivered to the Ace Heating Solutions, LLC facility, transportation charges prepaid. This warranty does not cover the cost of labor, removal, or installation of the warranted item during the limited period. This warranty is limited to the above and applies only for the period set forth. Ace Heating Solutions, LLC will not be liable for any loss damage, direct, incidental or consequential damages of any kind, whether based upon warranty, contract, negligence or strict liability and arising in connection with the sale, use or repair of the products. Ajax Boiler Inc.'s maximum liability shall exceed the contract price for the product's merchantability or fitness for any particular purpose and in no event shall be held responsible for any consequential damages.

For complete Limited Warranty conditions see Section G and H under terms and condition of sale.

Ace Heating Solutions, LLC, also doing business as Ace Heating Solutions, LLC, is referred to herein as Ace Heating Solutions, LLC

Ace Heating Solutions, LLC

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Ace Heating Solutions, LLC

WARNING

PRODUCT SAFETY NOTICE

ACE BOILER AND WATER HEATER PRODUCTS OPERATE AT HIGH TEMPERATURE AND PRESSURES

- Before using this product, read and understand instructions. Save these instructions for future use.
- Before servicing, to prevent serious burns or injury, the boiler and water heater products must be cooled to less than 80°F (27°C) and the pressure must be 0 psi (0 bar).
- Turn off the electrical power before making electrical connections to prevent electrical shock.
- These products must be placed in a controlled location where untrained or unqualified personnel cannot access the operating or safety controls, must not be able to come in contact with high temperature or high pressure parts and must not perform maintenance or demolition work.
- All work performed must be by qualified properly equipped personnel trained in the proper application, installation, and maintenance or demolition of plumbing, steam, and electrical equipment and/or systems in accordance with all applicable codes and ordinances.
- ACE Boilers and Water Heaters are complete package units with safety and operating controls and are constructed with non ASBESTOS materials. Any replacement gaskets, refractory, insulation, etc used must not contain Asbestos.
- No additional insulation is required on the Boilers and Water Heaters.
- Additions or replacement of insulation on any connecting pipes or accessories to the Boilers and/or Water Heaters must be of "NON-ASBESTOS" and contain only non-hazardous materials.
- Crystalline Silica, a material known to cause cancer, may be encapsulated in some refractory or insulation materials and must be handled only by authorized trained personnel. Crystalline Silica as used is encapsulated and is not harm full in this form. Care must be taken during removal or replacement of refractory or insulation to remove it in bulk form and avoid generation or inhalation of dust. Removal must be properly performed by trained, qualified and equipped personnel. This is also true of Asbestos not contained in ACE products but may be otherwise contained in replacement materials or parts, in connecting piping or other nearby products.
- All safety and operating controls must be set within the specified operating limits and tested periodically to assure proper operation. All limit and operating controls must be installed in series on the boiler.
- Connect drain pipes to a safe drain to prevent serious personal injury from relief valve discharge and or from boiler blow down discharge.
- After installation, check for proper operation of all limit and operating controls before leaving the site.
- Perform scheduled and annual inspections including checking Controls for proper calibration and performance.

Failure to follow these warnings, to allow access by unauthorized persons and the use of non-properly trained and equipped personnel in the operation, service, modification, removal or demolition of these products or replacement of parts with non-authorized factory non-asbestos materials could cause damage, personal injury or death.

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APPLICATION

These Ignition modules provide ignition sequence, flame monitoring, and safety shutoff for intermittent pilot central furnaces and heating appliances. S8610 and S8670 models include a connector that converts the existing Ignition cable from a stud terminal receptacle to a 1/4 inch female quick-connect. S8610 and S8670 provide up to 1.0 A pilot

and 2.0 A main valve current rating. Minimum ambient temperature rating is -40° F [-40° C]. Maximum ambient rating is +175° F [+79° C] for S8610, S8670 used with 1.0 A or less main valve. Maximum ambient rating for S8610, S8670 used with 1.0 to 2.0 A main valve is +165° F [+74° C]. See Table 1 for a summary of other differences between models.

TABLE 1—INTERMITTENT PILOT IGNITION MODULES.

MODEL	IGNITER-SENSOR TYPE	TYPE OF GAS	PREPURGE TIMING	100 PERCENT SHUTOFF	LOCKOUT TIMING	IGNITION SEQUENCE ^a
S8610A	Separate	Natural	None	No	No	Spark on until pilot lightoff or manual shutoff; pilot valve open until manual shutdown.
S8610F	Combination					
S8610B	Separate	Natural or LP	None	Yes, at lockout	15 or 90 sec. max., as ordered	Spark on until pilot lightoff or lockout; pilot valve closes on lockout.
S8610H	Combination					
S8670D	Combination	Natural or LP	45 sec.	Yes, at lockout	15 or 90 sec. max., as ordered	Ignition trial follows prepurge; spark on until pilot lightoff or lockout; pilot valve closes on lockout.

^aIf established flame is lost, all models restart Ignition trial.

PLANNING THE INSTALLATION

Intermittent pilot systems are used on a wide variety of central heating equipment and on heating appliances such as commercial cookers, agricultural equipment, industrial heating equipment, and pool heaters. Some of these applications may make heavy demands on the controls, either because of frequent cycling or because of moisture, corrosive chemicals, dust, or excessive heat in the environment. In these situations, special steps may be required to prevent nuisance shutdowns and premature control failure. These applications require Honeywell Residential and Building Controls Engineering review; contact your Honeywell Sales Representative for assistance.

FREQUENT CYCLING

These controls are designed for use on space heating appliances that typically cycle 3 to 4 times an hour during the heating season and not at all during the cooling season. In an application with significantly greater cycling rates and closer to year-round use, we recommend monthly checkout because the controls may wear out more quickly.

WATER OR STEAM CLEANING

Once a module or gas control has been wet, it may operate unreliably and must be replaced. If the appliance is likely to be cleaned with water or steam, the controls and associated wiring should be covered so water or steam flow cannot reach them. The controls should be high enough above the bottom of the cabinet so they will not be subject to flooding or splashing during normal cleaning procedures. If necessary, shield the controls to protect them from splashing water. A NEMA 4 enclosure is recommended for the Ignition module; see the Electronic Ignition Service Manual, form 70-6604.

S8610A,B,F,H AND S8670D
INTERMITTENT PILOT MODULE

HEAT

The controls can be damaged by excessively high temperatures. Make sure the maximum ambient temperature at the control locations will not exceed the rating of the

control. If the appliance normally operates at very high temperatures, insulation, shielding, and air circulation may be necessary to protect the controls. Proper insulation or shielding should be provided by the appliance manufacturer; make sure adequate air circulation is maintained when the appliance is installed.

INSTALLATION

WHEN INSTALLING THIS IGNITION SYSTEM...

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

WARNING

FIRE OR EXPLOSION HAZARD
MAY CAUSE PROPERTY DAMAGE, SEVERE INJURY, OR DEATH

1. The ignition module can malfunction if it gets wet, leading to accumulation of explosive gas.
 - Never install where water can flood, drip, or condense on module.
 - Never try to use a module that has been wet—replace it.
2. Liquefied petroleum (LP) gas is heavier than air and will not vent upward naturally.
 - Do not light pilot or operate electric switches, lights, or appliances until you are sure the appliance area is free of gas.

CAUTION

1. Disconnect power supply before beginning wiring to prevent electrical shock or equipment damage.
2. If a new gas control is to be installed, turn off gas supply before starting installation. Conduct Gas Leak Test according to gas control manufacturer's instructions after the gas control is installed.
3. If module must be mounted near moisture or water, provide suitable waterproof enclosure.

PERFORM PREINSTALLATION SAFETY INSPECTION

The preinstallation checks described in ANSI Standard Z21.71 on page 21 must be done before the replacement module is installed. If a condition which could result in unsafe operation is detected, the appliance should be shut off and the owner advised of the unsafe condition. Any potentially unsafe condition must be corrected before proceeding with the installation.

Maintenance Requirements in Severe Environments

Regular preventive maintenance is important in any application, but especially so in commercial cooking, agricultural, and industrial applications because:

- In many such applications, particularly commercial cooking, the equipment operates 100,000-200,000 cycles per year. Such heavy cycling can wear out the gas control in one to two years. A normal forced air

WARNING

FIRE OR EXPLOSION HAZARD
MAY CAUSE PROPERTY DAMAGE, SEVERE INJURY, OR DEATH
Do not attempt to disassemble or clean the module. Improper reassembly and cleaning may cause unreliable operation.

Maintenance frequency must be determined individually for each application. Some considerations are:

- *Cycling frequency.* Appliances that may cycle more than 20,000 times annually should be checked monthly.
- *Intermittent use.* Appliances that are used seasonally should be checked before shutdown and again before the next use.
- *Consequence of unexpected shutdown.* Where the cost of an unexpected shutdown would be high, the system should be checked more often.
- *Dusty, wet, or corrosive environment.* Since these environments can cause the controls to deteriorate more rapidly, the system should be checked more often.

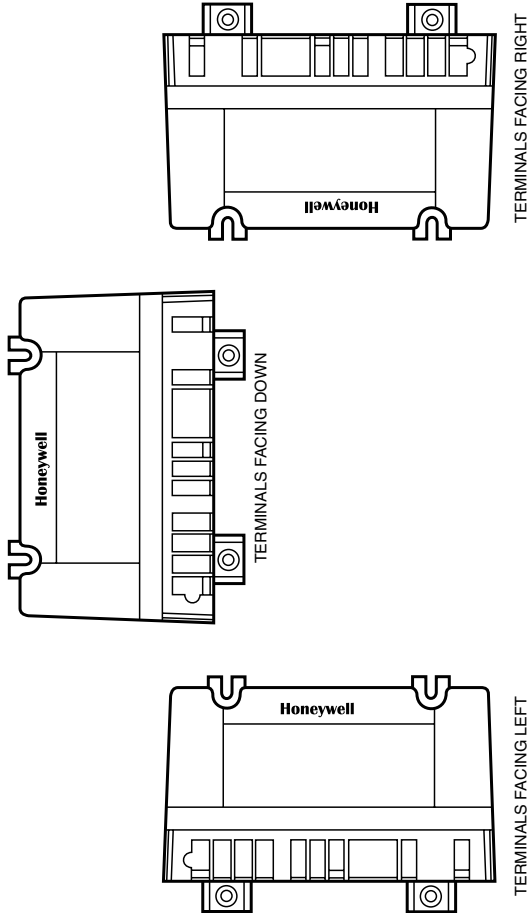
Any control should be replaced if it does not perform properly on checkout or troubleshooting. In addition, replace any module if it is wet or looks like it has ever been wet. Protective enclosures as outlined under "Planning the Installation" are recommended regardless of checkout frequency.

MOUNT IGNITION MODULE

Select a location close enough to the burner to allow a short (3 ft. [0.9 m] max.), direct cable route to the igniter. Ambient temperature at the module must be within the range listed under APPLICATION, page 1. The module must be protected from water, moisture, corrosive chemicals, and excessive dust and grease.

We recommend mounting the module with the terminals down to protect them from dripping water and dust. It can also be mounted with the terminals on either side. DO NOT MOUNT with terminals pointing up. Refer to Fig. 1 for mounting recommendations. Fasten securely with four No. 6-32 machine or No. 8 sheetmetal screws (S8610 and S8670 mounting hole pattern) is the same as the S86 and S89 mounting hole pattern).

MOUNT THE S8610 OR S8670 IN ANY OF THESE POSITIONS:



DO NOT MOUNT THE S8610 OR S8670 WITH TERMINALS FACING UP

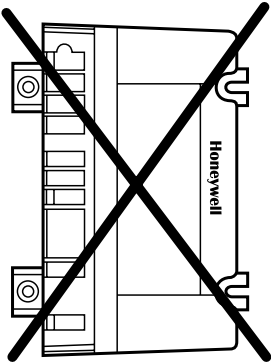


FIG. 1—IGNITION MODULE MOUNTING RECOMMENDATIONS.

MOUNT THE SYSTEM CONTROLS

Mount any required controls, such as the gas control, spark igniter, flame sensor, thermostat, limit, and transformer according to manufacturer's instructions.

WIRE THE SYSTEM

CAUTION

1. Check the wiring diagram furnished by the appliance manufacturer, if available, for circuits differing from the wiring hookups shown. Carefully follow any special instructions affecting the general procedures outlined below.
2. Disconnect the power supply before making wiring connections to prevent electrical shock or equipment damage.

Connect Ignition Cable

Use Honeywell ignition cable or construct an ignition cable that conforms to suitable national standards such as Underwriters Laboratories Inc. See Tables 2 and 3.

NOTE: When using an S8610 or S8670 to replace an S86, use the enclosed adapter to convert the S86 ignition cable to an S8610 ignition cable. Then, install adapter and cable to the S8610 ignition module.

TABLE 2—HONEYWELL PREASSEMBLED IGNITION CABLES (UL STYLE 3257).

CABLE PART NUMBER	LENGTH	MODULE END	IGNITER END
394800-30	30 in.	1/4 in. quick connect, insulated	Rajahh connector receptacle, 90 deg. rubber boot
394801-30	30 in.	1/4 in. quick connect, insulated	Rajahh connector receptacle, straight rubber boot

TABLE 3—RECOMMENDED IGNITION CABLE FOR FIELD ASSEMBLY.

CABLE TYPE	VOLTAGE RATING (rms)	TEMPERATURE RATING	
		C	F
UL Style 3217	10,000	150	302
UL Style 3257	10,000	250	484

Cable must be no longer than 36 in. [0.9 m]. To construct a cable, fit one end of ignition cable with 1/4 in. diameter Rajahh connector receptacle and the other with a 1/4 in. female quick-connect. Protect both ends with insulated boots.

NOTE: The cable must not run in continuous contact with a metal surface or spark voltage will be greatly reduced. Use ceramic or plastic standoff insulators as required.

To install:

1. Connect one end of the cable to the male quick connect SPARK terminal on the ignition module.
2. Connect the other end of the cable to the igniter or igniter-sensor stud on the pilot burner/igniter-sensor.

Connect Vent Damper

The D80B Vent Damper can be used with all ignition modules, although the Molex plug provided on some modules simplifies wiring connections when used with the D80D Plug-In Vent Damper. Once a module with vent damper plug has powered a vent damper circuit, it cannot be used in a gas system without a vent damper. A non-replaceable fuse in the module blows on initial power-up. Once this fuse has blown, the module won't work unless the vent damper is connected.

To connect the plug-in model to D80D:

1. Remove the plug from the terminal strip on the ignition module case and discard.
2. Using the wiring harness supplied, insert the matching pin plug into receptacle on case and other end to vent damper.

To connect the D80B, follow the wiring diagrams supplied with the vent damper or see Fig. 8 for typical connections.

Connect Ignition Module

1. Connect remaining system components to the ignition module terminals as shown in the appropriate wiring diagram, Figs. 2 through 11.

- Fig. 2 is a basic circuit for a heating only atmospheric burner with S8610F,H or S8670D.
- Fig. 3 shows S8610F,H with vent damper plug in a heating only atmospheric burner system with D80D Vent Damper. Never use a vent damper in an LP gas system or in a fan-assisted combustion system.
- Figs. 4 and 5 show S8610A,B with separate sensor and igniter, with and without the D80D Vent Damper.
- Figs. 6 through 11 show S8610F,H and S8670D in a variety of systems with alternate connections for modules with vent damper plug. Remember, however, that a vent damper should not be used in an fan-assisted combustion system or an LP gas system and that the vent damper plug must not be removed except to connect the module to a D80D with the plug-in cable. S8610A,B can be substituted in these drawings by simply connecting the igniter and sensor as shown in Figs. 4 and 5.
- 2. Refer to heating appliance manufacturer's instructions for wiring auxiliary controls.
- 3. Adjust thermostat heat anticipator to match system current draw. The current draw equals the total current required for the ignition module (0.2 A) plus the gas control and any other auxiliary equipment in the control circuit.

Connect Gas Control

Use No. 18 gauge solid or stranded wire. Use 1/4 in. female quick-connects for module connections. Connect to gas control terminals as shown in wiring diagrams, using terminals appropriate to the gas control.

Ground Control System

The igniter, flame sensor, and ignition module must share a common ground with the main burner. Use thermoplastic insulated wire with a minimum rating of 105° C [221° F] for the ground wire; asbestos insulation is not acceptable. If necessary, use a shield to protect the wire from radiant heat generated by the burner. Connect the ground wire as follows:

1. Fit one end of the ground wire with a female 1/4 in. quick-connect terminal and connect it to the male quick-connect GND(BURNER) terminal on the ignition module.
 2. Strip the other end of the wire and fasten it under the igniter bracket mounting screw. If necessary, use a shield to protect the ground wire from radiant heat.
 3. The burner serves as the common grounding area. If there is not good metal-to-metal contact between the burner and ground, run a lead from the burner to ground.
- NOTE: "Earth" ground is not required.

