Slant/Fin®

SENTINEL™

HOT WATER MODELS SE-70 THROUGH SE-245

GAS-FIRED CAST-IRON BOILERS FOR NATURAL AND L.P. PROPANE GASES

INSTALLATION AND OPERATING INSTRUCTIONS

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IMPORTANT

READ ALL OF THE FOLLOWING WARNINGS AND STATEMENTS BEFORE READING THE INSTALLATION INSTRUCTIONS

WARNING
LIQUEFIED PETROLEUM (L.P.)
PROPANE GAS-FIRED BOILERS

Installation location ONLY as permitted in paragraph entitled "LIQUEFIED PETROLEUM (L.P.) PROPANE GAS-FIRED BOILER LOCATION" on page 4 of this instruction book.
The above warning does not apply to **NATURAL** gas-fired boilers.

The installation must conform to the requirements of the authority having jurisdiction or, in the absence of such requirements, to the National Fuel Gas Code, ANSI Z223.1-latest edition. The installation must also conform to the additional requirements in this Slant/Fin Instruction Book.

In addition, where required by the authority having jurisdiction, the installation must conform to American Society of Mechanical Engineers Safety Code for Controls and Safety Devices for Automatically Fired Boilers, No. CSD-1. If there is any conflict in the above requirements, then the more stringent requirement will apply.

This manual must be left with owner and should be hung on or adjacent to the boiler for reference.

WARNING
This boiler, gas piping and accessories must be installed, connected, serviced and repaired by a trained, experienced service technician, familiar with all precautions required for gas-fired equipment and licensed otherwise qualified, in compliance with the authority having jurisdiction.

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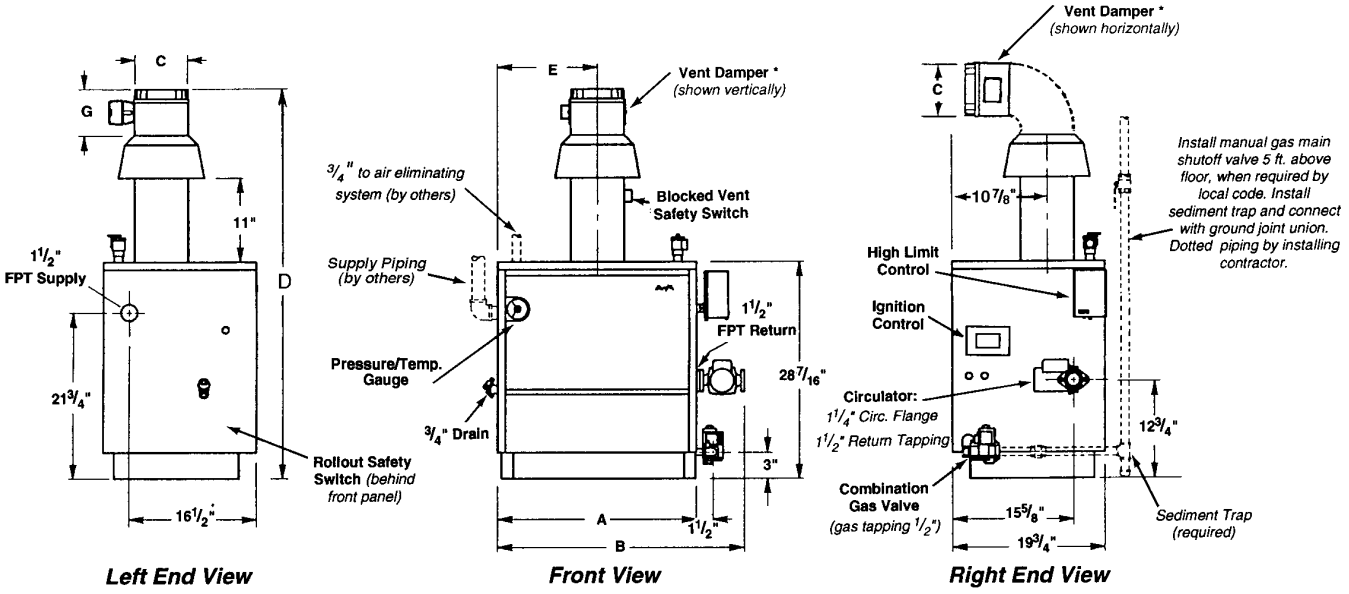
Dimensions
MODEL SE-70 to SE-245



Note: Height dimension increases by 1-3/4" when combustible floor kit is used.
* Vent damper may be installed horizontally on all models with use of a vent elbow. For more information, see Figure **2**, page 5.

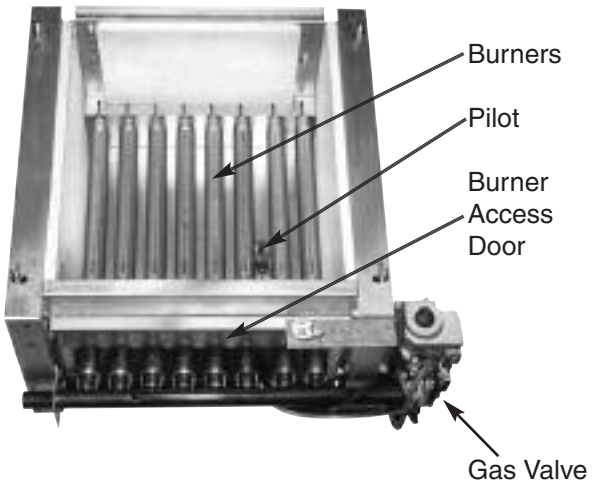
Boiler Model	No. of Sect.	Dimensions (Inches)						Approx. Total Wt. Full of Water (lb.)
		A	B	C	D	E	G	
SE-70	3	11⅛"	17⅝"	4	49¾"	5⅝"	6¼"	250
SE-105	4	14⅛"	20⅝"	5	51¼"	7⅛"	6¼"	310
SE-140	5	17⅛"	23⅝"	5	51¾"	8⅝"	6¼"	365
SE-175	6	20⅛"	26⅝"	6	51¾"	10⅛"	6¼"	425
SE-210	7	23⅛"	29⅝"	7	53¾"	11⅝"	6¾"	485
SE-245	8	26⅛"	32⅝"	7	53¾"	13⅛"	6¾"	545

CHIMNEY RECOMMENDATIONS
HEIGHT:15 ft. (minimum) from draft hood skirt to top of chimney.
INSIDE DIAMETER: Same as dimension C (or larger).
NOTE: Larger chimney may be required if two or more boilers or a boiler and another appliance are vented to a single chimney.

Gas Type	Orifice Size for Sea Level	Orifice Sizes for High Altitudes Includes 4% Reduction for Each 1000 Feet								
		Elevation - Feet								
		2000	3000	4000	5000	6000	7000	8000	9000	10000
Natural	47	48	48	49	49	49	50	50	51	51
Propane	56	56	56	57	57	57	58	59	59	60

Orifice indicated for sea level above are factory installed in boiler unless otherwise specified by the local authority.
See “III” on page 9 for burner input adjustment.

Base Assembly
Sentinel Boiler



INSTALLATION REQUIREMENTS

The installation must conform to the requirements of the authority having jurisdiction or, in the absence of such requirements, to the National Fuel Gas Code, ANSI Z223.1-latest edition.

This installation must also conform to the additional requirements in this Slant/Fin Instruction Book.

NATURAL GAS-FIRED BOILER LOCATION

Provide a level, solid foundation for the boiler. Location should be as near as possible to chimney or outside wall so that the flue pipe from boiler is short and direct.

The location should also be such that the gas ignition system components are protected from water (dripping, spraying, rain, etc.) during appliance operation and service (circulator replacement, condensate trap, control replacement, etc.).

BOILER FOUNDATION

A. Provide a solid, level foundation, capable of supporting the weight of the boiler filled with water, and extending at least 2" past the jacket on all sides. See dimensions of boiler, page 2.
B. For installation on non-combustible floors only. The Combustible Floor Kit part number printed on the boiler rating plate is the only one to be used when installing on combustible floors. The boiler must not be installed on carpeting.
C. If boiler is to be located over buried conduit containing electric wires or telephone cables, consult local codes or the National Board of Fire Underwriters for specific requirements.