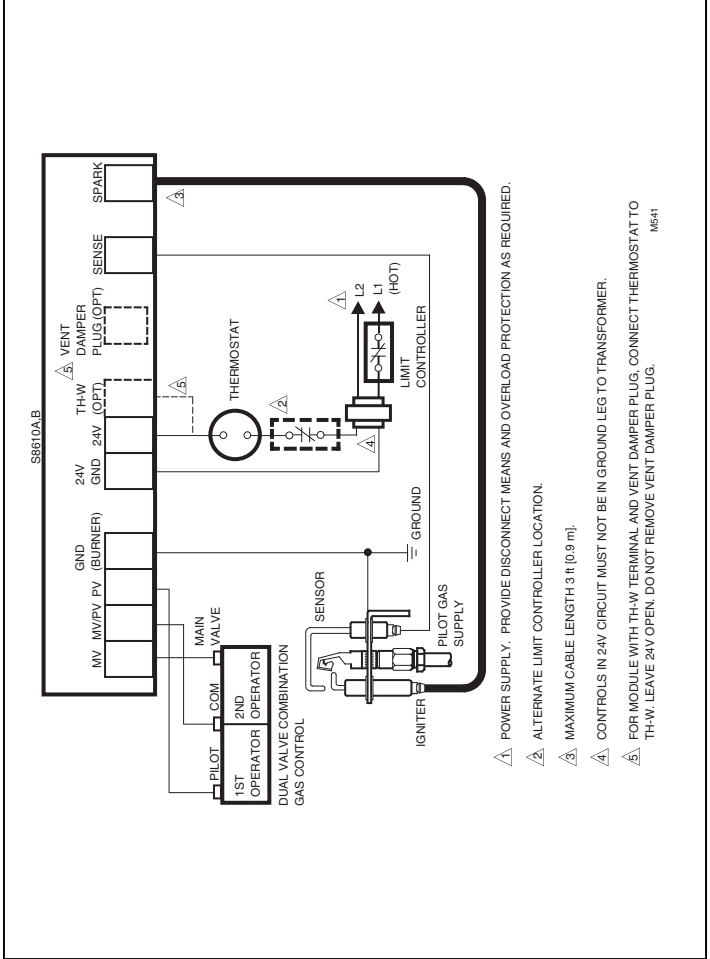
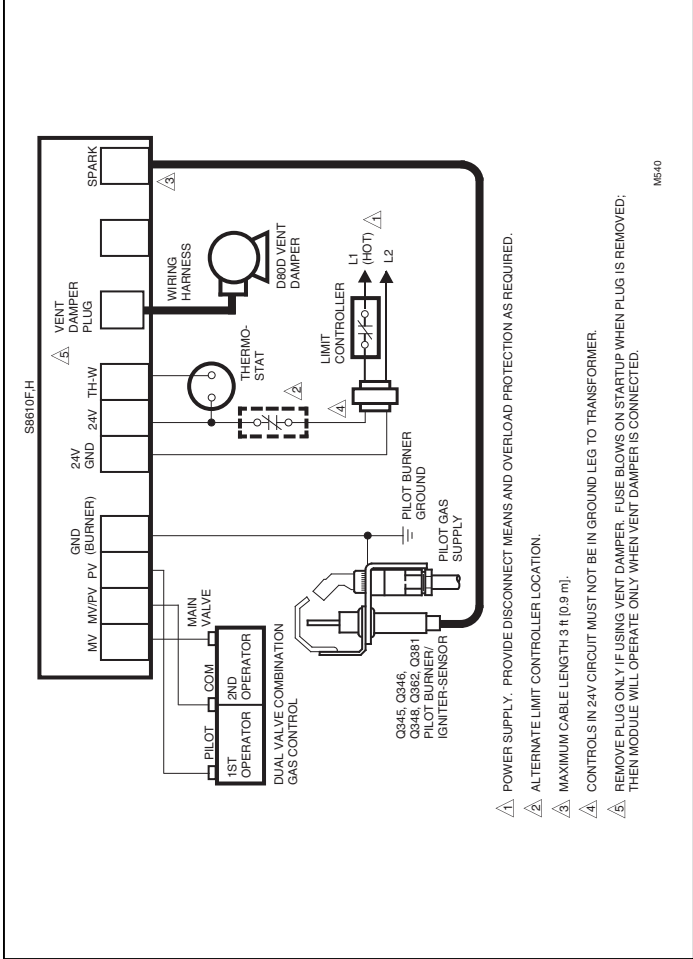
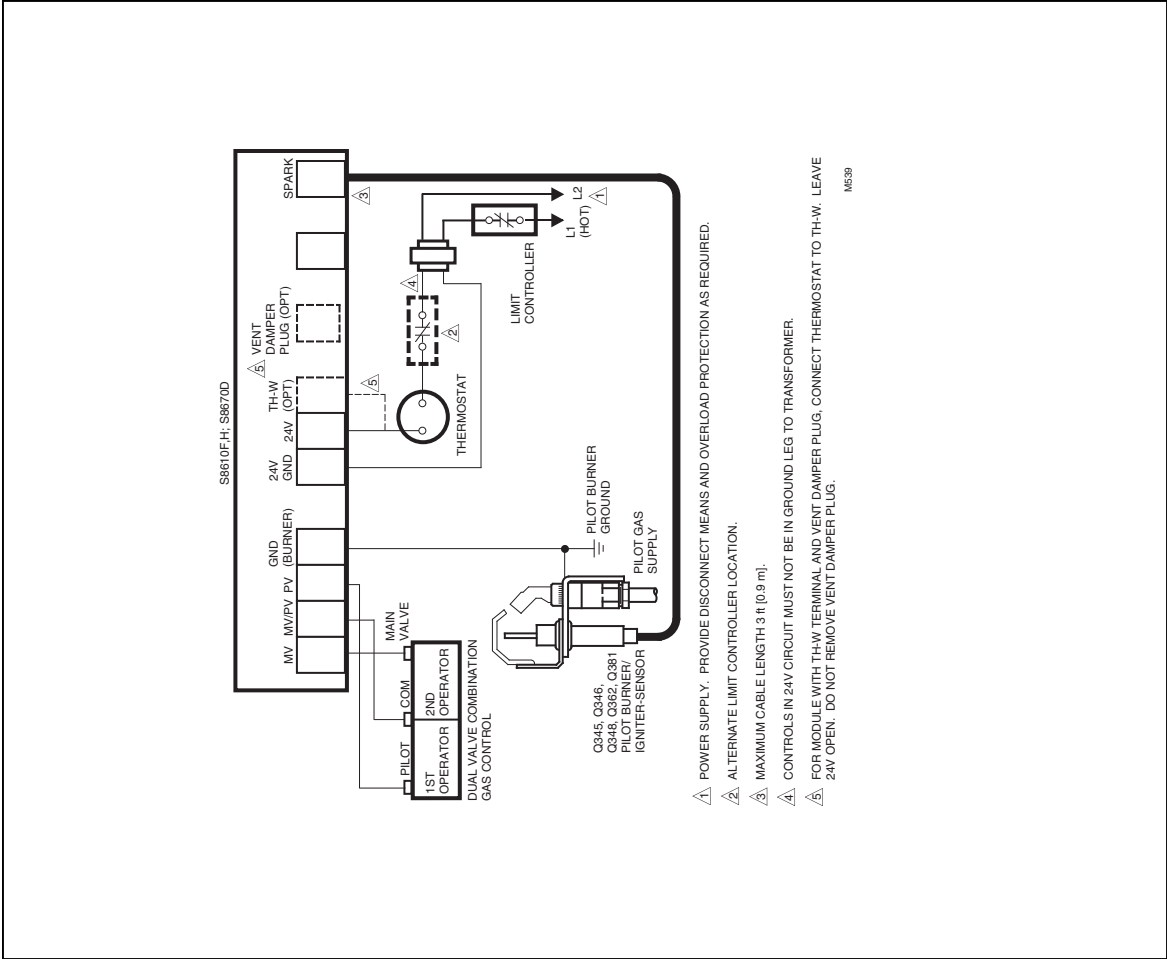
REPLACING MODULE WITH TH-R, TH-W TERMINALS

On modules that do not have a vent damper plug, the thermostat must be connected between the transformer and the 24V terminal on the module. To change out a module with TH-R, TH-W terminals:

1. Remove the wires from the 25V(2) and TH-R terminals on the old module. Connect these two wires with a solderless connector.
2. Tag and remove the remaining wires from the old module.
3. Remove the old module and mount the new one in the same location.
4. Reconnect the remaining wires as shown in Table 4.
5. Increase the thermostat anticipator setting by 0.2 A.

TABLE 4—TERMINAL CROSS REFERENCE.

TERMINAL ON OLD MODULE:	TERMINAL ON NEW MODULE:
25 V (1)	24 V (GND)
TH-W	24 V
MV	MV
MV/PV	MV/PV
PV	PV
GND (Burner)	GND (Burner)



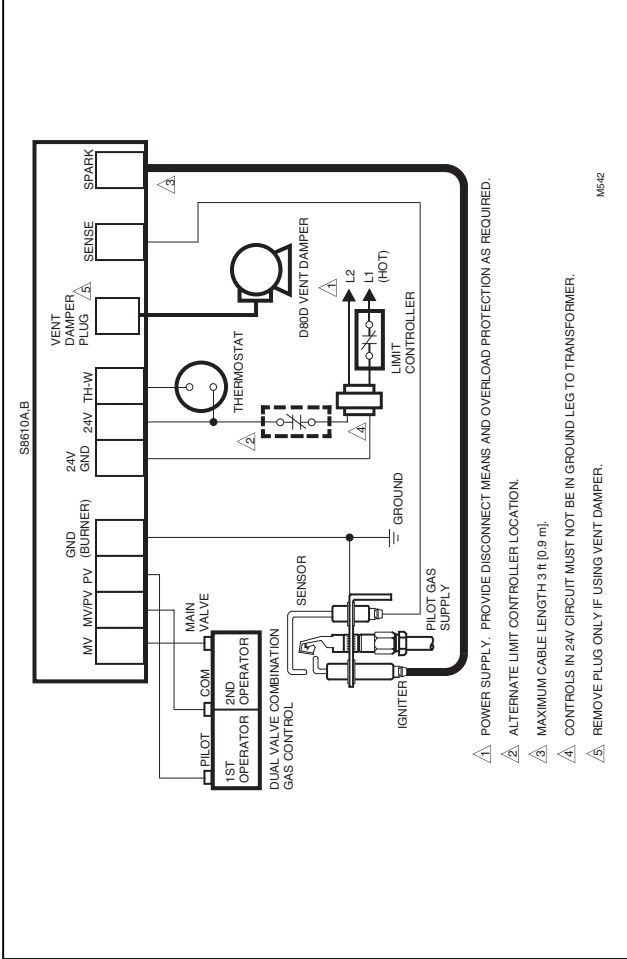


Fig. 5—S8610A,B with vent damper plug in an atmospheric burner heating system with a D80D Vent Damper.

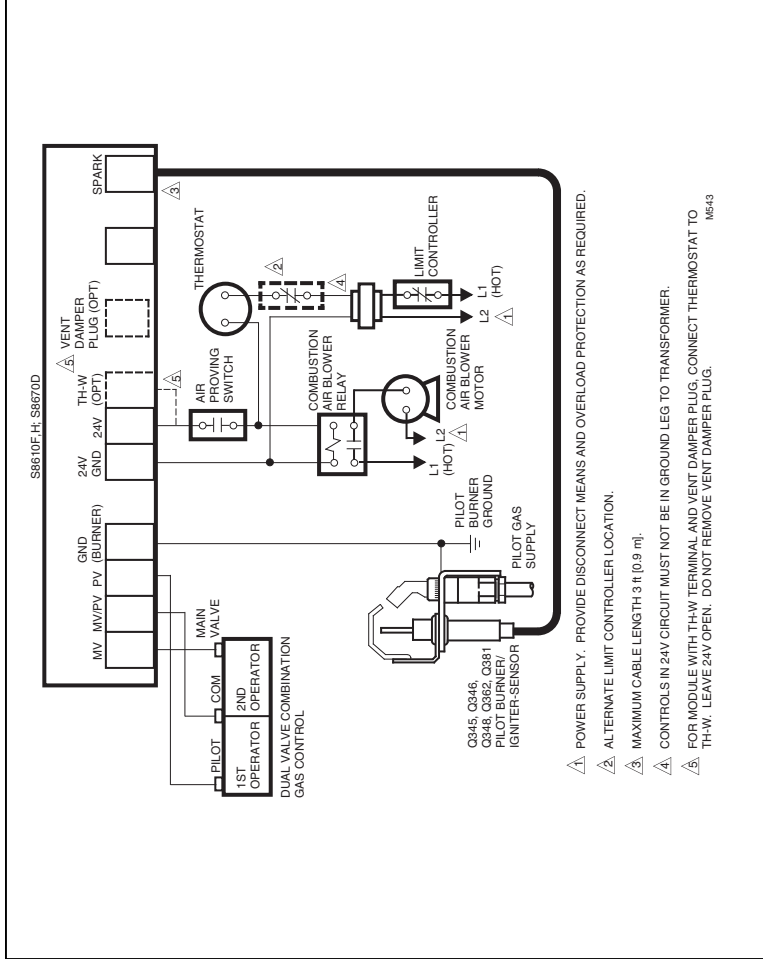


Fig. 6—S8610F,H; S8670D in a heating system with power-assisted combustion.

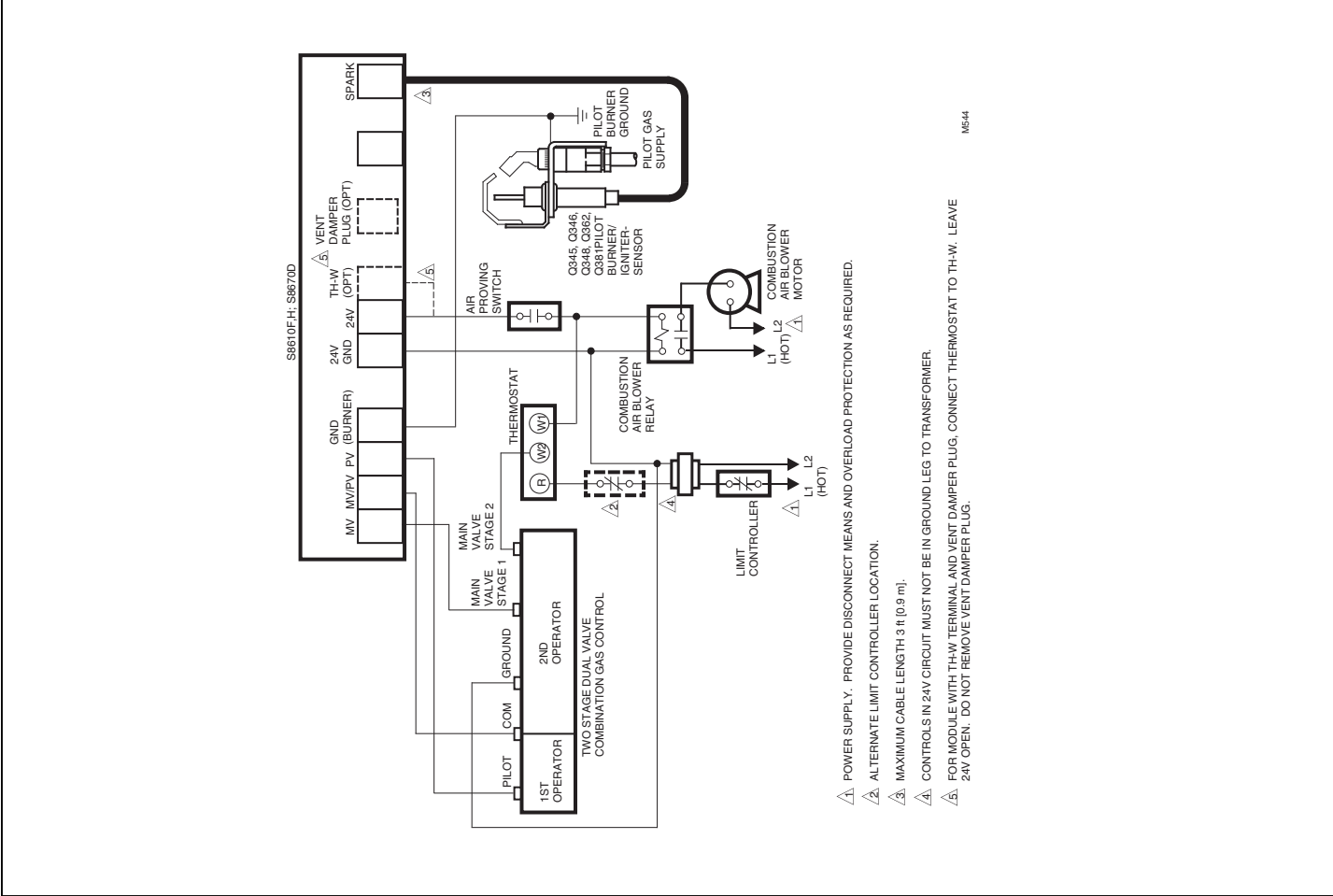
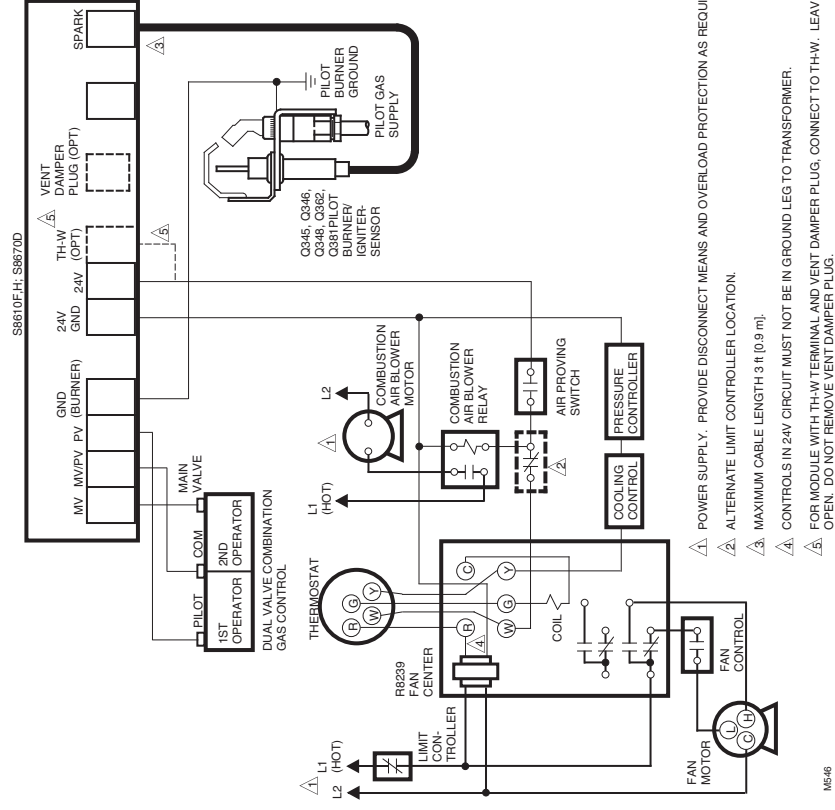
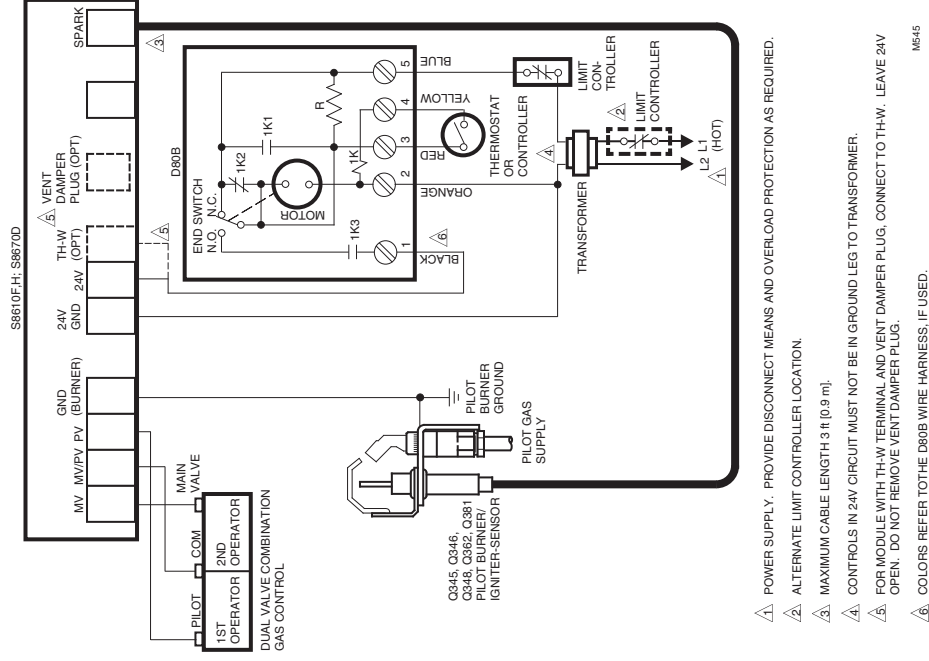


Fig. 7—S8610F,H; S8670D in a heating system with a two-stage gas control and power-assisted combustion.



CHECKOUT

- Check out the gas control system:
- At initial installation of the appliance.
 - As part of regular maintenance procedures. Maintenance intervals are determined by the application. See PLANNING THE INSTALLATION, page 1, for more information.
 - As the first step in troubleshooting.
 - Any time work is done on the system.
- STEP 3: Reset the Module.
- ☐ Turn the thermostat to its lowest setting.
 - ☐ Wait one minute.
- As you do Steps 4 and 5, watch for points where operation deviates from normal. Refer to Troubleshooting Chart to correct problem.

WARNING

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

1. If you smell gas or suspect a gas leak, turn off gas at manual service valve and evacuate the building. Do not try to light any appliance, do not touch any electrical switch or telephone in the building until you are sure no spilled gas remains.

2. Gas leak test must be done as described in Steps 1 and 5 below on initial installation and any time work is done involving the gas piping.

- STEP 1: Perform Visual Inspection.
- ☐ With power off, make sure all wiring connections are clean and tight.
 - ☐ Turn on power to appliance and ignition module.
 - ☐ Open manual shutoff valves in the gas line to the appliance.
 - ☐ Do gas leak test ahead of gas control if piping has been disturbed.

GAS LEAK TEST: Paint gas control gasket edges and all pipe connections downstream of gas control, including pilot tubing connections, with rich soap and water solution. Bubbles indicate gas leaks. Tighten joints and screws or replace component to stop gas leak. Recheck with soap and water solution.

- STEP 2: Review Normal Operating Sequence and Module Specifications.
- ☐ See OPERATION, page 13, and APPLICATION, page 1.

OPERATION

Module operation can be conveniently divided into two phases for S8610 and three for S8670. The phases are:

- Prepurge (S8670 only)
- Trial for ignition (all models)
- Main burner operation (all models)

Figs. 12 and 13 summarize the normal operating sequences of the modules.

PREPURGE (S8670 ONLY)

On proof of airflow, the air proving switch closes and energizes the S8670. When the module is used in an atmospheric system, the call for heat energizes the module. In either case, the module first initiates a 45 second delay to allow system prepurge. After prepurge, the module starts the pilot ignition sequence.

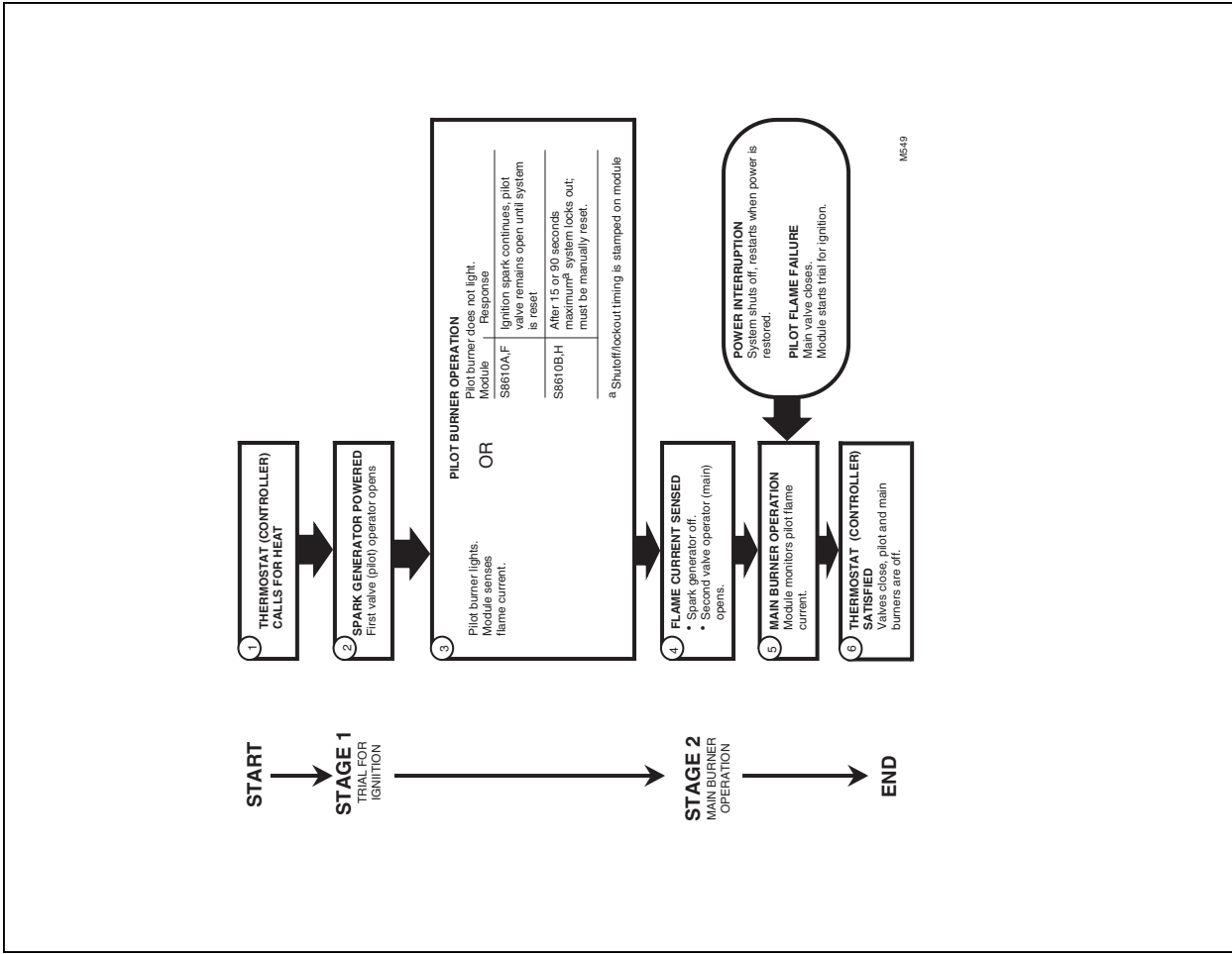


Fig. 12—S8610 normal operating sequence.

TRIAL FOR IGNITION

Pilot Ignition

Following prepurge timing (S8670), or on the call for heat (S8610), the module energizes the first main valve operator. The first main valve opens, which allows gas to flow to the pilot burner. At the same time, the electronic spark generator in the module produces an over 10,000 volt spark pulse output. The voltage generates a spark at the igniter (S8610A,B) or igniter-sensor (S8610F,H; S8670) that lights the pilot.

If the pilot does not light, or the pilot flame current is not at least 1.0 uA and steady, the module will not energize the second (main) valve and the main burner will not light. S8610A,F will continue to spark as long as the thermostat calls for heat, or until the pilot lights.

Safety Lockout (S8610B,H; S8670D)

These modules provide 100 percent shutoff and safety lockout. A timer in these models starts timing the moment the trial for ignition starts. Ignition spark continues only until

the timed trial for ignition period ends. Then the module goes into safety lockout. Lockout de-energizes the first main valve operator and closes the first main (pilot) valve in the gas control, stopping pilot gas flow. The control system must be reset by setting the thermostat below room temperature for one minute or by turning off power to the module for one minute.

MAIN BURNER OPERATION

When the pilot flame is established, a flame rectification circuit is completed between the sensor and burner ground. The flame sensing circuit in the module detects the flame current, shuts off the spark generator, and energizes the second main valve operator. The second main valve opens and gas flows to the main burner, where it is ignited by the pilot burner. On lockout models, the flame current also holds the safety lockout timer in the reset (normal) operating condition.

When the call for heat ends, both valve operators are de-energized, and both valves in the gas control close.

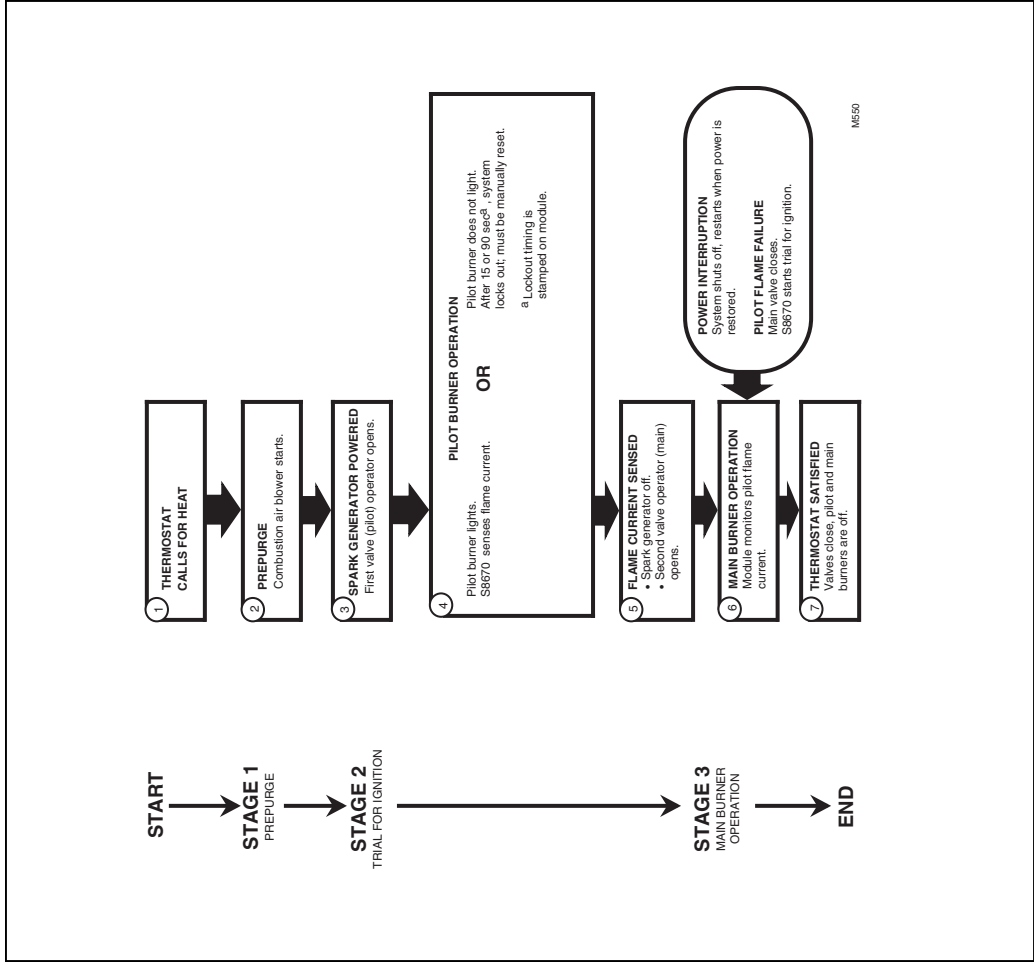


Fig. 13—S8670 normal operating sequence.

TROUBLESHOOTING

IMPORTANT

1. The following service procedures are provided as a general guide. Follow appliance manufacturer's service instructions if available.
2. On lockout and retry models, meter readings between gas control and ignition module must be taken within the trial for ignition period. Once the ignition module shuts off, lockout models must be reset by setting the thermostat down for at least one minute before continuing. On retry models, wait for retry or reset at the thermostat.
3. If any component does not function properly, make sure it is correctly installed and wired before replacing it.
4. The ignition module cannot be repaired. If it malfunctions, it must be replaced.
5. Only trained, experienced service technicians should service intermittent pilot systems.

Perform the checkout on page 12 as the first step in troubleshooting. Then check the appropriate troubleshooting guide (Fig. 15 or 16) and the schematic diagram (Fig. 17 or 18) to pinpoint the cause of the problem. If troubleshooting indicates an ignition problem, see Ignition System Checks below to isolate and correct the problem. Following troubleshooting, perform the checkout procedure (page 12) again to be sure system is operating normally.

IGNITION SYSTEM CHECKS

STEP 1: Check ignition cable.

- Make sure:
- ☐ Ignition cable does not run in contact with any metal surfaces.
 - ☐ Ignition cable is no more than 36 inches [0.9 meters] long.
 - ☐ Connections to the ignition module and to the igniter or igniter-sensor are clean and tight.
 - ☐ Ignition cable provides good electrical continuity.

STEP 2: Check ignition system grounding. Nuisance shutdowns are often caused by a poor or erratic ground.

- ☐ A common ground, usually supplied by the pilot burner bracket, is required for the module and the pilot burner/igniter-sensor.
- ☐ Check for good metal-to-metal contact between the pilot burner bracket and the main burner.
- ☐ Check the ground lead from the GND(BURNER) terminal on the module to the pilot burner. Make sure connections are clean and tight. If the wire is damaged or deteriorated, replace it with No. 14 through No. 18 gauge, moisture-resistant, thermoplastic-insulated wire with 105° C [221° F] minimum rating.
- ☐ Check the ceramic flame rod insulator for cracks or evidence of exposure to extreme heat, which can permit leakage to ground. Replace pilot burner/igniter-sensor and provide shield if necessary.
- ☐ If flame rod or bracket are bent out of position, restore to correct position.

STEP 3: Check spark ignition circuit. You will need a short jumper wire made from ignition cable or other heavily insulated wire.

- ☐ Close the manual gas valve.
- ☐ Disconnect the ignition cable at the SPARK terminal on the module.

WARNING

When performing the following steps, do not touch stripped end of jumper or SPARK terminal. The ignition circuit generates over 10,000 volts and electrical shock can result.

- ☐ Energize the module and immediately touch one end of the jumper firmly to the GND terminal on the module. Move the free end of the jumper slowly toward the SPARK terminal until a spark is established.
- ☐ Pull the jumper slowly away from the terminal and note the length of the gap when sparking stops. Check table below.

ARC LENGTH	ACTION
No arc or arc less than 1/8 inch [3 mm]	Check external fuse, if provided. Verify power at module input terminal. Replace module if fuse and power okay.
Arc 1/8 inch [3 mm] or longer.	Voltage output is okay.

STEP 4: Check pilot and main burner lightoff.

- ☐ Set the thermostat to call for heat.
- ☐ Watch the pilot burner during the ignition sequence. See if:

- Ignition spark continues after the pilot is lit.
- The pilot lights and the spark stops, but main burner does not light.
- S8610B,H; S8670D only: The pilot lights, the spark stops and main burner lights, but the system shuts down.
- If so, ensure adequate flame current as follows.
- ☐ Turn off furnace at circuit breaker or fuse box.
- Clean the flame rod with emery cloth.

APPEARANCE	CAUSE
SMALL BLUE FLAME	CHECK FOR LACK OF GAS FROM: • CLOGGED ORIFICE FILTER • CLOSED PILOT FILTER • LOW GAS SUPPLY PRESSURE • PILOT ADJUSTMENT AT MINIMUM
LAZY YELLOW FLAME	CHECK FOR LACK OF AIR FROM: • DIRTY ORIFICE • DIRTY LINT SCREEN, IF USED • DIRTY PRIMARY AIR OPENING, IF THERE IS ONE • PILOT ADJUSTMENT AT MINIMUM
WAVING BLUE FLAME	CHECK FOR: • EXCESSIVE DRAFT AT PILOT LOCATION • RECIRCULATING PRODUCTS OF COMBUSTION
NOISY LIFTING BLOWING FLAME	CHECK FOR: • HIGH GAS PRESSURE
HARD SHARP FLAME	THIS FLAME IS CHARACTERISTIC OF MANUFACTURED GAS. CHECK FOR: • HIGH GAS PRESSURE • ORIFICE TOO SMALL

Fig. 14—Examples of unsatisfactory pilot flames.

- adjustment screw on the gas control clockwise  to increase pilot flame. Following adjustment, always replace pilot adjustment cover screw and tighten firmly to assure proper gas control operation.
- Set thermostat below room temperature to end call for heat.
- Recheck ignition sequence as follows.
- Reconnect main valve wire.
 - Set thermostat to call for heat.
 - Watch ignition sequence at burner.
- If spark still doesn't stop after pilot lights, replace ignition module.
- If main burner doesn't light or if main burner lights but system locks out, check module, ground wire, and gas control as described in appropriate troubleshooting chart, Fig. 15 or 16.

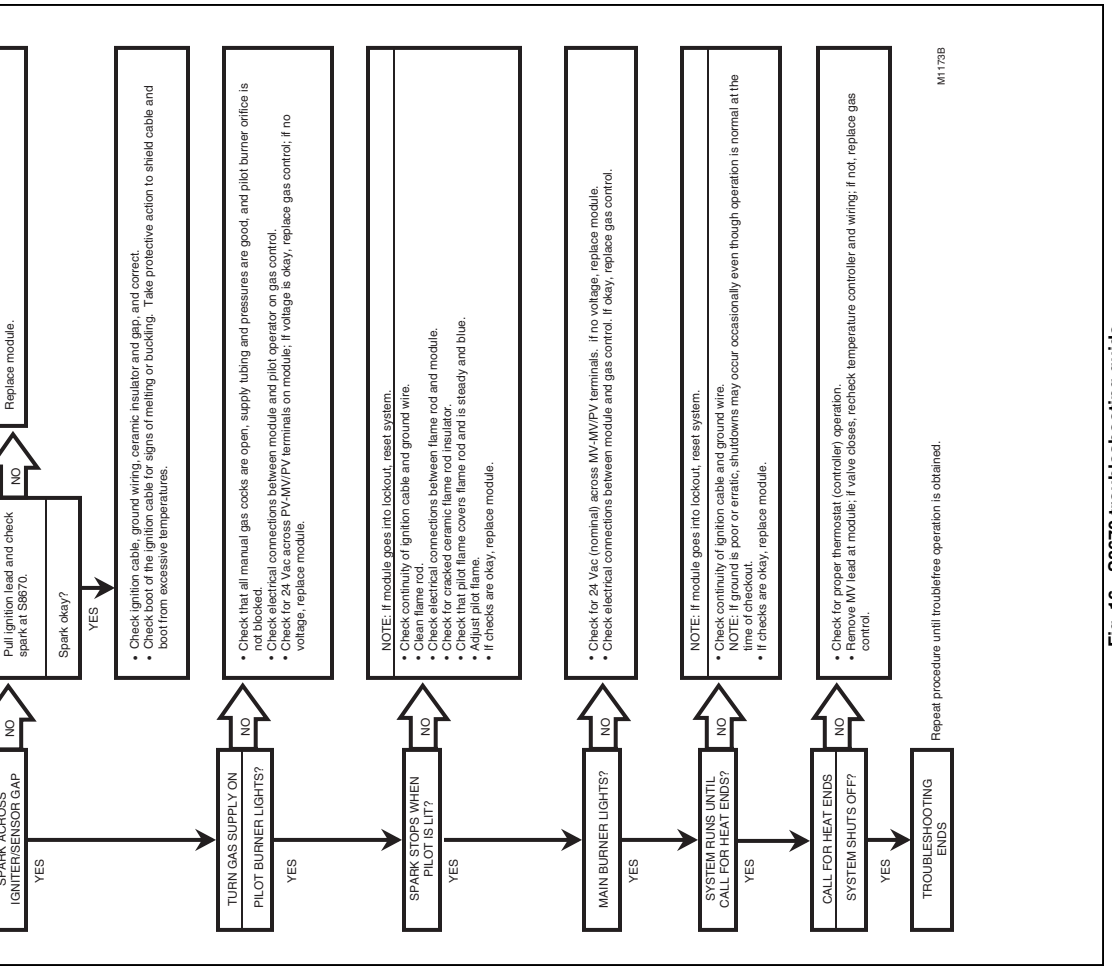


Fig. 16—S86/U troubleshooting guide.