WARNING
LIQUEFIED PETROLEUM (L.P.) PROPANE GAS-FIRED BOILER LOCATION
REQUIRES SPECIAL ATTENTION

Liquefied Petroleum (L.P.) propane gas is *heavier than air*. Therefore, propane boilers, piping, valves should NOT be installed in locations where propane leaking from defective equipment and piping will "pool" in a basement or other space below the leak.

A spark or flame from the boiler or other source may ignite the accumulated propane gas causing an explosion or fire. Provide a level, solid foundation for the boiler. Location should be as near the chimney as possible so that the flue pipe from boiler to chimney is short and direct.

The UNIFORM MECHANICAL CODE may be in effect in your geographic area

The following precautions are cited by the 1994 UNIFORM MECHANICAL CODE, section 304.6:

"**LPG Appliances**. Liquefied petroleum gas-burning appliances shall not be installed in a pit, basement or similar location where heavier-than-air-gas might collect. Appliances so fueled shall not be installed in an above-grade under-floor space or basement unless such location is provided with an approved means for removal of unburned gas."

Consult Chapter 5 of the 1994 UNIFORM MECHANICAL CODE for design criteria of the "approved" means for removal of unburned gas.

CHIMNEY REQUIREMENTS

A. Sentinel boilers may be vented into a masonry vitreous tile-lined chimney or type "B" venting system NOT EXPOSED to the OUTDOORS below the roof line.
   Venting and sizing of venting system must be in accordance with Part 7, Part 10 and Appendix G of the National Fuel Gas Code ANSI Z223.1, NFPA 54, -latest edition which will be referred to as the National Fuel Gas Code. Local codes apply.
   If a masonry chimney is exposed to the outdoors on one or more sides below the roof line (exterior chimney), ONE of the following options apply:
   1. Chimney must be re-lined with a metallic liner. When this is done, the chimney will be considered NOT exposed to the outdoors and the requirements of the National Fuel Gas Code for NON-exposed chimneys and/or local codes will apply.
   2. If an exposed tile-lined chimney is to be used WITHOUT a metallic liner, the boiler must first meet the requirements of the following tables and paragraphs of the National Fuel Gas Code:
      I. For Single Sentinel Boiler - Paragraph 10.1.9 and table 10.11.
      II. For multiple appliances - Paragraph 10.2.18 and table 10.12 (or 10.13 if applicable).
      In addition, all requirements of Part 7, Part 10 and Appendix G of the National Fuel Gas Code and/or local codes apply.
B. If an existing boiler is removed from a common venting system, the common venting system may be too large for proper venting of the remaining appliances connected to the common vent. Follow the test procedure shown in Appendix "A" on page 19 of this manual to insure proper operation of venting system and appliances.
C. Inspect for proper and tight construction. Any restrictions or obstructions must be removed. An existing chimney may require cleaning.
D. Chimney or vent must extend at least 3 feet above any ridge within 10 feet of the chimney.

MINIMUM CLEARANCES FOR COMBUSTIBLE CONSTRUCTIONS

SENTINEL SERIES
MINIMUM CLEARANCES FOR COMBUSTIBLE CONSTRUCTION. MINIMUM ALCOVE AND CLOSET CLEARANCE.

Front	6"
Rear	6"
Left Side	6"
Right Side	12"
Top (above boiler)	28"
Flue Connector	6"

A. Minimum boiler clearances shall be as follows:
B. Provide accessibility clearance of 24" on sides requiring servicing and 18" on sides used for passage.
C. All minimum clearances shown above must be met. This may result in increased values of some minimum clearances in order to maintain the minimum clearances of others.
D. Clearance from hot water pipes shall be 1 inch**.
   ** At points where hot water pipes emerge from a floor, wall or ceiling, the clearance at the opening through the finished floor, wall or ceiling boards may not be less than 1/2 inch. Each such opening shall be covered with a plate of non-combustible material.

SAFETY

KEEP THE BOILER AREA CLEAR AND FREE FROM COMBUSTIBLE MATERIALS, GASOLINE AND OTHER FLAMMABLE VAPORS AND LIQUIDS.

DRAFT HOOD

The draft hood supplied with SE models is part of the listed boiler assembly. DO NOT alter the hood. See dimensions, page 2.

Attach the hood to the boiler flue outlet. Connect flue pipe full size of hood outlet. Vent damper must be installed on the outlet side of the hood. See Vent Piping, below.

VENT PIPING

A. Vent piping installation must be in accordance with ANSI Z223.1-latest edition, National Fuel Gas Code, Part 7, Venting of Equipment. Other local codes may also apply and must be followed.
B. Boiler vent pipe must be the full diameter of the boiler outlet. See dimensions, page 2.
C. If more than one appliance vents into a common breeching, the area of the breeching must be equal to the area of the largest vent plus 50% of the area of the additional vent areas. Vent connectors serving appliances vented by natural draft shall not be connected into any portion of mechanical draft systems operating under positive pressure. Horizontal breeching or vent pipe should be as high as possible, consistent with codes, so that vertical vents from appliances will have a high rise above draft diverter openings. All horizontal runs must slope upwards not less than 1/4 inch per foot of run. Horizontal portions of the venting system must be

supported to prevent sagging by securing each joint with metal screws and by providing hanger spaced no greater than 5 feet apart.

D. Vent or breeching into chimney should not be inserted past the inside wall of the chimney liner.
E. All venting means should be inspected frequently. See Care and Maintenance and separate User's Information Manual.

VENT DAMPER INSTALLATION

The vent damper referred to in the following instructions is the Slant/Fin Corporation vent damper.

This device is design certified by A.G.A. for use ONLY on specific Slant/Fin Corp. gas boiler models. These boilers must also be equipped with a label which states that the boiler must be used with a Slant/Fin Corp. automatic vent damper device and indicates the proper vent damper model number.

A. INSTALLATION INSTRUCTIONS BEFORE YOU START TO INSTALL
   1. Read this installation manual, the "DANGER" label attached to the top of the boiler, the "WARNING" on the wiring diagrams, vent damper carton and operator cover.
   2. Perform pre-installation inspection as required by ANSI specification Z21.66. (See Vent Damper Instructions.)
   3. Select a proper, convenient location for vent damper. Vent damper may be installed vertical or horizontal on all models (see figures 1 and 2).
   4. Carefully unpack the unit. DO NOT FORCE IT OPEN OR CLOSED! Forcing the damper may damage the gear train and void the warranty.

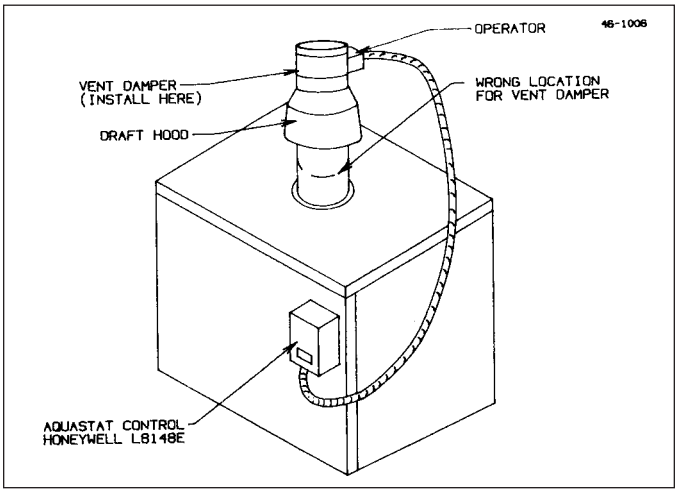
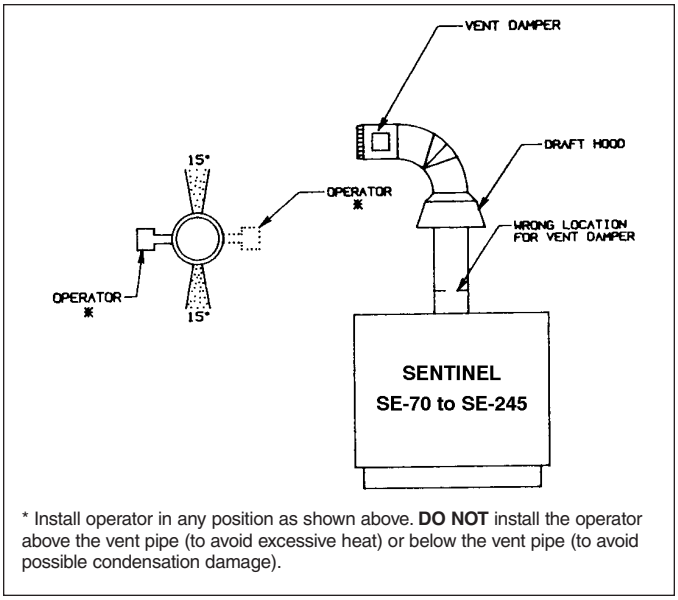


Figure 1. Vertical installation of vent damper on Sentinel "SE" boilers



* Install operator in any position as shown above. **DO NOT** install the operator above the vent pipe (to avoid excessive heat) or below the vent pipe (to avoid possible condensation damage).