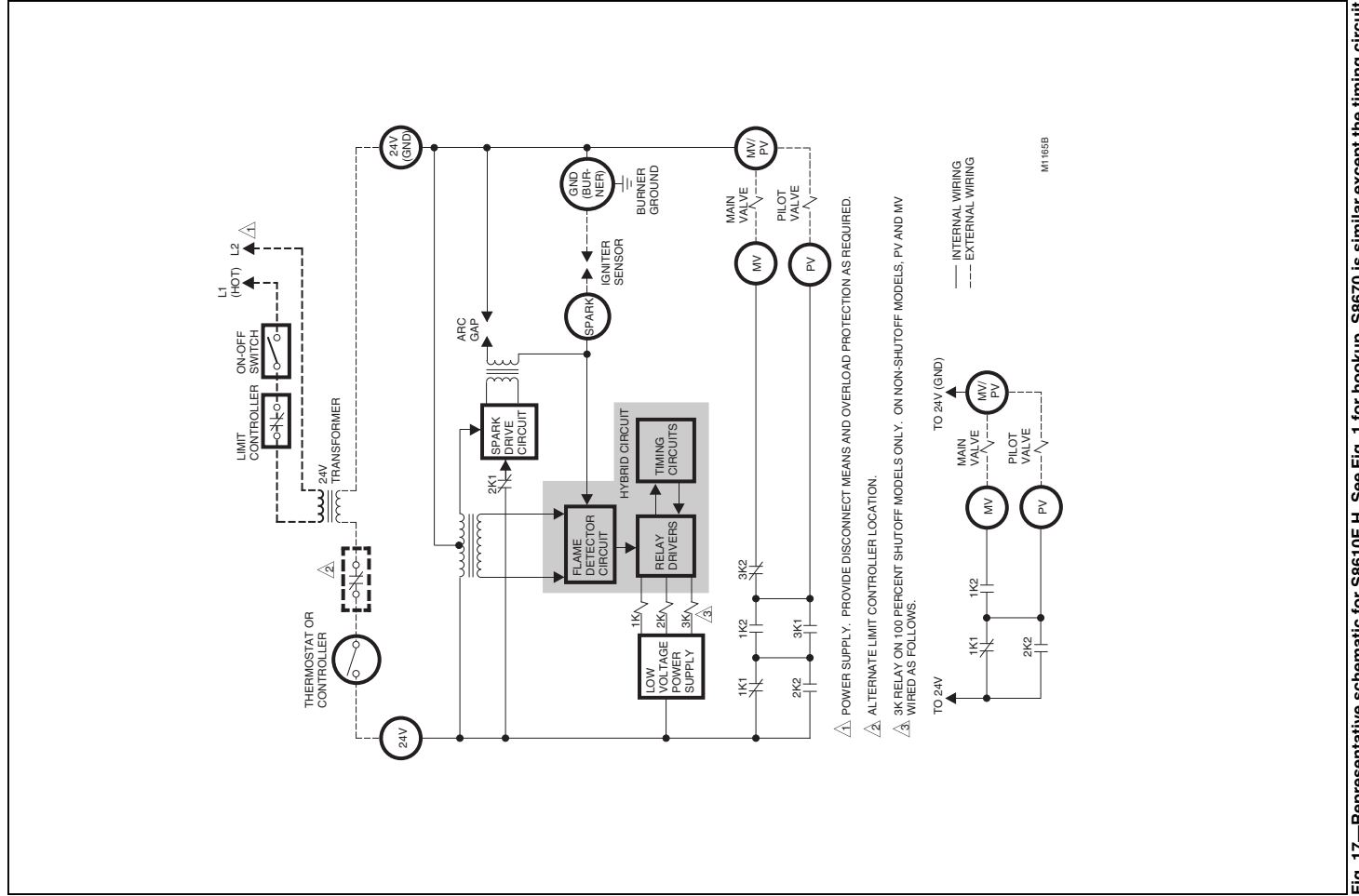


Fig. 17—Representative schematic for S8610F.H. See Fig. 1 for hookup. S8670 is similar except the timing circuit includes a purge timer. See Fig. 6 for hookup.

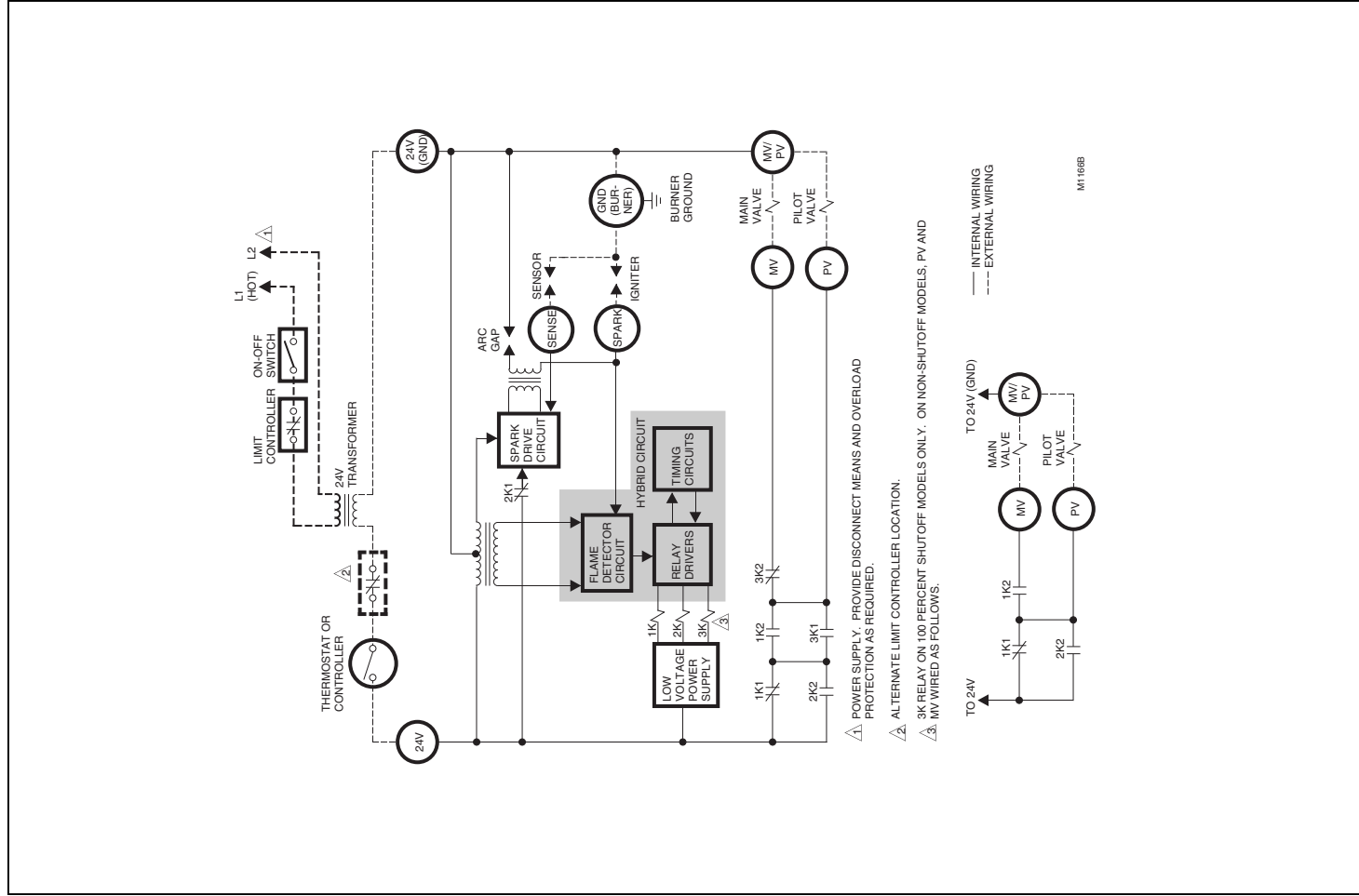


Fig. 18—Representative schematic for S8610A,B. See Fig. 3 for hookup.

EXHIBIT A

RECOMMENDED PROCEDURE FOR SAFETY INSPECTION OF AN EXISTING APPLIANCE INSTALLATION AS A PRELIMINARY STEP TO APPLYING AN AUTOMATIC INTERMITTENT PILOT SYSTEM

- The following procedure is intended as a guide to aid in determining that an appliance is properly installed and is in a safe condition for continuing use.
- This procedure is predicated on central furnace and boiler installations equipped with an atmospheric gas burner(s) and not of the direct vent type. It should be recognized that generalized test procedures cannot anticipate all situations. Accordingly, in some cases, deviation from this procedure may be necessary to determine safe operation of the equipment.
- This procedure should be performed prior to any attempt at modification of the appliance or the installation.
 - If it is determined there is a condition which could result in unsafe operation, the appliance should be shut off and the owner advised of the unsafe condition.
- The following steps should be followed in making the safety inspection:
- Conduct a Gas Leakage Test of the appliance piping and control system downstream of the shutoff valve in the supply line to the appliance.
 - Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restrictions, leakage or corrosion or other deficiencies which could cause an unsafe condition.
 - Shut off all gas to the appliance and shut off any other fuel-burning appliance within the same room. Use the shutoff valve in the shutoff valve in the supply line to each appliance.
 - Inspect burners and crossovers for blockage and corrosion.
 - Applicable only to warm air heating appliances. Inspect heat exchangers for cracks, openings or excessive corrosion.
 - Applicable only to boilers. Inspect for evidence of water or combustion product leaks.
 - Insofar as is practical, close all building doors and windows and all doors between the space in which the appliance is located and other spaces of the building. Turn on clothes dryers. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers. If, after completing steps 7 through 12, it is believed sufficient combustion air is not available, refer to 1.3.4 of the National Fuel Gas Code (Z223.1) for guidance.
 - Place in operation the appliances being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.
 - Determine that the pilot is burning properly and that main burner ignition is satisfactory by interrupting and re-establishing the electrical supply to the appliance in any convenient manner.
 - Determine manifold pressure in order to match input after the new control is installed.
 - Visually determine that main burner gas is burning properly; i.e., no floating, lifting or flashback. Adjust the primary air shutter(s) as required.
 - If appliance is equipped with high and low flame control or flame modulation, check for proper main burner operation at low flame.
- Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use a draft gauge, the flame of a match or candle, or smoke from a cigarette, cigar or pipe.
 - Return doors, windows, exhaust fans, fireplace dampers and all other fuel-burning appliances to their previous conditions of use.
 - Applicable only to warm air heating appliances. Check both limit controller and fan controller for proper operation. Limit controller operation can be checked by temporarily disconnecting the electrical supply to the blower motor and determining that the limit control acts to shut off the main burner gas.
 - Applicable only to boilers:
 - Determine that the circulating water pumps are in operating condition.
 - Test low water cutoffs, automatic feed controls, pressure and temperature limit controls and relief valves in accordance with the manufacturer's recommendations and instructions to determine they are in operating condition.

EXHIBIT A OF ANSI STANDARD Z21.71 FOR AUTOMATIC INTERMITTENT PILOT IGNITION SYSTEMS FOR FIELD INSTALLATION

EXHIBIT B

PROCEDURE FOR INSTALLING AUTOMATIC INTERMITTENT PILOT SYSTEMS

- Prior to beginning this procedure, a preliminary examination of the appliance and the automatic intermittent pilot system should be made to determine that the automatic intermittent pilot system can be properly applied to the appliance.
- This procedure is intended as a guide to aid in safely installing a listed automatic intermittent pilot system on an existing listed appliance equipped with an atmospheric gas burner(s) and not of the direct vent type.
- This procedure is based on the assumption that the history of the specific installation has been one of safe and satisfactory operation.
- This procedure is predicated on central furnace and boiler installations, and it should be recognized that generalized procedures cannot anticipate all situations. Accordingly, in some cases, deviation from this procedure may be necessary to determine safe operation of the equipment.
- The following steps should be followed in making the modifications:
- Perform a safety inspection of the existing appliance installation. See Exhibit A for a recommended procedure for such a safety inspection.
 - Shut off all gas and electricity to the appliance. To shut off gas, use the shutoff valve in the supply line to the appliance. Do not use the shutoff valve which is provided as part of a combination control.
 - Install the automatic intermittent pilot system in strict accordance with the manufacturer's installation instructions.
 - Turn on all gas and electricity to the appliance.
 - Determine that the appliance transformer has adequate capacity by following the steps outlined below:
 - Compute the approximate current draw by adding the current draw of the automatic intermittent pilot system to (1) the current draw of the associated valving, and (2) the current draw of any relays or other devices operated by the transformer.
 - Multiply the total current draw as computed above by 24 V to determine the total VA (volt-ampere) required.
 - The total VA (volt-ampere) required should be equal to or less than the VA rating of the transformer.
 - If the total VA (volt-ampere) required is greater than the VA rating of the transformer, the transformer must be replaced with a Class 2 transformer of adequate rating.
 - Check the heat anticipator in the comfort thermostat to determine if it is properly adjusted to the current draw of the control system. Follow the thermostat manufacturer's instructions.

- Make certain wiring connections are tight and wires are positioned and secured so they will not be able to contact high temperature locations.
- Conduct a Gas Leakage Test of the appliance piping and control system downstream of the shutoff valve in the supply line to the appliance.
- Adjust the thermostat to its highest temperature setting, and test manifold pressure and adjust the pressure regulator to match original input as required (refer to Exhibit A, step 9b).
- Visually determine that main burner is burning properly; i.e., no floating, lifting or flashback. Adjust the primary air shutter(s) as required.
- If the appliance is equipped with high and low flame control or flame modulation, check for proper main burner operation at both high and low flame.
- Determine that the pilot is igniting and burning properly and that main burner ignition is satisfactory by interrupting and re-establishing the electrical supply to the appliance in any convenient manner. Make this determination with the appliance burner both cold and hot. Perform this step as many times as is necessary to satisfy yourself that the automatic intermittent pilot system is operating properly.
- Test the pilot safety device (1) to determine if it is operating properly, and (2) for shutdown characteristics according to the manufacturer's installation instructions. No adjustments should be made other than those recommended by the system manufacturer.
- Sequence the appliance through at least three operating cycles.
- Applicable only to furnaces. Check both the limit controller and the fan controller for proper operation. Limit control operation can be checked by blocking the circulating air inlet or temporarily disconnecting the electrical supply to the blower motor and determining that the limit controller acts to shut off the main burner gas.
- Applicable only to boilers.
 - Determine that the circulating water pumps are in operating condition.
 - Test low water cutoffs, automatic feed water controls, pressure and temperature limit controllers and relief valves in accordance with the manufacturer's recommendation to determine they are in operating condition.
- Add the labels (see 1.6.1-n and -o) on the appliance.

EXHIBIT B OF ANSI STANDARD Z21.71 FOR AUTOMATIC INTERMITTENT PILOT IGNITION SYSTEMS FOR FIELD INSTALLATION.

Q345A, Q348A, Q348B, Q362A, Q373A and Q381A Pilot Burner/Igniter-Sensors

Application

These pilot burner/igniter-sensors provide pilot flame ignition and sensing in intermittent pilot systems. They consist of a target type pilot burner with a combination spark igniter and flame sensor mounted in place of the thermocouple.

Installation

WHEN INSTALLING THIS PRODUCT...

1. Read these instructions carefully. Failure to follow instructions can damage product or cause a hazardous condition.
2. Check ratings given in instructions and on product to make sure product is suitable for your application.
3. Make sure installer is a trained, experienced service technician.
4. After completing installation, use these instructions to check out product operation.



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

Follow these warnings exactly:

1. Disconnect power supply before wiring to prevent electrical shock or equipment damage.
2. To avoid dangerous accumulation of fuel gas, turn off gas supply at appliance service valve before starting installation and perform Gas Leak Test after completion of installation.
3. Do not bend pilot tubing at the control or pilot after compression nut has been tightened. Gas leakage at the connection may result.

Follow appliance manufacturer instructions if available; otherwise, use instructions provided below.

LOCATION

1. Position pilot burner/igniter-sensor for easy access and observation. In replacement applications, replace pilot burner/igniter-sensor with an identical unit and position new pilot burner/igniter-sensor in the same location and orientation as the original one.

Fig. 1—Mount pilot burner/igniter-sensor on main burner.

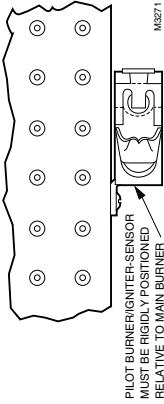
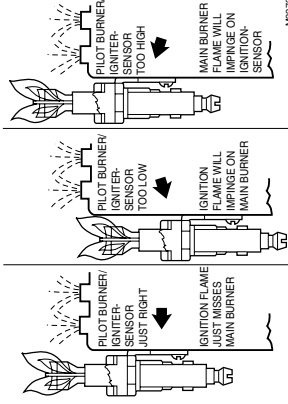


Fig. 2—Location of pilot burner/igniter-sensor.



2. Mount pilot burner/igniter-sensor on main burner. Mounting surfaces other than the main burner may shift, bend, or warp as furnace expands and contracts while operating. See Fig. 1.
3. Mount pilot burner/igniter-sensor so the pilot flame remains properly positioned with respect to the main burner flame. See Fig. 2.
4. Supply pilot flame with ample air free of combustion products.
5. Do not impinge pilot flame on adjacent parts. Do not impinge main burner flame on pilot burner/igniter-sensor.
6. Do not expose pilot flame to falling scale, which could impair main burner ignition.
7. Do not expose pilot burner/igniter-sensor to main burner rollout while igniting or extinguishing.
8. Do not expose pilot flame to drafts that push or pull pilot flame away from the igniter-sensor.

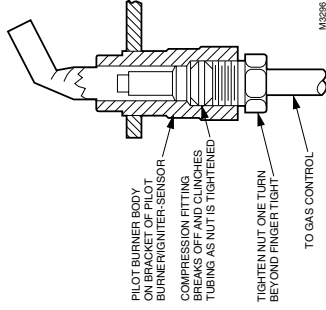
NOTE: The Q381A Pilot Burner/Igniter-Sensor is for horizontal mounting only. Mounting bracket must remain vertical.

CONNECT PILOT GAS TUBING

1. Cut tubing to desired length and bend as necessary for routing to pilot burner/igniter-sensor. Do not make sharp bends or deform tubing. Do not bend tubing at control after compression nut has been tightened because this can result in gas leakage at connection.
2. Square off and remove burrs from end of tubing.
3. Push tubing into compression nut clearance hole until tubing bottoms.

NOTE: When replacing a control, cut off old compression fitting and replace with new compression fitting provided with new pilot burner. Never use old compression fitting because it may not provide a gas-tight seal. See Fig. 3.

Fig. 3—Always use new compression fitting.



4. While holding tubing all the way in, engage threads and turn until finger tight.
5. Using a wrench, turn compression nut one turn beyond finger tight. Do not overtighten.
6. Connect other end of tubing to gas control according to gas control manufacturer instructions.

WIRE IGNITER-SENSOR

The igniter-sensor must be mounted on the burner. Connect the control module ground wire to one of the igniter-sensor mounting screws to complete the system grounding.