Figure 2. Horizontal or sloping installation of vent damper

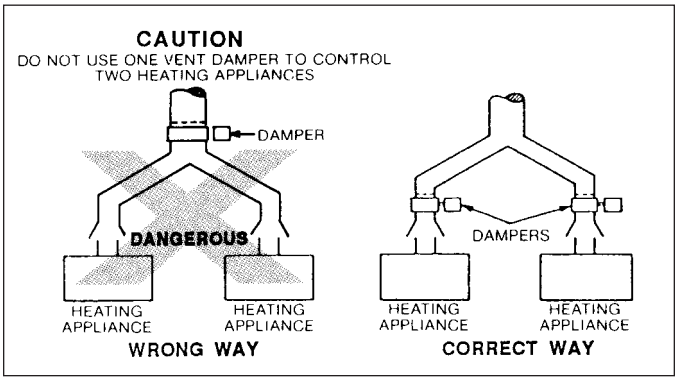
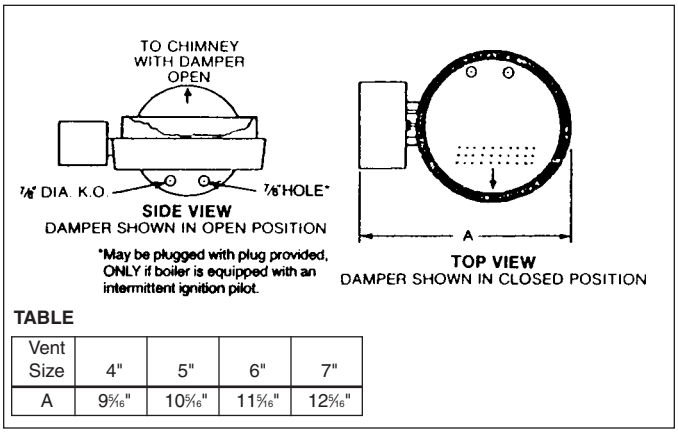


Figure 3.



TABLE

Vent Size	4"	5"	6"	7"
A	9 5/16"	10 5/16"	11 5/16"	12 5/16"

Figure 4. Vent damper dimensions

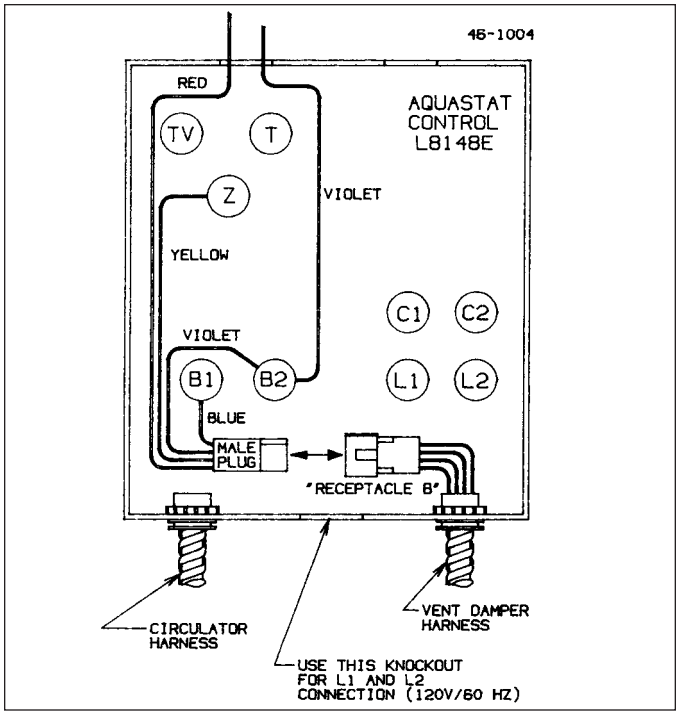


Figure 5. Connecting "RECEPTACLE B" to "MALE PLUG" inside L8148E aquastat box

WARNING—DANGER

Once you have begun vent damper installation procedure, DO NOT restore electric power and gas supply until installation and inspection have been completed (in order to prevent the main burners from operating). DO NOT operate the boiler until the vent damper harness "RECEPTACLE B" is plugged into "MALE PLUG" (as described in the installation instructions), and the vent damper installation and checkout procedures have been completed. Failure to observe this warning may create a hazardous condition that could cause an explosion or carbon monoxide poisoning.

B. 1. This device must be installed after the boiler draft hood (between the draft hood outlet and the connector to the outdoor chimney or vent) as close to the draft hood as practicable, and without modification of the draft hood or the vent damper. (See figure 1 and 2.)
   2. The inlet size of the vent damper must be the same nominal trade size as the outlet of the draft hood.
   3. This device must be located in a venting system or section of a venting system so that it serves only the single appliance for which it is installed. (See figure 3.)
   4. Clearances of not less than 6 inches (152MM) must be maintained from combustible materials, with provisions for service access.

C. NOW, PROCEED AS FOLLOWS:
Remove the cover from the aquastat control. Note the Molex connector (MALE PLUG) inside the control box (see figure 5). Remove knockout in the control housing marked for vent damper, pass "Receptacle B" of vent damper harness through the knockout and attach the flexible metallic connector to the control housing with the nut. Join the two halves of the Molex connector (MALE PLUG AND RECEPTACLE B). Replace the control cover. Attach the other side of vent damper harness to vent damper operator (if not attached) and connect Molex connector to operator receptacle. (See figure 1.)

D. AFTER INSTALLATION:
   1. Operate system through two complete cycles to check for opening and closing in proper sequence, and proper burner operation. DAMPER MUST BE IN OPEN POSITION WHEN BOILER MAIN BURNERS ARE OPERATING.
   2. Perform installation checks as required by ANSI specification Z21.66. (See Vent Damper Instructions.)
   3. Check the troubleshooting section if problems arise with the installation.

E. THERMOSTAT HEAT ANTICIPATOR ADJUSTMENTS
If the 24V room thermostat that controls this boiler has an adjustable heat anticipator and has previously been adjusted without a vent damper, then see publication VD-40 for correct electrical requirement adder for the vent damper used. If room thermostat has not been adjusted, connect entire system to thermostat and run the system while measuring the current drawn through the thermostat wires. Set the heat anticipator at the value of current measured. For more information, see Slant/Fin vent damper installation manual, pub. VD-40, and the manufacturer's vent damper booklet shipped with the vent damper.

GAS PIPING

A. Local installation codes apply. The pipe joint compound used on threads must be resistant to the action of liquefied petroleum gases.

B. The gas supply line to the boiler should be run directly from the meter for natural gas or from the fuel tank for L.P. propane gas. See page 2 for location of union and manual main shutoff valve that may be specified locally.
Selecting pipe size for natural gas:
   1. Measure or estimate the length of piping from the meter to the installation site.
   2. Consult gas supplier for heating value of gas (BTU/cu. ft.).
   3. Divide boiler rated input by heating value to find gas flow in piping (cu. ft. per hour).
   4. Use table A to select proper pipe size.

Example: Boiler model SE-175 is to be installed. Distance from gas meter to the boiler is 20 ft. Heating value of natural gas is 1020 BTU/cu. ft. Select proper pipe size.

$$\text{Gas flow} = \frac{175{,}000 \text{ BTU/hour}}{1020 \text{ BTU/cu.ft.}} = 171.5 \text{ cu. ft. per hour}$$

At 20 ft. length of pipe, match required capacity from Table A (choose higher capacity, in this case is 190 cu. ft. per hour). Required pipe size is 3/4".
Improper gas pipe sizing will result in pilot flame outages, insufficient heat and other installation difficulties. For more information and also if other appliances are to be attached to the piping system, see Appendix C of National Fuel Gas Code ANSI Z223.1-latest edition.

C. The boiler and its gas connection must be leak tested before placing the boiler in operation. Use liquid soap solution for all gas leak testing. DO NOT use open flame.
This boiler and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 PSIG. This boiler must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG. This boiler must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG.

Table A.

Length of Pipe in Feet	Gas Flow In Piping -- cu. ft. per hr. Iron Pipe Size (IPS)—inches				
	1/2	3/4	1	1-1/4	1-1/2
10	132	278	520	1050	1600
20	92	190	350	730	1100
30	73	152	285	590	890
40	63	130	245	500	760
50	56	115	215	440	670
60	50	105	195	400	610
70	46	96	180	370	560
80	43	90	170	350	530
90	40	84	160	320	490
100	38	79	150	305	460

At pressure drop of 0.3 in. water, specific gravity = 0.60.

D. All gas piping used should be inspected thoroughly for cleanliness before makeup. A sediment trap must be provided, as illustrated on page 2.
E. The minimum and maximum gas supply pressure (at the inlet of gas valve) are shown on the boiler rating plate for the type of gas used. Gas supply pressure should never be less than minimum or more than maximum pressure when the boiler or any other appliance is turned on or off.

ELECTRICAL CONTROLS AND WIRING

A. The electrical power to the boiler must be on a separately fused and live circuit.
B. If an external electrical source is utilized, the boiler, when installed, must be electrically grounded in accordance with the requirements of the authority having jurisdiction or, in absence of such requirements, with the National Electrical Code, ANSI/NFPA No. 70-latest edition.
C. Basic control wiring diagrams are given on page 13. Other control systems may be factory supplied, see User's Information Manual and Instructions packed with control system supplied.
D. After placing the boiler in operation, the safety shutoff device must be tested. See page 12 safety check.

BOILER ROOM AIR SUPPLY AND VENTILATION

An ample supply of air is required to obtain combustion and ventilation. ALL AIR COMES FROM OUTSIDE, directly through wall openings to the boiler or through unsealed openings around windows, doors, etc. in the whole building. When buildings are insulated, caulked and weather stripped, now or later on, direct openings to outside may be required and should be provided. If the boiler is not near an outside wall, air may be ducted to it from outside wall openings.

Provisions for combustion and ventilation air must be made in accordance with section 5.3, Air for Combustion and Ventilation, of the National Fuel Gas Code, ANSI Z223.1-latest edition, or applicable provisions of the local building codes. The following recommendation applies to buildings of energy-saving construction, fully caulked and weather stripped:

Provide one GRILLED opening near the floor and one near the ceiling on an outside wall near the boiler (or duct from such openings to the boiler), EACH opening to be a minimum of one square inch per 2000 Btuh input to ALL APPLIANCES in the area. For a total appliance input of 200,000 Btuh, each opening will be 100 square inches. A grilled opening 10"X10" has 100 square inches of area. If fly screen must be used over openings, double the area and inspect and clean the screen frequently.

Openings must never be reduced or closed. If doors or windows are used for air supply, they must be locked open. Protect against closure of openings by snow and debris. Inspect frequently.

No mechanical draft exhaust or supply fans are to be used in or near the boiler area.

The flow of combustion and ventilating air to the boiler must not be obstructed.

WATER PIPING

I. CIRCULATING SYSTEMS
   A. Packaged water boilers are equipped with a water circulating pump, mounted to return the water into the boiler. For some installations, the pump should be on the supply main. See figure 6.

II. AIR CONTROL SYSTEM
   A. DIAPHRAGM-TYPE COMPRESSION TANKS are used to control system pressure in an AIR ELIMINATING SYSTEM: an automatic air vent is used to REMOVE air from the system water. See figure 6. If system pressure needs further control, add an additional tank or install a larger capacity tank. Locate the tank near the boiler, as illustrated.An automatic air vent should be installed in the top of the boiler or air purger. See figure 6.
   B. PUMP LOCATION — Locating low-head pump(s) on return to boiler is acceptable for smaller boiler sizes in residences of one or two stories. The alternate pump location shown in illustration is required in large, multi-story building installations, especially when high-head pumps are used. The compression tank must be at the boiler or between boiler and supply main pump(s). IMPORTANT: Hot water heating systems containing high water volume, such as would occur with cast-iron radiation, require special care with air elimination. The circulator pump should be located on the boiler supply pipe and the expansion tank and air scoop should be located near the pump suction.
   C. On a hot water boiler installed above radiation level, the boiler must be provided with a low water cutoff device at the time of installation by the installer.

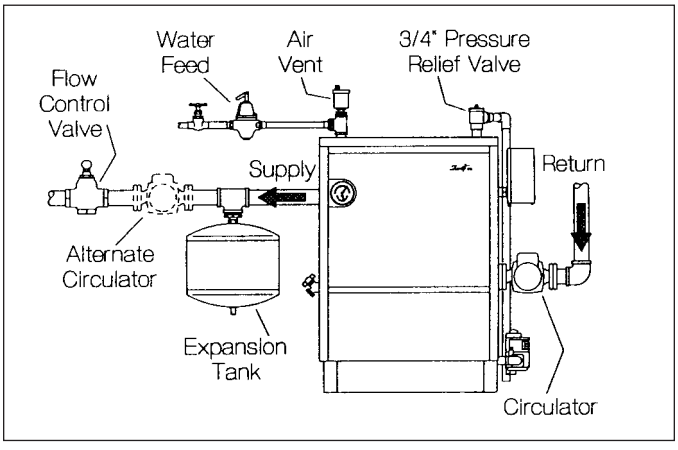


Figure 6. Piping arrangement

OPERATING INSTRUCTIONS

I. FILLING AND VENTING WATER SYSTEMS

A. Fill the system with water. Vent or purge off air.
B. Fire the boiler as soon as possible (see following warning and instructions) and bring water temperature to at least 180 degrees, while circulating water in the system.
C. Vent air and add water as needed to achieve operating pressure on boiler gauge. Pressure must be between approximately 12 psi (cold water) and 25 psi (at water temperature setting of high limit control), for boilers equipped with 30 psi relief valves. Boilers rated for a higher pressure and equipped with a matching relief valve may operate at a higher pressure, but no higher than 5 psi below the relief valve opening pressure.
D. Check for and repair any leaks before placing system in service. Before firing boiler, make these checks:
1. System is full of water. Air is vented or purged.
2. Relief valve is installed in accordance with the ASME Boiler Pressure Vessel Code, Section IV. Valve opening is not closed or reduced in size.
3. Venting is installed according to instructions under “VENT PIPING”.
4. All wiring is completed, following applicable wiring diagrams.
5. Using soap solution, check for gas leaks in all gas piping from meter to boiler pilot and manifold. DO NOT use open flame.

II. INITIAL START

Safe lighting and other performance criteria were met when testing various gas manifold and control assemblies used on the Sentinel Series Boilers under the ANSI-Z21.13-1991 Standard.

INSTRUCTIONS

Follow the lighting instructions in this manual that apply to the particular ignition system equipped on this boiler. (Also, see figures on page 2 for location of gas manifold, gas valve and control assembly.) These instructions are also attached to the boiler.

1. Continuous Burning Pilot (24V).
FOR BOILERS EQUIPPED WITH HONEYWELL GAS VALVE VR8200 or VR8300 (see figures 7 and 8).

SAFETY INFORMATION
FOR YOUR SAFETY READ BEFORE LIGHTING

WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

A. This appliance has a pilot which must be lighted by hand. When lighting the pilot, follow these instructions exactly.
B. BEFORE LIGHTING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.
WHAT TO DO IF YOU SMELL GAS
- DO NOT try to light any appliance.
- DO NOT touch any electric switch; DO NOT use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

C. Use only your hand to push in or turn the gas control knob. NEVER use tools. If the knob will not push in or turn by hand, DON'T try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.
D. DO NOT use this appliance if any part has been under-water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under-water.

Lighting Instructions

1. STOP! Read the safety information on this page.
2. Set the thermostat to lowest setting.
3. Turn off all electric power to the appliance.
4. Remove control access panel.
5. Push in gas control knob slightly and turn clockwise to "OFF".
6. Wait five (5) minutes (longer for propane) to clear out any gas, then smell for gas, including near the floor. If you then smell gas, STOP! Follow "B" in the safety information on this page. If you don't smell gas, go to next step.