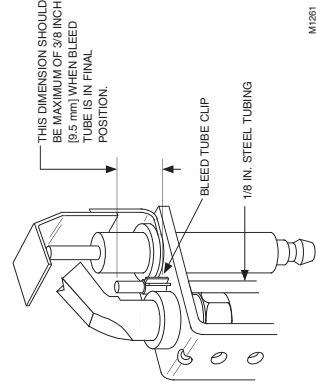
- Connect ground wire as follows:
1. Use 221° F [105° C] minimum thermoplastic-insulated wire for the ground leadwire (asbestos insulation is not acceptable).
 2. A male 1/4 in. [6 mm] quick-connect terminal is provided on Honeywell ignition modules. Fasten female quick-connect to wire end at ignition module.
 3. Strip other end and fasten under igniter-sensor mounting screw.
 4. If necessary, use shield to protect lead from radiant heat of burner.
 5. The pilot burner serves as the grounding area for the flame signal. Run lead from pilot burner to the common ground selected.
- Connect the ignition cable as follows:
1. The high tension ignition cable must conform to applicable local or national standards.

2. Connect one end of the ignition cable to stud terminal on igniter-sensor using 1/4 in. [6 mm] diameter snap-spring or cage-clips on cable ends.
3. Connect the other end of the ignition cable to the igniter terminal on ignition module.
4. Use ceramic or plastic standoff insulators as necessary to prevent cable from contacting metal surfaces.

INSTALL BLEED GAS TUBE (optional)

1. Route bleed tube from bleed tap on gas control to the pilot burner/igniter-sensor.
2. Push clip into place. See Fig. 4.
3. Insert bleed gas tube until 3/8 in. [10 mm] to tubing is above pilot burner/igniter-sensor bracket. Tip of bleed gas tube must not extend into pilot flame.

Fig. 4—Install bleed gas tube.



Startup and Checkout

PERFORM GAS LEAK TEST



WARNING

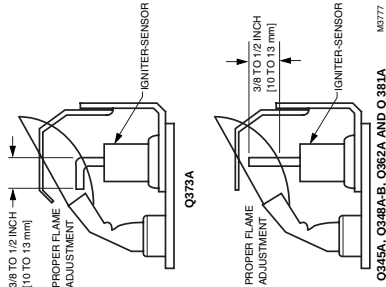
**FIRE OR EXPLOSION HAZARD
CAN CAUSE PROPERTY DAMAGE,
SEVERE INJURY, OR DEATH.**

Check for gas leaks with soap and water solution any time work is done on a gas system.

Gas Leak Test:

1. Ensure that gas supply is turned on at the appliance service valve.
2. Paint pipe connections upstream of pilot burner with rich soap and water solution. Bubbles indicate gas leak.
3. If leak is detected, tighten pipe connections.
4. Set thermostat to call for heat to light main burner.
5. With main burner in operation, paint pipe joints (including adapters) and gas control inlet and outlet with rich soap and water solution.
6. If another leak is detected, tighten adapter screws, joints, and pipe connections.
7. Replace part if leak cannot be stopped.

Fig. 5—Igniter-sensor tip must be in pilot flame.



ADJUST PILOT FLAME

The pilot flame should envelop 3/8 to 1/2 in. [10 to 13 mm] of the igniter-sensor tip. See Fig. 5. To adjust pilot flame:

1. Turn off system by setting thermostat below temperature to call for heat.
2. Disconnect lead to MV terminal on gas control.
3. Light pilot by setting thermostat to call for heat.
4. Remove pilot adjustment cover screw from gas control.
5. Turn inner pilot adjustment screw clockwise to decrease or counterclockwise to increase pilot flame.
6. Always replace pilot adjustment cover screw and tighten firmly after completing adjustment to assure proper operation.

Service



WARNING

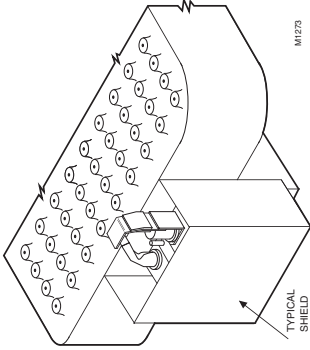
**FIRE OR EXPLOSION HAZARD
CAN CAUSE PROPERTY DAMAGE,
SEVERE INJURY, OR DEATH.**

Perform Gas Leak Test anytime work is done to the system.

PILOT OUTAGE

1. If pilot flame goes out during ignition, but is properly adjusted, recheck mounting and location instructions in Location section.
2. Refer to ignition module instructions to check wiring between igniter-sensor and ignition module or between gas control and ignition module.
3. If all mounting and location instructions are followed but pilot continues to go out, construct shielding to protect pilot flame from main burner ignition and extinction and drafts. See Fig. 6.
4. Check pilot and main burner lighthoff.

Fig. 6—Proper shielding of pilot flame.



- ☐ Set the thermostat to call for heat.
- ☐ Watch the pilot burner during the ignition sequence. See if:

- Ignition spark continues after the pilot is lit.
- The pilot lights and the spark stops, but main burner does not light.
- S8600B,H; S86H only: The pilot lights, the spark stops and main burner lights, but the system locks out.

- ☐ If so, assure adequate flame current as follows:

- Turn off furnace at circuit breaker or fuse box.
- Clean the flame rod with emery cloth.
- Make sure electrical connections are clean and tight.
- Replace damaged wire with moisture-resistant no. 18 wire rated for continuous duty up to 221° F [105° C].
- Check for cracked ceramic insulator, which can cause short to ground, and replace pilot burner/igniter-sensor if necessary.
- At the gas control, disconnect main valve wire from the TH or MV terminal.
- Turn on power and set thermostat to call for heat. The pilot should light but the main burner will remain off because the main valve actuator is disconnected.

- Check the pilot flame. Make sure it is blue, steady and envelops 3/8 to 1/2 in. [10 to 13 mm] of the flame rod. See Fig. 7 for possible flame problems and their causes.
- If necessary, adjust pilot flame by turning the pilot adjustment screw on the gas control clockwise to decrease or counterclockwise to increase pilot flame. After adjustment, always replace pilot adjustment cover screw and tighten firmly to assure proper gas control operation.
- Set thermostat below room temperature to end call for heat.

- ☐ Recheck ignition sequence as follows:

- Reconnect main valve wire.
- Set thermostat to call for heat.
- Watch ignition sequence at burner.
- If spark still does not stop after pilot lights, replace ignition module.
- If main burner does not light or if main burner lights but system locks out, check module, ground wire, and gas control as described in control module instructions.

Fig. 7—Example of unsatisfactory pilot flames.

APPEARANCE	APPEARANCE	CAUSE
SMALL BLUE FLAME	SMALL BLUE FLAME	CHECK FOR LACK OF GAS FROM: • CLOGGED ORIFICE FILTER • CLOGGED PILOT FILTER • LOW GAS SUPPLY PRESSURE • PILOT ADJUSTMENT AT MINIMUM
LAZY YELLOW FLAME	LAZY YELLOW FLAME	CHECK FOR LACK OF AIR FROM: • DIRTY ORIFICE • DIRTY LINT SCREEN, IF USED • DIRTY PRIMARY AIR OPENING, IF THERE IS ONE • PILOT ADJUSTMENT AT MINIMUM
WAVING BLUE FLAME	WAVING BLUE FLAME	CHECK FOR: • EXCESSIVE DRAFT AT PILOT LOCATION • RECIRCULATING PRODUCTS OF COMBUSTION
NOISY LIFTING BLOWING FLAME	NOISY LIFTING BLOWING FLAME	CHECK FOR: • HIGH GAS PRESSURE
HARD SHARP FLAME	HARD SHARP FLAME	THIS FLAME IS CHARACTERISTIC OF MANUFACTURED GAS
		CHECK FOR: • HIGH GAS PRESSURE • ORIFICE TOO SMALL

M277B

CHECK IGNITION CABLE

1. Assume that ignition cable is not in contact with metal surfaces.
2. Assume that ignition cable is not more than 3 feet [1 m] long.
3. Assume connections to the ignition module stud terminal and the igniter-sensor are clean and tight.
4. Check electrical continuity of ignition cable.

CHECK GROUNDING

1. If ground is poor or erratic, safety shutdown will occur. Therefore, if nuisance shutdowns are reported, check the ground precautions in Wire Igniter-Sensor section.

2. If leadwire is damaged or deteriorated, use no. 14 to 18 gauge, moisture-resistant, thermoplastic, insulated wire with 221° F [105° C] minimum rating as replacement.

3. Excessive temperature at the ceramic flame rod insulator will permit electrical leakage to ground.

- a. If bracket is bent, bend it back to correct position.
- b. If insulator is cracked, replace pilot burner/igniter-sensor.

TEST SAFETY LOCKOUT

Refer to appliance manufacturer instructions to test for proper safety lockout times.

Honeywell

Helping You Control Your World

Home and Building Control
Honeywell Inc.
1985 Douglas Drive North
Golden Valley, Minnesota 55422

Home and Building Control
Honeywell Limited—Honeywell Limitée
740 Ellesmere Road
Scarborough, Ontario
M1P 2Y9



Printed in U.S.A.



GENERAL

The Model IFS is a flow switch used in liquid flow lines carrying water or any fluid not harmful to brass, stainless steel, EPDM or fluorosilicone, and not classified as a hazardous fluid.

This switch can serve as a way to start and stop electrically operated equipment when a flow or no flow condition occurs in a variety of applications.

This device is designed for use only as an operating control. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety, limit controls) that protect against, or systems (alarm, supervisory systems) that warn of control failure.

- Listings/Approvals:**
- UL Guide (NKPZ) for industrial control equipment per UL Standard 508 Industrial Control Equipment
 - UL Guide (MFHX) for heating/cooling appliance switch per UL Standard 353 Limit Controls
 - CSA Class (321106) for industrial control equipment per CSA Standard C22.2 No. 14-M Industrial Control Equipment
- Maximum Service Pressure:** 250 PSI
- Enclosure:**
NEMA Type 1 (For indoor use only)
Formed sheet metal with powdercoat finish.
Not for use in hazardous locations.

Contacts:

IFSH1: One SPDT (Form C) switch
IFSH2: Two sets of SPDT (Form C) switches to provide versatility in wiring two separate circuits.

15 Amps at 125/250VAC	
25 Amps at 125VDC	
25 Amps at 250VDC	
Motor Ratings : 120VAC	240VAC
Horsepower : 1/8	1/4
AC F.L.A. : 3.8	2.9
AC L.R.A. : 22.8	17.4
Pilot Duty Rating : 125 VA	120/240 VAC

IFSH1/2 Contacts:

IFSH1: One SPDT (Form C) switch
IFSH2: Two sets of SPDT (Form C) switches to provide versatility in wiring two separate circuits.

22 Amps at 125/250VAC	
Motor Ratings : 120VAC	240VAC
Horsepower : 1/2	1
AC F.L.A. : 9.8	8.0
AC L.R.A. : 58.8	48.0
Pilot Duty Rating : 125 VA	120/240 VAC

Ambient Temperature Range:
32°F/176°F (0°C/80°C)

Media Temperature Range:
32°F/250°F (0°C/121°C)

Pipe Connections:
1" NPT Brass on models IFSxxB
1" NPT 316 Stainless Steel on models IFSxxS

Conduit Entrance: Two openings for 1/2" conduit
Usage: For pipe sizes 1" - 8"
Caution: This device is not intended for applications in explosive environments.
Note: IFSW Series available with NEMA 4 enclosure for outdoor use. (See bulletins #102-026 & #102-027 or Catalog 100-8.2).

MOUNTING AND INSTALLATION

The Model IFS may be mounted in a horizontal pipe line or a vertical pipe line with upward liquid flow. It is not recommended for installations where flow is downward. When mounted in a horizontal pipe line the switch will trip at a lower flow rate than shown in Fig. 7.

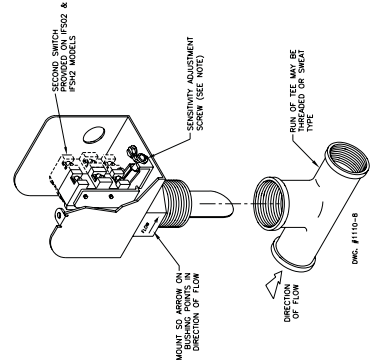
Mount the device in a section of pipe where there is a straight run of at least 5 pipe diameters on each side of the flow switch. Do not locate adjacent to valves, elbows or orifices. The switch should be mounted so the terminals or wire leads are easily accessible for wiring.

IFS models with flexible paddles are furnished with 4 paddles. Rigid paddle models are furnished with 2 paddles. For pipe sizes 1", 2", 3" or 6", use the paddles provided. Intermediate sizes may be trimmed from the appropriate paddle using the paddle template in Fig. 5. The paddle must not touch the inside of the pipe or bind in any way. Paddles smaller than the actual pipe size should be used for added support and higher sensitivity, see Fig. 3. The paddles must be properly attached and the screw that holds the paddle must be securely tightened.

For a 1" pipe application mount in a standard 1" x 1" x 1" tee. Use a reducing tee for larger sizes of pipe to keep flow switch close to pipe and provide adequate paddle length in the flow stream.

Example: Use a 2" x 2" x 1" tee for 2" pipe. A weldolet may also be used. Screw the device into the tee fitting as shown in Fig. 4. The flat of the paddle must be at a right angle to the flow. The arrow on the side of the bushing must point in the direction of flow, see Fig. 1.

FIG. 1



Sensitivity Adjustment Note:

Turn screw clockwise to increase the flow rate required to activate the switch.
Turn screw counter-clockwise to decrease the flow rate required to activate the switch.

FIG. 2

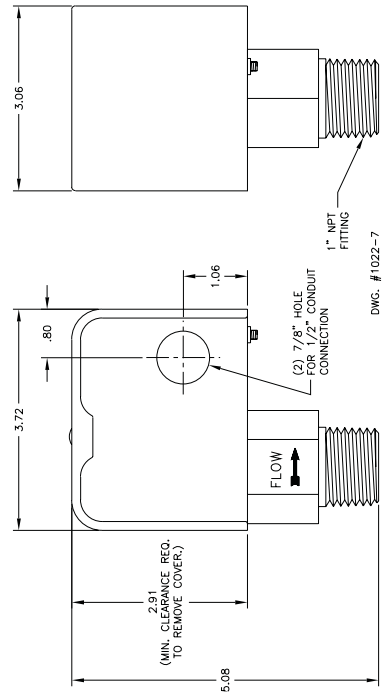
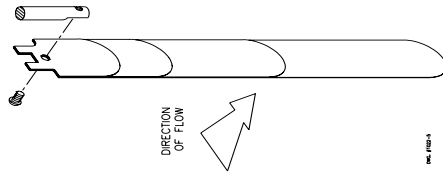


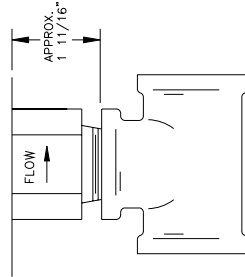
FIG. 3

Typical paddle arrangement for 6" to 8" pipe, using smaller flexible paddles for added support and higher sensitivity.



DWG. # 1022-3

FIG. 4



DWG. # 1022-3

CAUTION:

Screw the device into the TEE fitting as shown. Care must be taken to properly orient the device for the direction of the flow. Do not tighten by grasping the switch enclosure. Use the wrenching flats on the bushing only. Turning radius required for mounting the IFS is 3".

FIG. 5

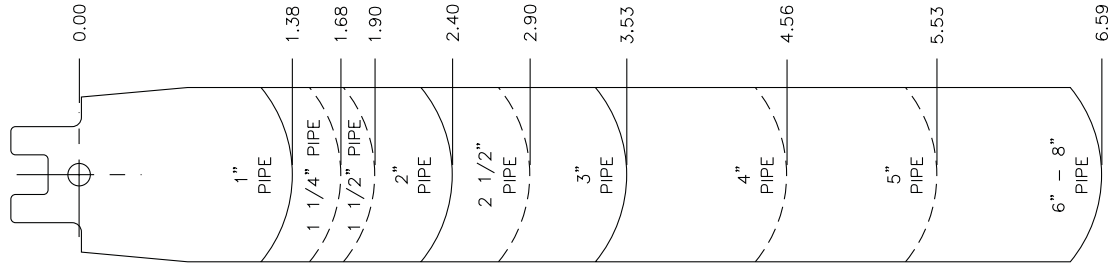
Use the drawing at right as a template and trim at the dotted arc when trimming the appropriate paddle for intermediate pipe sizes.

CAUTION:

The paddle must not touch the inside of the pipe or bind in any way.

NOTE:

When installing **rigid paddles**, do not stack paddles. Only install **ONE** paddle that best fits the pipe.



DWG. # 1022-6

WIRING

Use properly rated temperature supply wire for the anticipated service temperature.

Make all electrical connections in accordance with the National Electrical Code and local regulations.

See Figs. 6A and 6B for diagrams illustrating switch action.

ADJUSTMENT

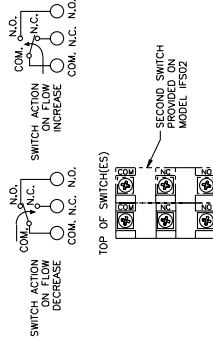
Remove switch cover and turn the sensitivity adjusting screw clockwise to increase the flow

rate required to actuate the switch. Turn the sensitivity adjusting screw counter-clockwise to decrease the flow rate required to actuate the switch. (See Fig. 1.) Be sure to replace the cover upon completion of the installation and adjustment.

CAUTION: Check the installation for "no-flow" switch operation. Make appropriate adjustments to the sensitivity adjustment screw to be sure the switch restores fully at the desired flow rate.

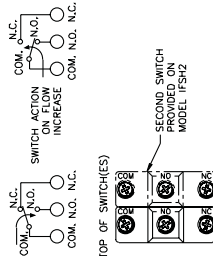
**IFS01 / IFS02
SWITCH INFORMATION**

FIG. 6A



**IFS01 / IFS02
SWITCH INFORMATION**

FIG. 6B



DWG. # 1022-2

FIG. 7

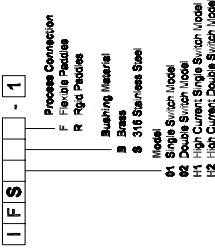
SPECIFICATIONS									
Typical Flow Rates - GPM Required to Actuate Switch (For various pipe installations)									
Pipe Size (inches)	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6
Flow Increase	4.5	4.5	6	7.5	13.5	18	35	50	70
Flow Decrease	3.5	3.5	5	6.5	9.5	13	25	40	60
Flow Increase	8.5	10	13.5	20	29	50	70	100	180
Flow Decrease	7	8.5	10.5	16.5	26	45	65	105	160

NOTES:

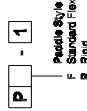
1. Typical flow rates for 1" to 1 1/2" pipe sizes are averages which may vary approximately ± 1 GPM with the use of a bronze reducing tee.
2. Typical flow rates for 2" to 8" pipe sizes are averages which may vary $\pm 10\%$ with the use of a 1" weldolet.

(*) Flow rates for these sizes are calculated.

IFS Ordering



Paddle Kit Only Ordering



Do it Once. Do it Right.