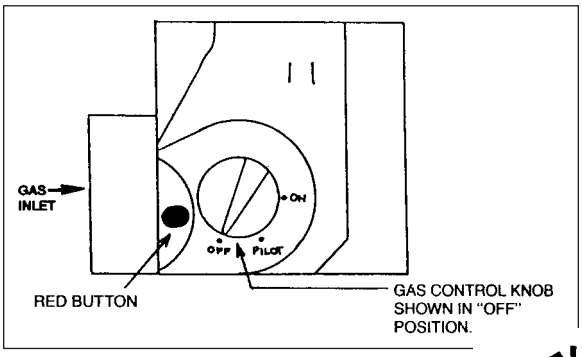


Figure 7. Valve VR8200 or VR8300

7. Remove the pilot access panel located below and behind the gas control unit.
8. Find pilot—follow metal tube from gas control. The pilot is between two burner tubes behind the burner access panel.
9. Turn knob on gas control counterclockwise to "PILOT".
10. Push in red button all the way and hold in. Immediately light the pilot with a match. Continue to hold the red button in for about one (1) minute after the pilot is lit. Release knob and it will pop back up. Pilot should remain lit. If it goes out, repeat steps 5 through 10.
- If knob does not pop up when released, stop and immediately call your service technician or gas supplier.
- If the pilot will not stay lit after several tries, turn the gas control knob to "OFF" and call your service technician or gas supplier.

11. Replace pilot access panel.
12. Turn gas control knob counterclockwise to "ON".
13. Replace control access panel.
14. Turn on all electric power to the appliance.
15. Set thermostat to desired settings.

To Turn Off Gas To Appliance

1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. Remove control access panel.
4. Turn gas control knob clockwise to "OFF". DO NOT force.
5. Replace control access panel.

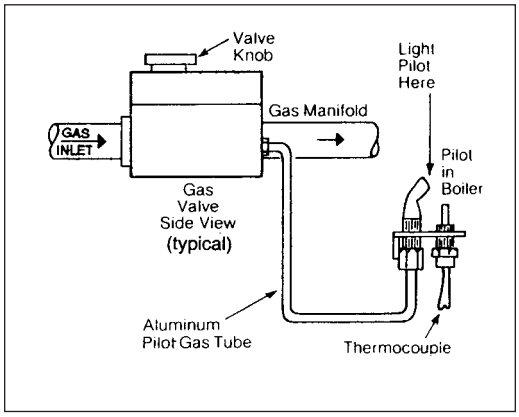


Figure 8.

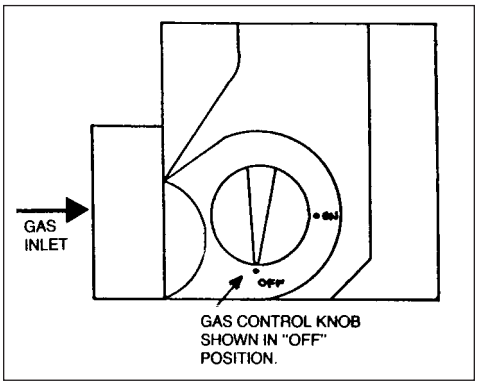


Figure 9. Valve VR8204 or VR8304

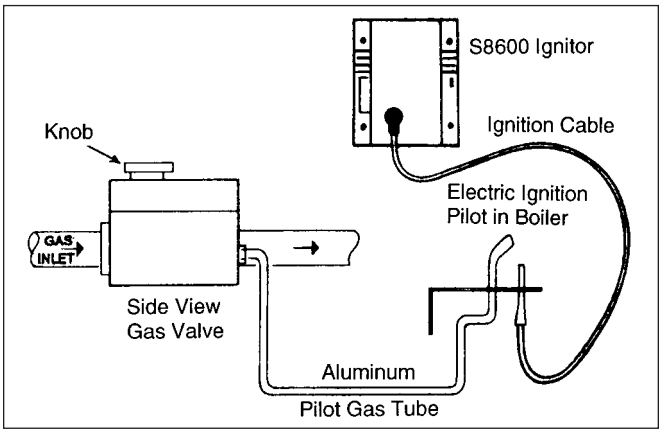


Figure 10.

2. Intermittent Pilot System (IID). FOR BOILERS EQUIPPED WITH HONEYWELL GAS VALVE VR8204 OR VR8304 (see figures 9 and 10).

SAFETY INFORMATION
FOR YOUR SAFETY READ BEFORE OPERATING

WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

A. This appliance is equipped with an ignition device which automatically lights the pilot. DO NOT try to light the pilot by hand.
B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.
   WHAT TO DO IF YOU SMELL GAS
   - DO NOT try to light any appliance.
   - DO NOT touch any electric switch; DO NOT use any phone in your building.
   - Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
   - If you cannot reach your gas supplier, call the fire department.
C. Use only your hand to push in or turn the gas control knob. NEVER use tools. If the knob will not push in or turn by hand, DON'T try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.
D. DO NOT use this appliance if any part has been underwater. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been underwater.

Operating Instructions

1. STOP! Read the safety information above.
2. Set the thermostat to lowest setting.
3. Turn off all electric power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the pilot. DO NOT try to light the pilot by hand.
5. Remove control access panel.
6. Turn gas control knob clockwise ↷ till knob stops then continue to "OFF". DO NOT force.
7. Wait five (5) minutes (longer for propane) to clear out any gas, then smell for gas, including near the floor. If you then smell gas, STOP! Follow "B" in the safety information above on this page. If you don't smell gas, go to next step.
8. Turn gas control knob counterclockwise ↶ to "ON".
9. Replace control access panel.
10. Turn on all electric power to the appliance.
11. Set thermostat to desired setting.
12. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier

To Turn Off Gas To Appliance

1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. Remove control access panel.
4. Turn gas control knob clockwise ↷ till knob stops, then continue to "OFF". DO NOT force.
5. Replace control access panel.

III. BURNER ADJUSTMENT

A. Adjust gas input rate:
   1. Consult gas supplier for higher* heating value of gas (Btu/cu.ft.)
   2. Set thermostat high enough so that boiler will remain on while checking rate.
   3. Measure manifold pressure at 1/8" tapping. Correct manifold pressure for gas used is printed on boiler rating plate. NOTE: Gas pressure may be adjusted by turning pressure regulator screw on combination gas valve (turn clockwise to increase pressure, counterclockwise to decrease pressure).
      a. Input for PROPANE is approximately at rating shown on rating plate when manifold pressure is 9-1/2" water column.

b. Input for NATURAL GAS is approximately at rating when manifold pressure is 3-1/2" water column, but should be checked on the gas meter:
Btuh Input = Btu/cu. ft. x cu. ft. metered in 3 minutes x 20
Example #1:
For 1000 Btu/cu.ft. gas, this becomes:
Btuh Input = cu. ft. metered in 3 minutes x 1000 Btu/cu.ft. x 20
Example #2:
For 1050 Btu/cu.ft. gas, this becomes:
Btuh Input = cu. ft. metered in 3 minutes x 1050 Btu/cu.ft. x 20

4. The higher heating value* of gas varies substantially for different localities. Consult with Slant/Fin's Technical Service Dept. for re-orificing procedures if any of the following apply:
   a. Boiler (burner) is overfiring. CAUTION! National Fuel Gas Code ANSI Z223.1-latest edition, does NOT permit firing at a higher input rate than the input rate indicated on the boiler rating plate in order to avoid hazardous conditions such as explosion or carbon monoxide poisoning.
   b. Poor higher heating value* of gas is causing the actual input to be substantially lower than the rating plate indication.

* "Higher heating value" of gas is commonly known as a "heating value."

Boiler rated input in cu. ft./hr. of 1000 Btu/cu. ft. Natural Gas	Cubic Feet Gas Consumption 1000 Btu/cu. ft. gas, in 3 minutes, at rated input
70	3.50
105	5.25
140	7.00
175	8.75
210	10.50
245	12.25

Gas rate table: The gas metered in 3 minutes to obtain rated input for each boiler model, using 1000 Btu/cu. ft. gas, is tabulated in gas rate table.