TACO, INC., 1160 Christie Street, Cranston, RI 02906 Telephone: (401) 945-4600 FAX: (401) 945-2960
TACO Canada Ltd., 6180 Ordan Drive, Mississauga, Ontario L5T 2B3 Telephone: 905/564-4422 FAX: 905/564-4436
Manufactured by POTTER ELECTRIC SIGNAL CO., St. Louis, MO
Visit our web site at: <http://www.taco-hvac.com>

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Unitrol 7000



Design Features

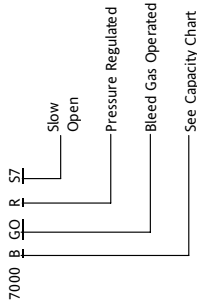
- Sequentially Controlled Lighting
- Soft Ignition
- Built in bleed gas and pilot filters
- Built in self protection
- Field replaceable electro-magnet in gas atmosphere
- Compact size
- AGA, CGA and British Gas Certified

REGULATION CAPACITIES BTU-HR NAT. GAS		
	MAX.	MIN.
7000 AGOR	118,000	11,800
7000 BGOR	360,000	100,000

The Unitrol 7000 GO (Gas-Operated) series controls are bleed gas controlled diaphragm valves. The diaphragm valve provides ON and OFF operation in response to the opening and closing of the external bleed line by a thermostatic bleed line valve, such as Invensys' Model GS depicted in the schematic drawing.

The Gas-Operated models of the Unitrol 7000 combine a manual main and pilot gas valve, a separate automatic safety pilot valve, pilot adjustment valve, pilot and bleed gas filtration, and a diaphragm valve as described above. The regulated models of the Unitrol 7000 series have the additional feature of "straight line" gas pressure regulation.

TYPICAL MODEL CODE DESIGNATIONS



1" P.D. CAPACITY - B. T. U. PER HOUR

Control	Size	Type of Gas	
		Nat	LP
7000 AGO	1/2 x 1/2	100,000	162,000
7000 BGO	3/4 x 3/4	305,000	494,000

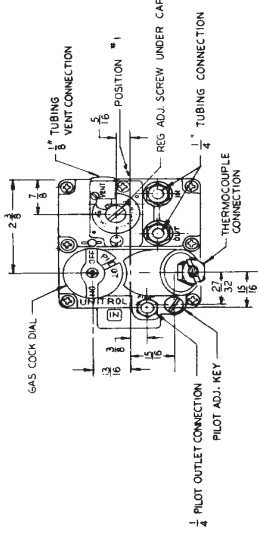
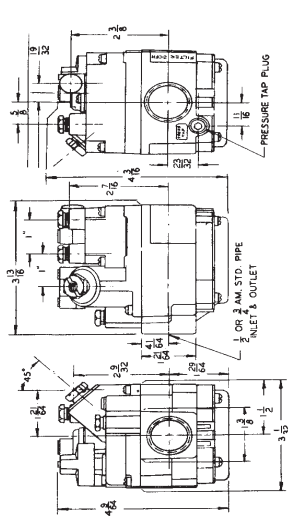
REGULATION CAPACITIES BTU-HR NAT. GAS		
	MAX.	MIN.
7000 AGOR	118,000	11,800
7000 BGOR	360,000	100,000

Refer to appliance manufacturer's instructions for proper system operation.

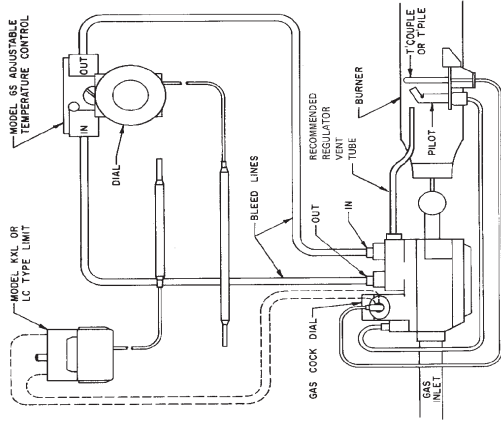
The 7000 "D" series controls contain dual automatic valves (solenoid and diaphragm) in accordance with ANSI standards. These valves are for use in a 24VAC system for either direct ignition or pilot ignition systems.

PILOT BURNER ADJUSTMENT

- 1 Remove the pilot adjustment cap (do not lose the gasket).
- 2 Adjust the pilot key to provide proper flame.
- 3 Re-assemble the gasket and cap.
- 4 Leak test per warning note 13.



SCHEMATIC SKETCH SHOWS ARRANGEMENT OF THERMOSTATS AND UNITROL 7000BGO IN TYPICAL FRYER APPLICATION



WARNING!

- 1 Installation and servicing of gas appliances and controls must only be performed by qualified personnel. After installation or servicing, test manual valve, operating valves, pressure regulation, and automatic safety shutt off valve for proper operation.
- 2 DO NOT use this control if it has been exposed to water corrosion through immersion, dripping, etc. It may be damaged and must be replaced.
- 3 Shut off gas and electricity before starting installation or service. Turn back on to test or operate.
- 4 DO NOT connect appliance before pressure testing gas piping. Damage to gas valve may result.
- 5 DO NOT insert any object other than suitable pipe or tubing in the inlet or outlet of the gas valve. Internal damage may occur and result in a hazardous condition.
- 6 DO NOT grip gas valve body with a pipe wrench or vise. Damage may result causing gas leakage. Use inlet or outlet bosses or a special body wrench.
- 7 DO NOT short the gas valve terminals. The thermostat or the fuse will be damaged.
- 8 DO NOT allow any flame to impinge on the regulator vent tubing if supplied. It may clog and cause gas valve malfunction.
- 9 DO NOT use the gas cock to adjust gas flow.
- 10 In case of failure of main burner to shut off, turn off gas supply. Allow fan, if so equipped, to run until heating unit has cooled off.
- 11 Keep all combustible materials away from gas appliances. DO NOT allow lint or dust to collect in burner area.
- 12 Dials must only be operated by hand. Never use pliers, wrench or other tools to turn dials.
- 13 Leas test with soap solution after installation or service with the main burner on. Coat pipe and tubing joints, gaskets, etc. Bubbles indicate leaks

L4008A,B,E,L; L6008A,G,H AquaStat® Controllers

INSTALLATION INSTRUCTIONS

L6008G—is used as a 2-stage AquaStat® controller to cycle 2-stage gas valve.
L6008H—is used as a low fire AquaStat® controller.

If immersion well or capillary compression fitting must be ordered, refer to form 88-0040, Wells and Fittings for Temperature Controllers, for part numbers and ordering information.

INSTALLATION

When Installing this Product...

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

CAUTION

Disconnect power supply before installation to prevent electrical shock or equipment damage.

Depending on model and installation requirements, install the temperature sensing bulb either in an immersion well (see Fig. 2) that extends into the boiler or tank, or directly immerse the temperature sensing bulb in the liquid. For installations not using a well, secure the bulb with a bulb compression fitting (see Fig. 3), or a capillary compression fitting (see Fig. 4). Order the well or the fitting separately.

The boiler manufacturer generally provides a tapping for inserting the AquaStat® controller sensing element. Locate this tapping in a representative point where typical water temperature can be measured. Never locate the bulb or protecting immersion well close to a hot or cold water inlet or steam coil. Install the bulb in the supply line of an indirect water heater, in the indirect water heater itself, or in the feed riser about 6 in. (152 mm) above the boiler. If the riser is installed, install the bulb between the boiler and the valve.

APPLICATION

These remote bulb (see Fig. 7), immersion type (see Fig. 1) controllers operate in response to temperature changes in hydronic heating systems and other heated liquids.

Electrical Ratings:
Switch ratings are shown on the inside cover of each device. The electrical requirements on controlled equipment must not exceed this rating.

L4008A—breaks the burner circuit on a rise in water temperature. It is normally used as a limit controller, separate high limit control must be used.

L4008B—makes a control circuit on a rise in water temperature. It is normally used as a circulator controller to prevent circulator operation until boiler water temperature is at or above the control setting.

L4008E—breaks the burner circuit and locks out on a rise in water temperature. It is used as a high limit controller where manual reset is desirable.

L4008L—is used as a 2-stage AquaStat® controller.
L6008A—makes the burner circuit on a drop in water temperature. It is normally used as a circulator and low limit cooling controller.

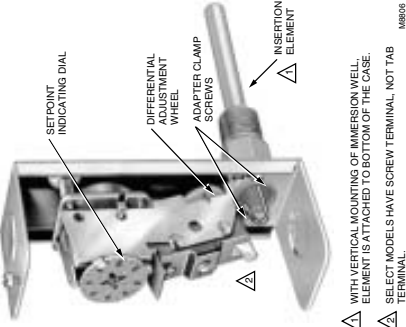


Fig. 1. Internal view.

- △ WITH VERTICAL MOUNTING OF IMMERSION WELL, ELEMENT IS ATTACHED TO BOTTOM OF THE CASE.
- △ SELECT MODELS HAVE SCREW TERMINAL, NOT TAB TERMINAL.

The AquaStat® controller can be remotely mounted—either vertically on a wall or panel, or directly on the boiler, tank, or vessel.

If the system is filled, drain the system to a point below the boiler tapping, or to wherever the sensing bulb is to be installed.

Mounting the Case

1. Remove the cover and fasten the case to the wall or panel using the three mounting holes in the back of the case.
2. When mounting the remote bulb, if desirable, route the tubing to run through any of the other three corner notches in the case. Be careful not to kink or bend tubing sharply. Be sure bends have at least 1 in. (25.4 mm) radius.

Installing Remote Bulb with Immersion Well

Fit well, if used, to sensing bulb snugly for good thermal response. Insert bulb until it rests against the bottom of the well; then hold it there while tightening the tubing clamp.

1. Screw the well into the boiler, tank or pipe tapping.
2. Insert the bulb into the well, pushing the tubing until the bulb bottoms in the well.
3. Attach the retainer clamp to the end of the well spud. Loosen the draw nut and spread the jaws of the clamp with the screwdriver if necessary.
4. With the retainer clamp attached to the well spud (be sure jaws of clamp hook over ridge at end of the spud, as shown in Fig. 2, points A), adjust tubing to fit through retainer clamp groove, as shown at point B.
5. Tighten the draw nut so the retainer clamp is firmly attached to the well spud and the tubing is held by the clamp.

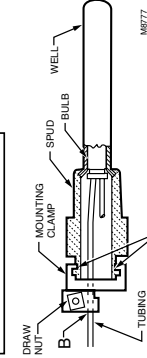
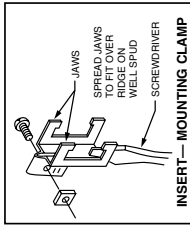


Fig. 2. Immersion well fitting.

IMPORTANT
Do not secure draw nut so tightly that retainer clamp could cut or collapse tubing.

Mounting with Bulb Compression Fitting

1. Screw the fitting into the boiler or pipe tapping.
2. Slide sealing washer onto the bulb.
3. Insert the bulb into the fitting until bulb bottoms.
4. Slide split sleeve into fitting.
5. Place clamps A and B on assembly so that sleeve is drawn into fitting when screws are tightened.

NOTE: Make sure that the nub on clamp A engages space between sleeve and clamp.

6. Tighten clamp screws evenly.

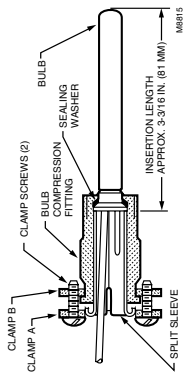


Fig. 3. Bulb compression fitting.

Mounting with Capillary Compression Fitting

1. Screw fitting into the boiler or pipe tapping.
2. Place packing nut on tubing.
3. Slide bulb completely through fitting.
4. Place composition disk and 4 slotted brass washers on tubing in the order shown in Fig. 4. Turn brass washers so that slots are 180 degrees to each other.
5. Slide seal assembly into fitting and tighten packing nut.

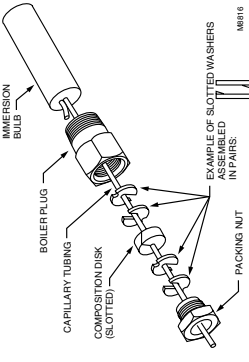
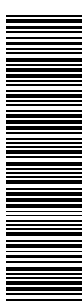


Fig. 4. Capillary compression fitting.

WIRING

All wiring must agree with applicable codes and ordinances and regulations in such matters as wire size, type of insulation, and enclosure. The controllers are provided with conduit knockouts in the top and bottom of case.

Refer to Fig. 5 or 6 for a typical connection diagram.



95-5971-2

SETTING

Control Point:
Insert a screwdriver in the slotted head visible through the cover, and turn the indicating dial to the control point. Temperature settings should be according to boiler manufacturer's recommendations.

Differential (on adjustable differential models):
Remove cover and move the differential adjustment wheel (Fig. 1 or 7) to a point on the scale corresponding to the desired differential. Replace cover.

Manual Reset (L4008E):
After boiler water temperature has dropped to a point below the high limit setting, less differential, the reset button at the front of the case must be pushed before the burner can operate.

ADJUSTMENTS

Adjusting Differential

Set the differential to correspond with the boiler manufacturer recommendations. To adjust models with adjustable differential, rotate the wheel on the back of the snap switch, see Fig. 7, until the desired reading is aligned with the V notch in the frame. The wheel provides as adjustment from 5° to 30°F (3° to 17°C). Replace the cover on the Aquastat® controller.

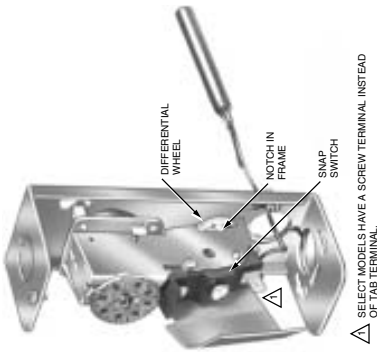


Fig. 7. Adjusting the differential.
Adjust the control point to correspond with the boiler manufacturer recommendations. To adjust, insert a screwdriver in the slotted screw type head located beneath the window in the cover. Turn the scale to the desired control point.

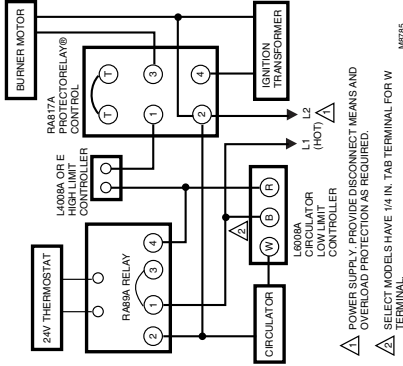
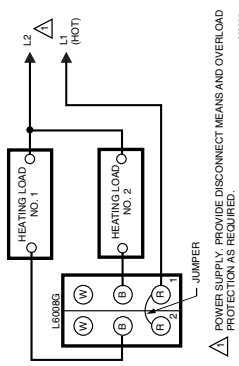
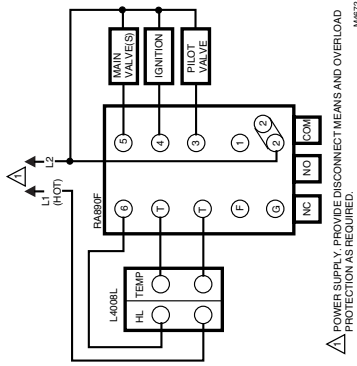


Fig. 5. Typical oil-fired hydronic heating system with domestic hot water.



VR8104, VR8204, and VR8304
Intermittent Pilot Combination
Gas Controls

APPLICATION

These intermittent pilot gas controls are used in gas-fired appliances with up to 415 ft3/hr capacity at 1 in. wc pressure drop (8.5 m3/hr at 0.25 kPa) on natural gas. They include safety shutoff, a manual valve, two automatic operators, a pressure regulator and a pilot adjustment.

INSTALLATION INSTRUCTIONS

These gas controls are available in a range of valve capacities; see Table 1. (Table 2 provides gas capacity conversion factors.) The suffix letter indicates temperature range and regulator type; see Table 3.

For CE-approved models, the relevant sections of these instructions and Table 4 are applicable.

Table 1. Valve Capacity^a

Model	Size Inlet-Outlet (in.)	AGA Certified Capacity for Natural Gas		AGA Certified Minimum Regulation for Natural Gas		AGA Certified Maximum Regulation for Natural Gas	
		ft ³ /hr	m ³ /hr	ft ³ /hr	m ³ /hr	ft ³ /hr	m ³ /hr
VR8104	1/2 x 1/2	85	2.3	10 ^d	0.4	120	3.4
VR8204		150	4.2	20 ^e	0.6	200	5.7
		240	6.8	30 ^f	0.8	340	9.6
VR8304 ^{b,c}	1/2 x 3/4	270	7.6			370	1.05
VR8304 ^{b,c}	3/4 x 3/4	300	8.5			415	11.8

^a Capacity based on 1000 Btu/ft³, 0.64 sp gr natural gas at 1 in. wc pressure drop (37.3 MJ/m³, 0.64 sp gr natural gas at 0.25 kPa pressure drop).

^b Capacity is reduced by 5 percent when using an outlet screen.

^c Valves are guaranteed at only 77 percent of the rating.

^d Minimum regulation for LP gas is 15,000 Btuh.

^e Minimum regulation for LP gas is 40,000 Btuh.

^f Minimum regulation for LP gas is 50,000 Btuh.

Table 2. Gas Capacity Conversion Factor.

Gas	Specific Gravity	Multiply Listed Capacity By
Manufactured	0.60	0.516
Mixed	0.70	0.765
Propane	1.53	1.62

These gas controls are used in appliances up to 121kW or 415 kBtuh on natural gas and approved on EN126, which consists of one automatic safety shutoff valve, Class B or C, one servo-operated shutoff valve, Class D, pressure governor, Class C, manually-operated valve, with or without pilot outlet. Only the A, H and U models are available CE-approved.

Table 4 shows the additional specifications for the CE-only models.



Table 3. Model Number Suffix Letter Designation.

Model No. Suffix Letter	Ambient Temperature Range	Pressure Regulator Type
A	0°F to 175°F (-18°C to +79°C)	Standard
C		Step-opening
H		Slow-opening
U ^a		Nonregulating (on-off)
K	-40°F to +175°F (-40°C to +79°C)	Slow-opening
M		Standard
P		Step-opening
Q		Two-Stage
R		Convertible

^a Available only on CE VR8204 models.

Table 4. VR8204A,H,VR8304A,H,U CE.

Specifications	VR8204A,H (CE Model Only)	VR8304A,H (CE Model Only)
Main valve connections (if NPT, the valves must be serviced by the appliance manufacturer.	1/2 in. ISO, 7/1 internal thread (BSP, NPT).	1/2 in., 3/4 in. ISO, 7/1 internal thread (BSP, PL) or 1/2 in., 3/4 in. NPT.
Valve Classification	B + D	C + D
Capacity (1kW = 3.41BTUH)	29 kW at 2.5 mBar 43 kW at 5.0 mBar	for 1/2 in., 70 kW at 2.5 mBar 99 kW at 5.0 mBar. For 3/4 in., 87 kW at 2.5 mBar; 121 kW at 5.0 mBar.
Supply Voltage	24 Vac, 50/60 Hz.	
Flanges	None.	
Closing time	Less than 1 second.	
Opening Time	Standard opening (A): less than 2 seconds. Slow opening (H): less than 6 seconds. Special fast opening (U): less than 1 second.	
Suited for gas families	2H, 2L, and 3.	
Outlet Press Range (Except unregulated models)	Natural gas: 7.5 to 12.5 mBar (3 to 5 in. wc). Natural gas: 12.5 to 17.5 mBar (5 to 7 in. wc). LP gas: 20 to 30 mBar (8 to 12 in. wc).	
Manually operated valve operations	10,000 cycles for manual valves; 200,000 cycles for automatic valves.	
Ambient temperature range	-20°C to +70°C (-4°F to +158°F).	
Maximum inlet pressure	60 mBar (24 in. wc).	
Screen	Fine mesh on inlet.	
Pilot connection ^a	M11 x 1 for 6 mm outside diameter tube.	
Ground terminal ^a	6.3 mm.	
Pressure taps ^a	9 mm OD for both inlet and outlet.	
Approval	CE-0063AU1215.	

^a The VR8204U uses standard U.S. construction. Inlet and outlet ports are 1/2 in. NPT, and the pilot connection is the standard 7/16 in. thread for a 1/4 in. pilot tube. European-style inlet and outlet pressure taps are available.



CAUTION

Equipment Damage Hazard.
Improper use can damage equipment.
Read the instructions before use. This control must be installed in accordance with the rules in force.

SPECIFICATIONS

Body Pattern: Straight through; see Table 1 for inlet and outlet size.

Electrical Ratings:
Voltage and Frequency: 24 Vac, 60 Hz.
Current Draw: 0.5A with both operators energized.

Capacity: See Table 1.

Conversion: Use conversion factors in Table 2 to convert capacities for other gases.

Regulation Range: See Table 1.

Natural-LP Gas Conversion Kits: See Table 5.

Table 5. Natural-LP Gas Conversion Kits.

Model No. Suffix Letter	Kit to Convert Natural Gas to LP	Kit to Convert LP to Natural Gas
H, K, M	393691	394588
P	Not field convertible.	Not field convertible.
Q	396021	396025
R	Not required, convertible valve.	Not required, convertible valve.

Pipe Adapters:
Angle and straight adapters available for 3/8-, 1/2- and 3/4-in. pipe. See Table 6. Flange kits include one flange with attached O-ring, four mounting screws, a 9/64 in. hex wrench and instructions.

Approvals:
American Gas Association Design Certificate: L2025006.
Canadian Gas Association Design Certificate: L2025006.
Australian Gas Association Design Certificate: 4214.
Approved for Delta C applications.
European Community (CE) Certificate: Pending.

PLANNING THE INSTALLATION



Fire or Explosion Hazard.
Can cause property damage, severe injury, or death.
Follow these warnings exactly:
1. Plan the installation as outlined below.
2. Plan for frequent maintenance as described in the Maintenance section.

Table 6. Flange Adapter Part Numbers.

Inlet/Outlet Pipe Size (in. NPT)	Flange Type	Part Number ^{a,b} Without Hex Wrench	With Hex Wrench
3/8	Straight	393690-1	393690-11
3/8	Elbow	393690-2	393690-12
1/2	Straight	393690-6	393690-16
1/2	Elbow	393690-3	393690-13
3/4	Straight	393690-4	393690-14
3/4	Elbow	393690-5	393690-15

^a Flange kits include one flange, one O-ring and four mounting screws.

^b Do not use flanges on control models with 3/4 in. inlet and 3/4 in. outlet. On models with 1/2 in. inlet and 3/4 in. outlet, use flanges only on the 1/2 in. inlet side.

Heavy demands are made on the controls when intermittent pilot systems are used on central heating properties in barns, greenhouses, and commercial properties and on heating appliances such as commercial cookers, agricultural equipment, industrial heating equipment and pool heaters.

Special steps may be required to prevent nuisance shutdowns and control failure due to frequent cycling, severe environmental conditions related to moisture, corrosive chemicals, dust or excessive heat. These applications require Honeywell Home and Building Control Engineering review; contact your Honeywell Sales Representative for assistance.

Review the following conditions that can apply to your specific installation and follow the precautions suggested.

Frequent Cycling

This control is designed for use on appliances that typically cycle three to four times an hour only during the heating season. In year-around applications with greater cycling rates, the control can wear out more quickly. Perform a monthly checkout.

Water or Steam Cleaning

If a control gets wet, replace it. If the appliance is likely to be cleaned with water or steam, protect (cover) the control and wiring from water or steam flow. Mount the control high enough above the bottom of the cabinet so it does not get wet during normal cleaning procedures.

High Humidity or Dripping Water

Dripping water can cause the control to fail. Never install an appliance where water can drip on the control. In addition, high ambient humidity can cause the control to corrode and fail. If the appliance is in a humid atmosphere, make sure air circulation around the control is adequate to prevent condensation. Also, regularly check out the system.

Corrosive Chemicals
Corrosive chemicals can attack the control, eventually causing a failure. If chemicals are used for routine cleaning, avoid contact with the control. Where chemicals are suspended in air, as in some industrial or agricultural applications, protect the control with an enclosure.

Dust or Grease Accumulation

Heavy accumulations of dust or grease can cause the control to malfunction. Where dust or grease can be a problem, provide covers for the control to limit contamination.

Heat

Excessively high temperatures can damage the control. Make sure the maximum ambient temperature at the control does not exceed the rating of the control. If the appliance operates at very high temperatures, use insulation, shielding, and air circulation, as necessary, to protect the control. Proper insulation or shielding should be provided by the appliance manufacturer; verify proper air circulation is maintained when the appliance is installed.

INSTALLATION

When Installing this Product...

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



Fire or Explosion Hazard.
Can cause property damage, severe injury or death.
Follow these warnings exactly:

1. Disconnect power supply before wiring to prevent electrical shock or equipment damage.
2. To avoid dangerous accumulation of fuel gas, turn off the gas supply at the appliance service valve before starting installation, and perform Gas Leak Test after installation is complete.
3. Do not bend pilot tubing at gas control or pilot burner after compression fitting is tightened, or gas leakage at the connection can result.
4. Always install a sediment trap in the gas supply line to prevent contamination of the gas control.
5. Do not force the gas control knob. Use only your hand to turn the gas control knob. Never use any tools. If the gas control knob will not operate by hand, the gas control should be replaced by a qualified service technician. Force or attempted repair may result in fire or explosion.



CAUTION
Equipment Damage.
Can burn out valve coil terminals.
Never apply a jumper across (or short) the valve coil terminals, even temporarily.

Follow the appliance manufacturers instructions if available; otherwise, use these instructions as a guide.

IMPORTANT

These gas controls are shipped with protective seals over the inlet and outlet tapings. Do not remove the seals until ready to install adapters or connect the piping.

Converting Gas Control from Natural Gas to LP Gas (or LP Gas to Natural Gas)



WARNING
Fire Or Explosion Hazard.
Can cause property damage, severe injury or death.

1. Do not attempt to convert step-opening models (suffix letter P).
 2. Always change the main and pilot burner orifices when converting from natural to LP gas or from LP to natural gas. Carefully follow appliance manufacturer specifications and instructions to assure proper appliance conversion.
 3. Gas controls are factory-set for natural (and manufactured) or LP gas. Do not attempt to use a gas control set for natural (manufactured) gas on LP gas, or a gas control set for LP gas on natural (manufactured) gas.
- Controls with standard, slow-opening, and two-stage regulators (model numbers with suffix H, K, M, or Q) can be converted from one gas to the other with a conversion kit (ordered separately). See Table 4 for the correct conversion kit.

Convertible Pressure Regulators

Controls with suffix letter R are convertible pressure regulator models. They can be converted from natural gas to LP gas or from LP gas to natural gas without a conversion kit.

Before converting the control from one gas to another, check the control label and the appliance manufacturer's rating plate to determine if the pressure regulator setting (factory set) will meet the appliance manifold requirements after conversion.

NOTE: Convertible pressure regulator models (suffix letter R) do not have field-adjustable regulators.

If the factory pressure regulator setting meets the appliance manifold requirement, convert the control as follows:

1. Remove the pressure regulator cap. Fig. 1.
2. Invert the cap so that the letters appear that represent the gas type appropriate for the appliance. NAT for natural manufactured gas, LP for liquid petroleum gas.
3. Replace the cap and tighten firmly.

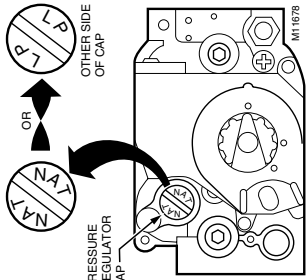


Fig. 1. Top view of convertible pressure regulator cap.

Install Adapters To Control

If adapters are being installed on the control, mount them as follows:

Flanges

1. Choose the appropriate flange for your application.
2. Remove the seal over the gas control inlet or outlet.
3. Make sure that the O-ring is fitted in the groove of the flange. If the O-ring is not attached or is missing, do not use the flange.
4. With the O-ring facing the control, align the screw holes on the gas control with the holes in the flange. Insert and tighten the screws provided with the flange. See Fig. 2. Tighten the screws to 25 inch-pounds of torque to provide a gas-tight seal.

Bushings

1. Remove the seal over the control inlet or outlet.
2. Apply a moderate amount of good quality pipe compound to the bushing, leaving two end threads bare. On an LP installation, use compound that is resistant to LP gas. Do not use Teflon tape.
3. Insert the bushing in the control and carefully thread the pipe into the bushing until tight.

Complete the instructions below for installing the piping, installing the control, connecting the pilot gas tubing and the wiring. Make sure the leak test you perform on the control after completing the installation includes leak testing the adapters and screws. If you use a wrench on the valve after the flanges are installed, use the wrench only on the flange, not on the control. See Fig. 5.

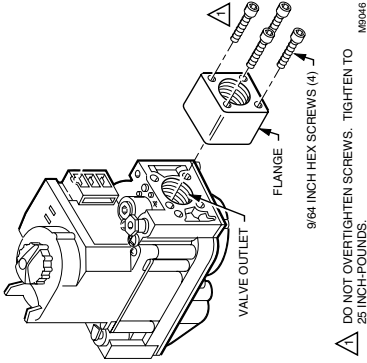


Fig. 2. Firmly fasten flange to valve, but do not overtighten screws.

Location

The combination gas control is mounted in the appliance vestibule on the gas manifold. If this is a replacement application, mount the gas control in the same location as the old control.

Locate the combination gas control where it cannot be affected by steam cleaning, high humidity, or dripping water, corrosive chemicals, dust or grease accumulation or excessive heat. To assure proper operation, follow these guidelines:

- Locate gas control in a well-ventilated area.
- Mount gas control high enough above cabinet bottom to avoid exposure to flooding or splashing water.
- Assure the ambient temperature does not exceed the ambient temperature ratings for each component.
- Cover gas control if appliance is cleaned with water, steam, or chemicals or to avoid dust and grease accumulation.
- Avoid locating gas control where exposure to corrosive chemical fumes or dripping water are likely.

Install Piping to Control

All piping must comply with local codes and ordinances or with the National Fuel Gas Code (ANSI Z223.1, NFPA No. 54), whichever applies. Tubing installation must comply with approved standards and practices.

1. Use new, properly reamed pipe that is free from chips. If tubing is used, make sure the ends are square, deburred and clean. All tubing bends must be smooth and without deformation.
2. Run pipe or tubing to the control. If tubing is used, obtain a tube-to-pipe coupling to connect the tubing to the control.
3. Install a sediment trap in the supply line to the control. See Fig. 3.

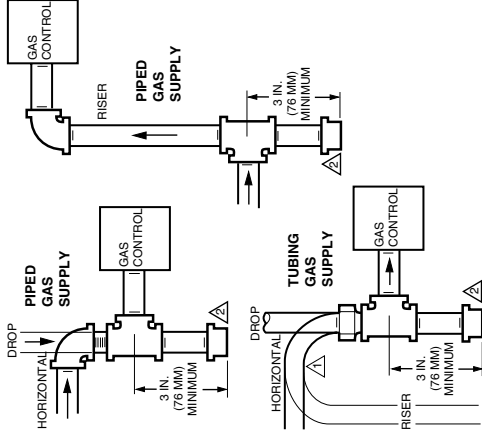


Fig. 3. Sediment trap installation.

Install Control

1. Mounted 0 to 90 degrees in any direction, including vertically, from the upright position of the gas control knob.
2. Mount so the gas flow is in the direction of the arrow on the bottom of the control.
3. Thread the pipe the amount shown in Table 7 for insertion into control or adapters. Do not thread pipe too far. Valve distortion or malfunction can result if the pipe is inserted too deeply.

Table 7. NPT Pipe Thread Length (in.).

Pipe Size	Thread Pipe this Amount	Maximum Depth Pipe can be Inserted into Control
3/8	9/16	3/8
1/2	3/4	1/2
3/4	13/16	3/4

4. Apply a moderate amount of good quality pipe compound (do not use Teflon tape) only to the pipe, leaving two end threads bare. On LP installations, use a compound resistant to LP gas. See Fig. 4.
5. Remove the seals over the control inlet and outlet if necessary.
6. Connect the pipe to the control inlet and outlet. Use a wrench on the square ends of the control. If a flange is used, place the wrench on the flange rather than on the gas control. Refer to Fig. 5 and 6.

Connect Pilot Gas Tubing

1. Cut tubing to the desired length and bend as necessary for routing to the pilot burner. Do not make sharp bends or deform the tubing. Do not bend the tubing at the gas control after the compression nut is tightened, because this can result in gas leakage at the connection.
2. Square off and remove burrs from the end of the tubing.
3. Unscrew the brass compression fitting from the pilot outlet (Fig. 6). Slip the fitting over the tubing and slide out of the way. See Fig. 7.

NOTE: When replacing a control, cut off the old compression fitting and replace with the compression fitting provided on the combination gas control. Never use the old compression fitting because it may not provide a gas-tight seal.

4. Push the tubing into the pilot gas tapping on the outlet end of the control until it bottoms. While holding the tubing all the way in, slide the fitting into place and engage the threads; then turn until finger tight. Tighten one more turn with a wrench, but do not overtighten.
5. Connect the other end of the tubing to the pilot burner according to the pilot burner manufacturer's instructions.

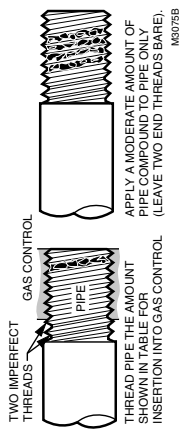
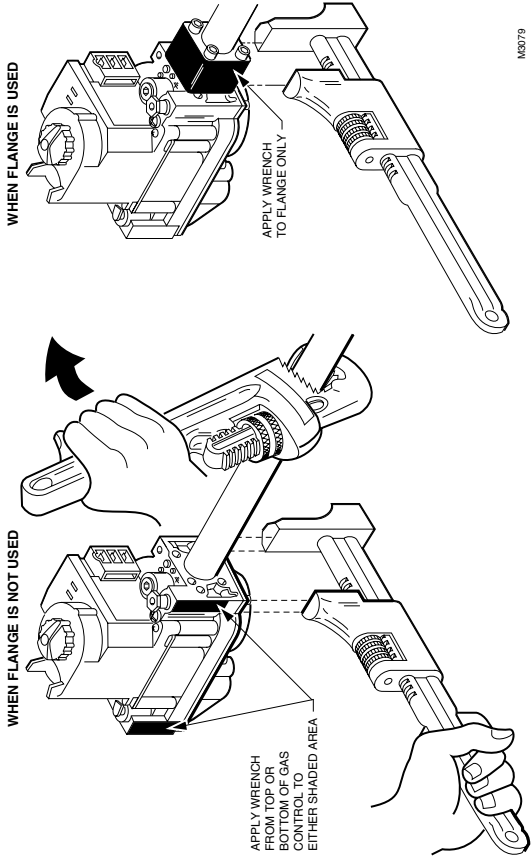
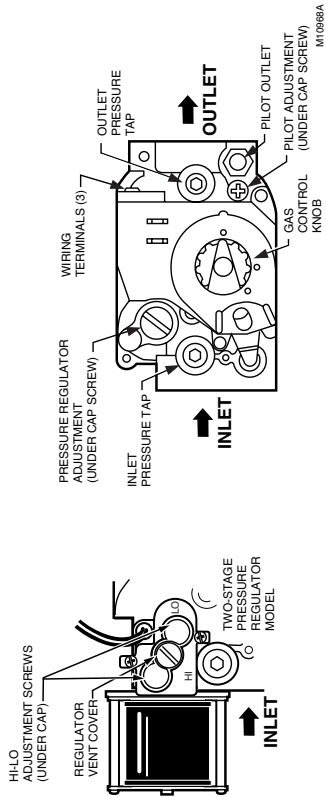


Fig. 4. Use moderate amount of pipe compound.



M3379

Fig. 5. Proper use of wrench on gas control with and without flanges.



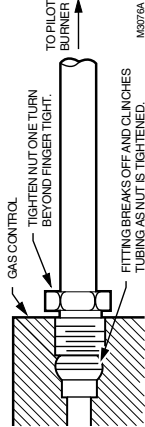
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Fig. 6. Top view of gas control.

All wiring must comply with applicable electrical codes and ordinances.

Disconnect power supply before making wiring connections to prevent electrical shock or equipment damage.

1. Check the power supply rating on the gas control and make sure it matches the available supply. Install a transformer, thermostat and other controls as required.
2. Connect control circuit to the gas control terminals. See Fig. 8.



M3376A

Fig. 7. Always use new compression fitting.

Wiring

Follow the wiring instructions furnished by the appliance manufacturer, if available, or use the general instructions provided below. When these instructions differ from the appliance manufacturer, follow the appliance manufacturer instructions.

Turn On Main Burner

Follow appliance manufacturer instructions or turn up thermostat to call for heat.

Perform Gas Leak Test

WARNING

Fire or Explosion Hazard.
Can cause property damage, severe injury or death.

Perform Gas Leak Test every time work is done on a gas system.

IMPORTANT

Do not spray soap and water solution on the gas control. Do not use an excessive amount of soap and water solution to perform the gas leak test. These can damage the control.

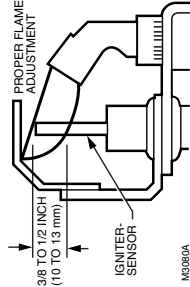
Gas Leak Test

1. Paint pipe connections upstream of the gas control with rich soap and water solution. Bubbles indicate a gas leak.
2. If a leak is detected, tighten the pipe connections.
3. Light the main burner. Stand clear of the main burner while lighting to prevent injury caused from hidden leaks that could cause flashback in the appliance vestibule.
4. With the main burner in operation, paint the pipe joints (including adapters) and the control inlet and outlet with rich soap and water solution.
5. If another leak is detected, tighten the adapter screws, joints, and pipe connections.
6. Replace the part if a leak cannot be stopped.

Check and Adjust Pilot Flame

The pilot flame should envelop $3/8$ to $1/2$ in. (10 to 13 mm) of the tip of the igniter-sensor. See Fig. 9. If the pilot flame is small or lazy, the inlet gas pressure may be too low, or the pilot orifice may be partially clogged. Check and repair as necessary. If the pilot flame is hard and noisy, the inlet gas pressure may be too high. The gas control has a pilot adjustment mechanism to reduce the pilot flow if necessary. If pilot adjustment is necessary, proceed as follows:

1. Remove pilot adjustment cover screw. See Fig. 6.
2. The pilot adjustment is shipped at the full pilot gas flow rate. Turn the inner adjustment screw clockwise if the inlet pressure is too high. Turn the inner adjustment screw clockwise to decrease or counterclockwise to increase pilot flame.
3. Replace the cover screw after the adjustment to prevent gas leakage.