B. Main Burners
1. Fire the boiler continuously for at least 15 minutes, to reach burner operating temperature.
2. Observe the flames, all burners. The base of all flame jets should be blue. The tips should be blue shading to orange. NOTE: Dust, disturbed by any movement, will cause bright orange flames. Wait for dust to settle.
3. For one burner, close the air shutter until some of its flame jet tips turn yellow-white, indicating insufficient primary air. Then open shutter until whitish tips disappear completely. Set all burner shutters to the same opening. Observe to make sure that no yellow-white tips appear over any portion of the flame. Small yellow tips at the pilot location are permitted.
   NOTE: This adjustment method gives MINIMUM primary air setting for safe combustion. DO NOT attempt to make this adjustment unless burners are at operating temperature. Adjustment should be made with burner access panel in final operating position. Use of a mirror may be helpful to observe flames. Note that burner ports are on top of main burner tube.

C. Main Burner Ignition Checkout and Pilot Adjustment.
1. The pilot flame must not smother or snuff out when tested as follows:
   a. Main burner ignition from cold start-repeat.
   b. Continued operation of main burner.
   c. Main burner ignition with appliance at maximum operating temperature after prolonged operation.
   NOTE: Observe operation of the pilot burner with appliance doors in the final operating position. Use of a mirror may be helpful.
2. Safety Shutdown Checkout
   a. For proper operation the pilot should engulf the thermocouple or flame sensor as shown below.
   b. To adjust pilot, turn pilot flow adjustment screw on valve clockwise or counterclockwise to give a steady flame enveloping 3/8 to 1/2 inch of the tip of the thermocouple or flame sensor. Note that turning the pilot adjust screw clockwise will decrease the pilot flame.
   c. Check safety shutdown of gas valve by following procedure outlined "CARE" and "MAINTENANCE" section.

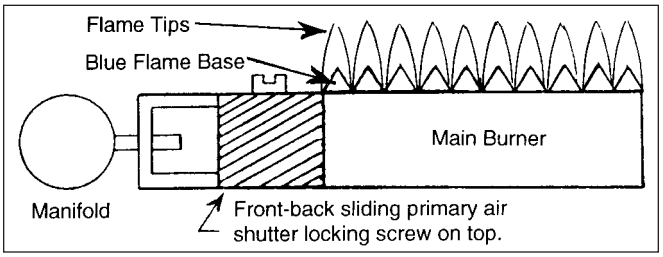


Figure 11.

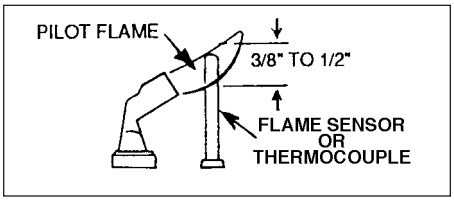


Figure 12.

CARE AND MAINTENANCE

WARNING: THE FLOW OF COMBUSTION AND VENTILATING AIR TO THE BOILER SHOULD NOT BE OBSTRUCTED. This section must be brought to the attention of the owner by the installer so that the owner can make the necessary arrangements with a qualified service agency for the periodic care and maintenance of this boiler. The installer must inform the owner that the gas supplier can recommend a number of qualified service agencies. The installer must also inform the owner that the lack of proper care and maintenance of this boiler and any fuel burning equipment may result in a hazardous condition.

1. GENERAL MAINTENANCE (Refer also to Owner's Information Manual)
These operations are recommended to be performed at regular intervals:
A. BOILER HEATING SURFACES: clean off all coatings found.
B. BOILER CONTROLS: check contacts, settings, correct functioning.
C. PIPING: check piping and accessories for leaks.
D. CHIMNEY VENTING SYSTEM: check for obstructions and leaks.

E. BOILER ROOM AIR SUPPLY: check air vents for continued POSITIVE supply of air as required. Air needs are greatest in cold weather. Air vents must be open and free of obstruction.

F. WATER SYSTEM CHECK:
1. System to be full of water, and pressure to remain stable at correct setting on gauge.
2. Air control system: noise and air binding in radiation should not occur.
3. Water lines: slightest leaks should be corrected.
4. Low water cutoff, for operation (see instructions furnished with unit).

2. WATER LEVEL CHECK DURING HEATING SEASON

A. Check water pressure regularly and add water slowly to system when needed. If much water is added, venting may be necessary.

B. Regular loss of water from water boiler system may indicate either a system leak, or a faulty air control system, or a faulty automatic fill valve.

3. ANNUAL INSPECTION AND CLEANING

A. It is important that this boiler be inspected by a competent serviceperson to help insure safe and reliable operation.

B. Check for gas leaks from valve and gas piping to burners and pilot. If leaks are found, repair or replace as required.

C. This inspection should include:
1. Controls check. See "Safety Check for Control System" (No.4) below.
2. Recheck of input gas rate to burners. See "Initial Start" paragraph in "Operating instructions" section.
3. Re-adjusting for best flame characteristics of main flame and pilot(s).
See "Initial Start" paragraph in "Operating Instructions" section and see "Burner Adjustment" section.
4. Burner and boiler flue passage cleanliness:
BURNER AND FLUE CLEANING (see figure 13). It is suggested that paper be placed on burners to collect any foreign material when cleaning flues.
5. Remove jacket top and flue cover.
6. Use wire brush to clean flueways.
7. Replace flue cover and re-seal with furnace cement. Replace jacket top. Remove and dispose of paper and accumulated material.
8. If burner surfaces are not clean, or if uneven flame indicates plugged burner ports, remove and clean burners.

NOTE-TO REMOVE BURNERS:
1. Disconnect pilot at pilot mount, or disconnect pilot gas line at gas valve, before removing burners next to pilot.
2. Lift burner and remove burner from orifice.
3. Clean and replace burners* and pilot. Adjust burners as described on page 9.

*To clean burners run a clean flue brush up the tube until all foreign matter is removed.

WARNING:
The ceramic combustion chamber in the burner box contains crystalline silica.
Wear proper dust mask and gloves when servicing combustion chamber or burners.
Crystalline Silica has been identified as a carcinogen or possibly carcinogenic to humans.

4. SAFETY CHECK FOR CONTROL SYSTEM

A. High limit control test: Set thermostat high enough for boiler water temperature to reach high limit control setting. When this temperature is reached, the high limit switch should open, and the main gas valve should close automatically. If the high limit does not operate to close the main gas valve, the valve, the high limit or the wiring is faulty. Repair or replace immediately.

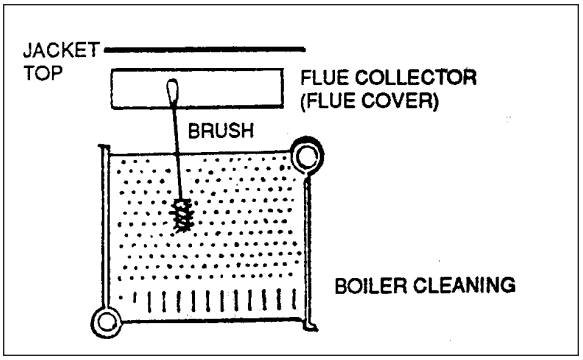


Figure 13.

B. Gas valve safety shutdown test:
1. For boiler equipped with continuous burning pilot, with main burners firing, disconnect the thermocouple from the gas valve. The gas valve should immediately shut off the main burners and the pilot.
2. For boilers equipped with Honeywell S8600 intermittent pilot system, with main burners firing, disconnect the ignition cable from the S8600 IGNITOR BOX. The gas valve should shut off the main burners.
If the gas valve fails to shut down main burners when the test in 1 or 2 is performed, replace the gas valve.

C. Check for gas leaks from valve and gas piping to burners and pilot. If leaks are found, repair or replace as required.

5. PROVIDING PROTECTION FROM FREEZING

A. Anti-freeze is sometimes used in hydronic heating systems to protect against freeze-up in the event of power failure or control shutdown when the building is unoccupied. It should be recognized that unless the building is kept above freezing temperature by some means, the plumbing system is not protected.
Two types of anti-freeze may be used: ETHYLENE GLYCOL, used in automobiles, has desirable properties, but is toxic. Its use may be prohibited when system water/glycol solution is in contact with a potable water vessel (as with a tankless heater). PROPYLENE GLYCOL is used in the quick-freeze food industry; it is practically non-toxic. Its use may be permitted when tankless heaters are used. When anti-freeze must be used, inhibited propylene glycol is recommended. Useful information on the characteristics, mixing proportions, etc. of glycol in heating systems is given in Technical Topics No. 2A, available from the Hydronics Institute 34 Russo Place, Berkeley Heights, NJ 07922. Consult glycol manufacturers for sources of propylene glycol.

B. Water Treatment:
A good water treatment program will not only extend the useful life of this boiler but it will also save much of the time and expense of repairs made necessary by preventable occurrences.
A reputable water treatment company should be consulted to evaluate and determine the best overall treatment program for your boiler equipment.

6. KEEP THE BOILER AREA CLEAR AND FREE FROM COMBUSTIBLE MATERIALS, GASOLINE, AND OTHER FLAMMABLE VAPORS AND LIQUIDS.

SEQUENCE OF OPERATION FOR SENTINEL BOILERS EQUIPPED WITH CONTINUOUS BURNING PILOTS FOR DIAGRAM SHOWN ON PAGE 13.

LIGHTED PILOT HEATS THERMOCOUPLE AND KEEPS PILOTSTAT OPEN.

⇨

THERMOSTAT CALLS FOR HEAT

⇨

CIRCULATOR ENERGIZED (IF COMBINATION AQUASTAT CONTROL USED)

HIGH LIMIT CONTACTS CLOSED? LOW WATER CUT-OFF (WHEN USED) CONTACTS CLOSED?

NO ⇦ NO FURTHER ACTION

⇨ YES

VENT DAMPER RELAY ENERGIZED. VENT DAMPER MOTOR OPENS VENT DAMPER. END SWITCH CLOSES.

⇨

MAIN VALVE OPERATOR OPENS. LIGHTED PILOT IGNITES MAIN BURNERS. IF PILOT SHOULD BLOW OUT, THERMOCOUPLE WILL SHUT OFF MAIN BURNER.

⇨

WHEN THERMOSTAT IS SATISFIED, OR WHEN HIGH LIMIT OR LOW WATER CUT-OFF CONTACTS ARE OPEN, MAIN VALVE OPERATOR CLOSES. VENT DAMPER CLOSES. CIRCULATOR OFF. SYSTEM GOES TO STANDBY WITH LIGHTED PILOT.

SEQUENCE OF OPERATION FOR SENTINEL BOILERS EQUIPPED WITH HONEYWELL INTERMITTENT IGNITION SYSTEM (IID) FOR DIAGRAM SHOWN ON PAGE 13.

THERMOSTAT CALLS FOR HEAT

⇨

CIRCULATOR ENERGIZED (IF COMBINATION AQUASTAT CONTROL USED)

HIGH LIMIT CONTACTS CLOSED? LOW WATER CUT-OFF (WHEN USED) CONTACTS CLOSED?

NO ⇦ NO FURTHER ACTION

⇨ YES

VENT DAMPER RELAY ENERGIZED. VENT DAMPER MOTOR OPENS VENT DAMPER. END SWITCH CLOSES.

⇨

IGNITION CONTROL ENERGIZED

⇨

SPARK GENERATOR MODULE POWERED.
S8600F OR S8600M: IGNITION SPARK STARTS AND PILOT VALVE OPERATOR OPENS.
S8670E: IGNITION SPARK AND PILOT VALVE OPERATOR DELAYED FOR 30-70 SECONDS.

L.P. PROPANE GAS (S8600M and S8670E) IGNITION TRIAL CONTINUES FOR 90 SECONDS. AFTER TRIAL FOR IGNITION, SYSTEM SHUTS OFF. AFTER 5 MINUTES MODULE RE-INSTATES TRIAL FOR IGNITION. IF PILOT FLAME NOT ESTABLISHED, IGNITION TRIAL, SYSTEM SHUT-OFF AND 5 MINUTES WAIT SEQUENCE REPEATS CONTINUOUSLY.

NO ⇦ THE PILOT FLAME ESTABLISHED ? NO ⇦ NATURAL GAS (S8600F) IGNITION SPARK CONTINUES. PILOT VALVE REMAINS OPEN UNTIL SYSTEM IS RESET.

⇨ YES

SPARK GENERATOR OFF. MAIN VALVE OPERATOR OPENS. MODULE MONITORS PILOT FLAME.

⇨

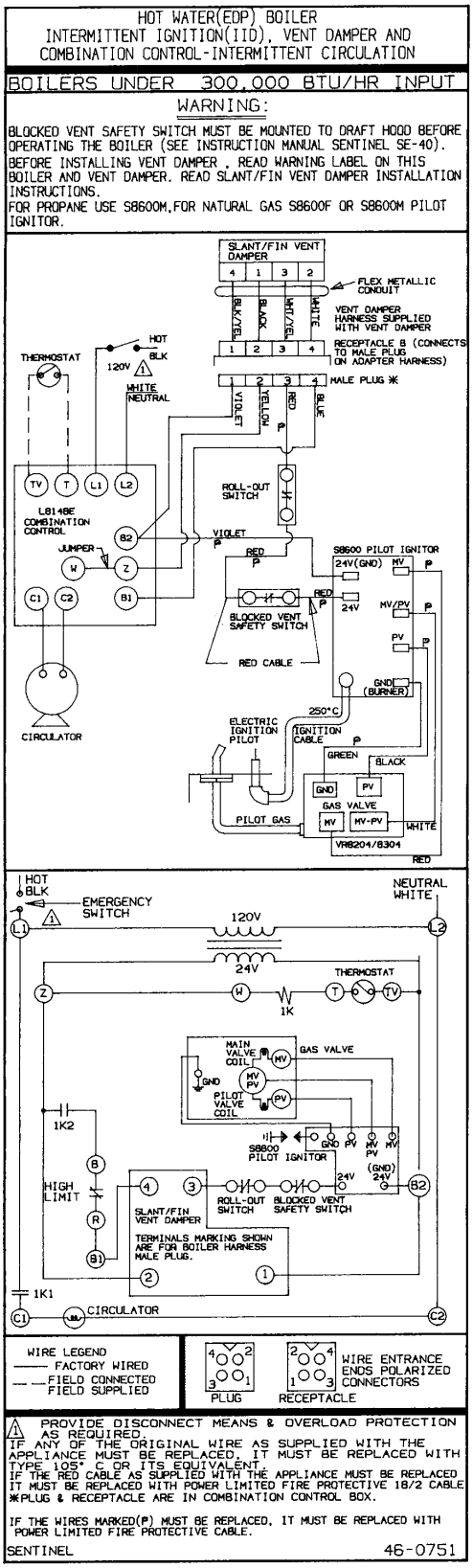
WHEN THERMOSTAT IS SATISFIED OR WHEN HIGH LIMIT OR LOW WATER CUT-OFF CONTACTS ARE OPEN, VALVE OPERATORS CLOSE. PILOT and MAIN BURNERS OFF. VENT DAMPER CLOSES. CIRCULATOR OFF. SYSTEM GOES TO STANDBY.

WIRING DIAGRAMS FOR SENTINEL HOT WATER BOILERS

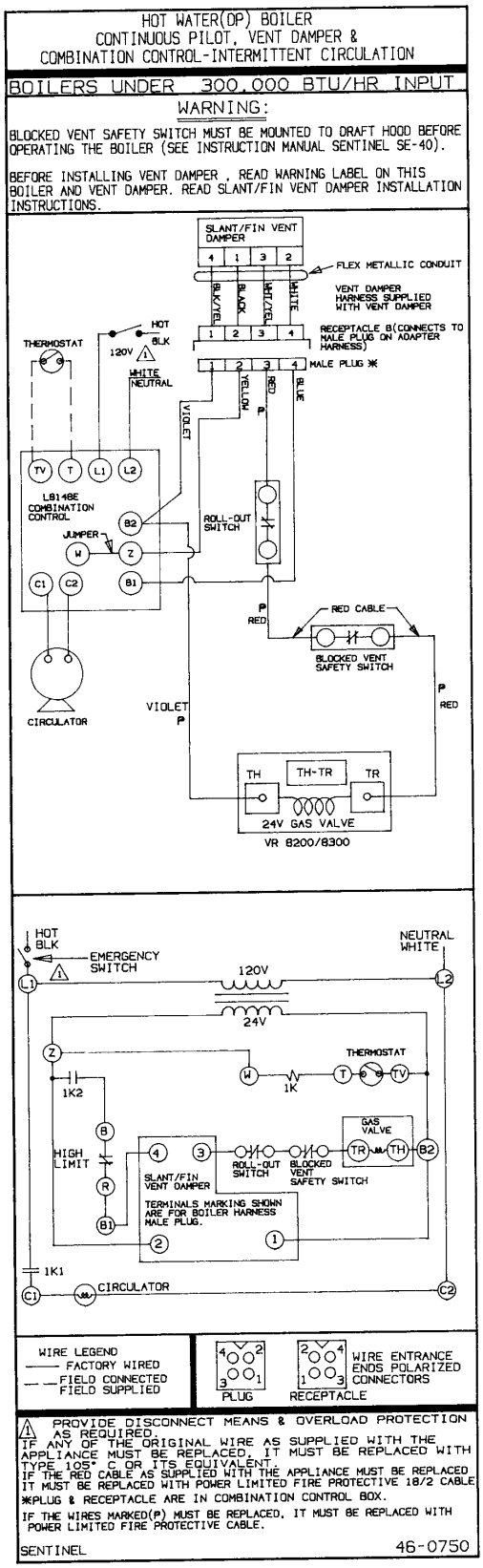
CAUTION: Label all wires prior to disconnection when servicing controls.
Wiring errors can cause improper and dangerous operation. "Verify proper operation after servicing."