M3376A

Fig. 9. Proper flame adjustment.

Fig. 8. Typical wiring connections for 24 volt control in intermittent ignition system with S8600.

STARTUP AND CHECKOUT

WARNING

Fire or Explosion Hazard.
Can cause property damage, severe injury or death.

1. Do not force the gas control knob on the appliance. Use only your hand to turn the gas control knob. Never use any tools.
2. If the knob does not operate by hand, the control should be replaced by a qualified service technician.

Gas Control Knob Settings

Gas control knob settings are as follows:

OFF: Prevents pilot and main gas flow through the control.

ON: Permits gas to flow into the control body. Under control of the thermostat and intermittent pilot module, gas can flow to the pilot and main burners.

NOTE: Controls are shipped with the gas control knob in the ON position.

Turn On System

Rotate the gas control knob counterclockwise to ON.

Check and Adjust Gas Input and Burner Ignition

IMPORTANT

1. Do not exceed input rating stamped on appliance nameplate, or manufacturer's recommended burner orifice pressure for size orifice(s) used. Make certain primary air supply to main burner is properly adjusted for complete combustion. Follow appliance manufacturer instructions.
2. IF CHECKING GAS INPUT BY CLOCKING GAS METER: Make certain there is no gas flow through the meter other than to the appliance being checked. Other appliances must remain off with the pilots extinguished (or deduct their consumption from the meter reading). Convert flow rate to Btu/h as described in form 70-2602, Gas Controls Handbook, and compare to Btu/h input rating on appliance nameplate.
3. IF CHECKING GAS INPUT WITH MANOMETER: Make sure the gas control knob is in the OFF position before removing outlet pressure tap plug to connect manometer (pressure gauge). Also move the gas control knob to the OFF position when removing the gauge and replacing the plug. Before removing inlet pressure tap plug, shut off gas supply at the manual valve in the gas piping to the appliance or, for LP, at the tank. Also shut off gas supply before disconnecting manometer and replacing plug. Repeat Gas Leak Test at plug with main burner operating.

NOTE: Check the inlet pressure before adjusting the pressure regulator.

Standard and Slow-Opening

(H, K and M) Models

1. Carefully check the main burner lightoff. Make sure that the main burner lights smoothly and that all ports remain lit.
2. Check the full rate manifold pressure listed on the appliance nameplate. Gas control full rate outlet pressure should match this rating.
3. With main burner operating, check the control flow rate using the meter clocking method or check pressure using a manometer connected to the outlet pressure tap on the control. See Fig. 6.
4. If necessary, adjust the pressure regulator to match the appliance rating. See Tables 8A and 8B for factory-set nominal outlet pressure and adjustment range.

- a. Remove the pressure regulator adjustment cap screw.
- b. Using a screwdriver, turn the inner adjustment screw (Fig. 6) clockwise  to increase or counterclockwise  to decrease the gas pressure to the burner.
- c. Always replace the cap screw and tighten firmly to prevent gas leakage.

5. If the desired outlet pressure or flow rate cannot be achieved by adjusting the gas control, check the gas control inlet pressure using a manometer at the inlet pressure tap of the gas control. If the inlet pressure is in the nominal range (see Tables 8A and 8B), replace the gas control. Otherwise, take the necessary steps to provide proper gas pressure to the control.

NOTE: If the burner firing rate is above 150,000 Btu/h on VR8304 models (see Table 1 for VR8304 capacities), it may not be possible to deliver the desired outlet pressure. This is an application issue, not a control failure. Take whatever steps are required to correct the situation.

Step-Opening (P) Models

Step-opening models require that you check and adjust the full-rate pressure first and then check the step pressure. The step pressure is not field adjustable.

1. Carefully check the main burner lightoff. Make sure that the main burner lights smoothly and that all ports remain lit.
2. Check the full rate manifold pressure listed on the appliance nameplate. Gas control full rate outlet pressure should match this rating.
3. With main burner operating, check the gas control flow rate using the meter clocking method or check pressure using a manometer connected to the outlet pressure tap on the gas control. See Fig. 6.
4. If necessary, adjust the pressure regulator to match the appliance rating. See Tables 8A and 8B for factory-set nominal outlet pressure and adjustment range.

- a. Remove the pressure regulator adjustment cap screw.

Using a screwdriver, turn the inner adjustment screw (Fig. 6) clockwise  to increase or counterclockwise  to decrease the gas pressure to the burner.

5. Always replace the cap screw and tighten firmly to prevent gas leakage.
6. If the desired outlet pressure or flow rate cannot be achieved by adjusting the gas control, check the gas control inlet pressure using a manometer at the inlet pressure tap of the control. If the inlet pressure is in the nominal range (see Tables 8A and 8B), replace the control. Otherwise, take the necessary steps to provide proper gas pressure to the control.
7. Carefully check the burner lightoff at step pressure. Make sure the burner lights smoothly and without flashback to the orifice. Make sure all ports remain lit. Cycle the burner several times, allowing at least 60 seconds between cycles for the regulator to resume the step function. Repeat after allowing the burner to cool. Readjust the full rate outlet pressure, if necessary, to improve lightoff characteristics.

Two-Stage (Q) Models

Two-stage models require that you check and adjust both high and low pressure regulator settings. Two-stage appliance operating sequences vary. Consult the appliance manufacturer instructions for the specific operating sequence and regulator adjustment procedure for the appliance in which the control is installed.

1. Set appliance to operate on high.
2. Carefully check the main burner lightoff. Make sure that the main burner lights smoothly and that all ports remain lit.
3. Check the full rate (high) manifold pressure listed on the appliance nameplate for high pressure. The gas control full rate outlet pressure should match this rating.

4. With main burner operating, check the gas control flow rate using the meter clocking method or check pressure using a manometer connected to the outlet pressure tap on the gas control. See Fig. 6.
5. If necessary, adjust the high pressure regulator to match the appliance rating. See Tables 8A and 8B for factory-set nominal outlet pressure and adjustment range.

- a. Remove the pressure regulator adjustment cap (Fig. 6).
- b. Using a screwdriver, turn the inner adjustment screw for HI pressure clockwise  to increase or counterclockwise  to decrease the gas pressure to the burner.

6. After high pressure has been checked, check low pressure regulation. Two-stage appliance operating sequences vary. Consult the appliance manufacturers instructions for the specific operating sequence and regulator adjustment procedure for the appliance in which the control is installed and for instructions on how to prevent the control from moving to high stage while checking the low pressure regulator setting.

7. Check the low rate manifold pressure listed on the appliance nameplate. Gas control low rate outlet pressure should match this rating.

8. With main burner operating, check the gas control flow rate as before (using the meter clocking method or check pressure using a manometer connected to the outlet pressure tap on the control).

9. If necessary, adjust the low pressure regulator to match the appliance rating. See Tables 8A and 8B for factory-set nominal outlet pressure and adjustment range.

 - a. Remove the pressure regulator adjustment cap (Fig. 6).

Using a screwdriver, turn the inner adjustment screw for LO pressure clockwise  to increase or counterclockwise  to decrease the gas pressure to the burner.

10. Once high and low pressure have been checked and adjusted, replace pressure regulator adjustment cap. If the desired outlet pressure or

flow rate cannot be achieved by adjusting the gas control, check the control inlet pressure using a manometer at the inlet pressure tap of the control. If the inlet pressure is in the nominal range (see Tables 8A and 8B), replace the gas control. Otherwise, take the necessary steps to provide proper gas pressure to the control.

Check Safety Shutdown Performance



Fire or Explosion Hazard.

Can cause property damage, severe injury or death.

Perform the safety shutdown test any time work is done on a gas system.

NOTE: Read steps 1 through 7 before starting, and compare to the safety shutdown or safety lockout tests recommended for the intermittent pilot (IP) ignition module. Where different, use the procedure recommended for the module.

1. Turn off gas supply.
2. Set thermostat or controller above room temperature to call for heat.
3. Watch for ignition spark or for glow at hot surface igniter either immediately or following prepurge. See IP module specifications.
4. Time the length of the spark operation. See the IP module specifications.
5. After the module locks out, open the manual gas cock and make sure no gas is flowing to the pilot or main burner. With modules that continue to spark until the pilot lights or the system shuts down manually, the pilot should light when the manual gas control knob is opened.
6. Set the thermostat below room temperature and wait one minute.
7. Operate system through one complete cycle to make sure all controls operate properly.

Table 8A. Pressure Regulator Specification Pressures (in. wc).

Model Type	Type of Gas	Nominal Inlet Pressure Range	Factory Set Nominal Outlet Pressure	
			Step	Full Rate
Standard, Slow	NAT	5.0 to 7.0	—	3.5
Step	LP	12.0 to 14.0	—	10.0
	NAT	5.0 to 7.0	0.9	3.5
Two-Stage	LP	12.0 to 14.0	2.2	10.0
	NAT	5.0 to 7.0	—	1.7 Low 3.5 High
LP	LP	121.0 to 14.0	—	4.9 Low 10.0 High
			—	3.5 to 5.5 Low 8.0 to 11.0 High

a Low Fire setting range for VR8304Q 1/2 in. by 1/2 in. by 1/2 in. is 1.5 to 3.0 in. wc.

Table 8B. Pressure Regulator Specification Pressures (kPa).

Model Type	Type of Gas	Nominal Inlet Pressure Range	Factory Set Nominal Outlet Pressure		Setting Range	
			Step	Full Rate	Step	Full Rate
Standard, Slow	NAT	1.2 to 1.7	—	0.9	—	0.7 to 1.2
	LP	2.9 to 3.9	—	2.5	—	2.0 to 3.0
Step	NAT	1.2 to 1.7	0.2	0.9	None	0.17 to 0.48
	LP	2.9 to 3.9	0.5	2.5	None	1.4 to 1.37
Two-stage	NAT	1.2 to 1.7	—	0.48 Low 0.9 High	—	0.22 to 0.75 Low ^a 0.75 to 1.2 High
	LP	2.9 to 3.9	—	1.2 Low 2.5 High	—	0.9 to 1.4 Low 2.0 to 2.5 High

^a Low Fire setting range for VR8304CQ 1/2 in. by 1/2 in. and 1/2 in. by 3.4 in. is 0.37 to 0.75 kPa.

Non-Regulating On-Off (U) Models

Non-regulating VR8204U Valves are designed for application in various parts of Europe where a separate, distinct, pressure regulator is required. The VR8204U is similar to the VR8204A in all other aspects and should be installed accordingly.

MAINTENANCE



WARNING

Fire or Explosion Hazard.

Can cause property damage, severe injury, or death.
Do not disassemble the gas control; it contains no replaceable components. Attempted disassembly, repair, or cleaning can damage the control, resulting in gas leakage.

Regular preventive maintenance is important for applications in the commercial cooking and agricultural and industrial industries that place a heavy load on system controls because:

- In many such applications, particularly commercial cooking, the equipment operates 100,000 to 200,000 cycles per year. Such heavy cycling can wear out the gas control in one to two years.
- Exposure to water, dirt, chemicals and heat can damage the gas control and shut down the control system.

The maintenance program should include regular checkout of the control as outlined in the Startup and Checkout section, and the control system as described in the appliance manufacturer literature.

Maintenance frequency must be determined individually for each application. Some considerations are:

- Cycling frequency. Appliances that may cycle 20,000 times annually should be checked monthly.
- Intermittent use. Appliances that are used seasonally should be checked before shutdown and again before the next use.
- Consequence of unexpected shutdown. Where the cost of an unexpected shutdown would be high, the system should be checked more often.

SERVICE



WARNING

Fire or Explosion Hazard.
Can cause property damage, severe injury or death.

Do not disassemble the control; it contains no replaceable components. Attempted disassembly, repair, or cleaning can damage the gas control, resulting in gas leakage.



CAUTION

Equipment Damage.

Can burn out valve coil terminals.
Never apply a jumper across (or short) the valve coil terminals, even temporarily.

After servicing, verify proper system operation.

If Main Burner Does Not Come On With Call For Heat

1. Confirm the gas control knob is in the ON position.
2. Adjust thermostat several degrees above room temperature.
3. Using ac voltmeter, check for 24V at gas control:
 - If pilot lights, measure across MV/PV and MV.
 - If pilot does not light, measure across MV/PV and PV before safety lockout occurs.
4. If voltage is incorrect or not present, check control circuit for proper operation.
5. If 24V is present, replace gas control.

INSTRUCTIONS TO THE HOMEOWNER



WARNING

Fire or Explosion Hazard.

Can cause property damage, severe injury, or death.

Follow these warnings exactly:

1. Pilot flame is lit automatically. Do not light the pilot flame manually.
2. Before lighting the pilot burner flame, smell around the appliance for gas. Be sure to smell next to the floor because LP gas is heavier than air. If you smell gas:
 - Turn off the gas supply at the appliance service valve. On LP gas systems, turn off the gas supply at the gas tank.
 - Do not light any appliances in the house.
 - Do not touch electrical switches or use the phone.
 - Leave the building and use a neighbor's phone to call your gas supplier.
 - If you cannot reach your gas supplier, call the fire department.
3. Replace the gas control in the event of any physical damage, tampering, bent terminals, missing or broken parts, stripped threads, or evidence of exposure to heat.

IMPORTANT

Follow the operating instructions provided by the heating appliance manufacturer. The information below describes a typical control application, but the specific controls used and the procedures outlined in your appliance manufacturer instructions can differ, requiring special instructions.

STOP: Read the Warnings Above Before Proceeding.

The pilot flame is lit automatically. If the appliance does not turn on when the thermostat is set several degrees above room temperature, follow these instructions:

1. Set the thermostat to its lowest setting to reset the safety control.
2. Disconnect all electric power to the appliance.
3. Remove the burner access panel if provided on your appliance.
4. Turn the gas control knob clockwise ↻ to the OFF position.
5. Wait five minutes to clear out any unburned gas. Then if you smell gas, STOP! Follow Step 2 in the Warning above. If you do not smell gas, continue with the next step.
6. Turn the gas control knob counterclockwise ↺ to the ON position.
7. Replace the burner access panel.
8. Reconnect all electric power to the appliance.
9. Set the thermostat to the desired setting.
10. If the appliance does not turn on, turn the gas control knob to the OFF position and contact a qualified service technician for assistance.

Turning Off the Appliance

Vacation Shutdown

Set the thermostat to the desired room temperature while you are away.

Complete Shutdown

Turn off power to the appliance. Turn off the gas supply to the appliance. Turn the gas control knob to OFF. The appliance will completely shut off. Follow the procedure in the Instructions to the Homeowner section above to resume normal operation.

Honeywell

Home and Building Control

Honeywell Inc.
1985 Douglas Drive North
Golden Valley, Minnesota 55422

Home and Building Control

Honeywell Limited-Honeywell Limitée
35 Dynamic Drive
Scarborough, Ontario
M1V 4Z9



**Ace Heating
Solutions, LLC**

Deliming Kit



Packages are available for domestic hot water systems, laundry systems, car wash systems, and swimming pool heating.



EFFECTIVE — ACE single coil, no parallel tubes, insures that all lime is removed

FAST — Simple hook up and single coil allows deliming to be accomplished in one hour or less under normal conditions

ECONOMICAL — Acid costs should not exceed \$15.00 on largest heater. Muriatic acid can be purchased at most drug stores or pool supply dealers.

Ace Heating Solutions, LLC
2701 S. HARBOR BLVD.
SANTA ANA, CA 92704
PHONE : (714) 540-2230
FAX: (714) 540-2239
www.aceheatingll.com

Water heaters that use fresh water will develop a coating of lime if the fresh water is not softened or if it is not naturally free from undissolved solids. When a water softener does not function properly, due to lack of servicing or due to undersizing, the heater will develop lime.

Inspection of Heater — Check heater every 6 months by closing water plug cocks, and removing high limit aquastat well, located in top manifold, and visually inspect the inside of the coil for lime. ACE recommends deliming if $\frac{1}{32}$ " or greater thickness of lime is found. If recovery rate of heater falls off, this is usually a sign of lime in the coil. The ACE coil will "bang" or "knock" if liming condition is severely restricting circulation. Customers have reported operating ACE heaters and softeners under heavy duty laundry service for 10 to 15 years without the need to delime or change the ACE conical coil. Under moderate water hardness conditions, ACE users have found that when operating without a softener that deliming once a year could be accomplished in approximately one hour.

For deliming, use solution of muriatic acid (which can be purchased from any drug or pool supply store) and dilute with equal amount of water to obtain a 50% solution for normal deliming. *Caution: Always add acid to water when diluting. Adding water to acid can result in splashing and acid burns.* If coil has a heavy coating of lime, use only 10% solution of acid to start with to prevent chunks of lime from breaking loose and plugging the coil before dissolving.

DELIMING PROCEDURE — Connect ACE deliming kit as shown in picture.

1. Close gas cock at heater.
2. Turn off water to and from heater and drain heater.
3. Type "C" ACE Heater, remove upper aquastat and well and install faucet; Type "D", "E" and "G" ACE Heater, remove pipe plug on left side of upper heater manifold and install faucet.
4. Attach hose from pump to top faucet and return hose from acid container to lower faucet as shown in picture.
5. Pour water into plastic container and add equal amount of acid. Approximately 4 gallons of diluted solution is required for 400,000 BTU and smaller heaters, 5 gallons to 7 gallons for heaters up to 760,000 BTU and 9 gallons for heaters between 1,000,000 and 1,500,000 BTU.
6. Turn on pump and circulate solution until foaming action of the solution stops indicating that dissolving of the lime has been completed. Add approximately an additional quart of solution to insure that end of foaming is not due to spent acid. Do not continue to pump acid solution for a prolonged time after foaming stops because the acid will dissolve the copper and brass.
7. Flush heater out with baking soda and water solution and return it to service.

In case of a completely plugged coil it is recommended that a heater serviceman be called in to do the deliming.

CAUTION! AVOID SPILLING OR DRIPPING ACID ON HANDS, FACE, CLOTHING OR ELECTRICAL CONTROLS OR WIRING. COVER CONTROLS WITH PLASTIC SHEETING SUCH AS SARAN, OR POLYETHYLENE BAG, TO AVOID DAMAGE TO THESE PARTS. USE A BAKING SODA AND WATER SOLUTION TO NEUTRALIZE ANY ACID ON HANDS, FACE, CONTROLS, ETC.

NON-ACID DELIMING SOLUTION — For those preferring to use a non-acid base solution, it will be noted that the effectiveness of such a solution is shorter-lived than regular acid and usually requires more stock solution. Such a solution, called "LIMINAL", may be obtained from Polyteck Co., 5112 W. Jefferson Blvd., Los Angeles, Calif. 90016. Also in the eastern areas contact Tri-Bros. Chemical Corp., P.O. Box 2, Morton Grove, Illinois 60053 for solution called "Lime Eater".

GAS FIRED COPPER FIN CONE COIL WATER HEATERS • HEAVY DUTY INDUSTRIAL WATER HEATERS • "MINI-PACK" SEMI-INSTANTANEOUS WATER HEATERS • PACKAGED STORAGE WATER HEATERS • CLEAN STEAM BOILERS • ASME HOT WATER STORAGE TANKS