Damper circuit is designed to be controlled by low voltage controls. DO NOT use line voltage operating controls to interrupt supply voltage to the L8148E aquastat.

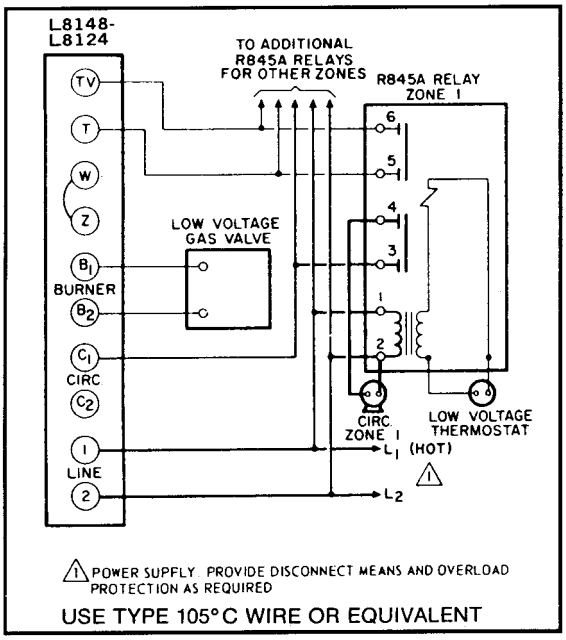
Models with Intermittent Pilot Ignition (IID)



Models with Continuous Burning Pilot

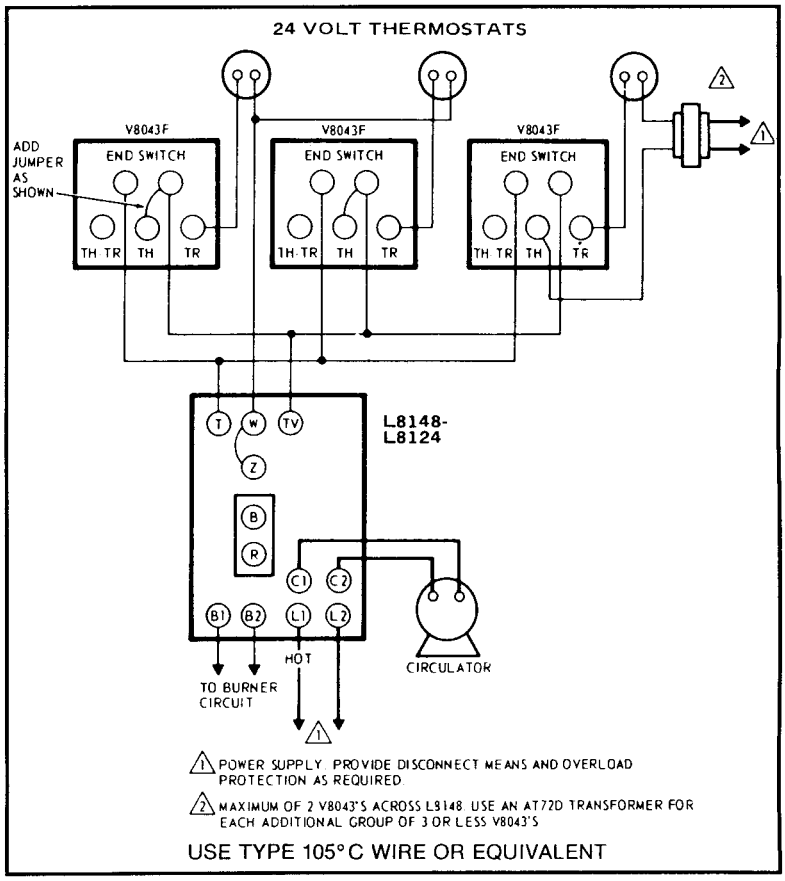


PUMP OR VALVE ZONING OF WATER BOILERS
COMBINATION CONTROLS WITH (T) (TV) (Z) TERMINALS*

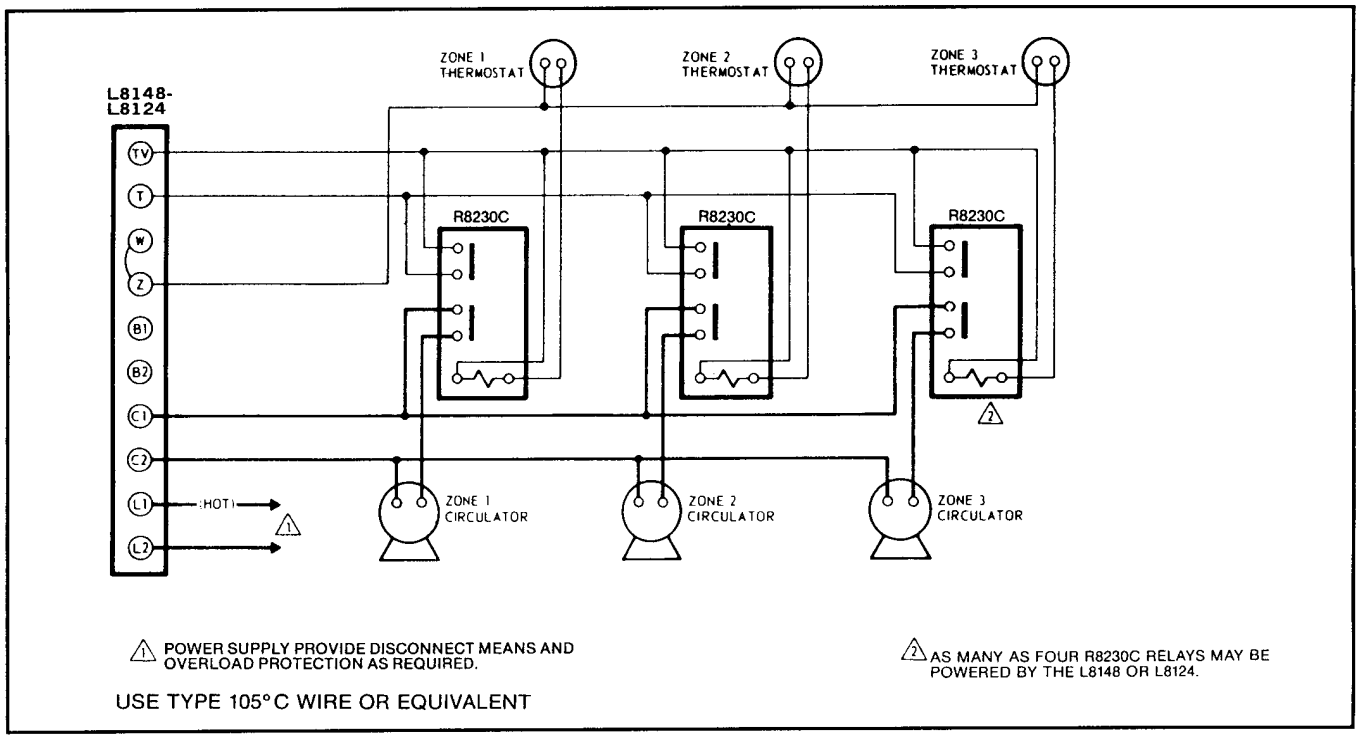


Pump Zoning system using R845A Relay.
One R845A needed for each circulator.

NOTE: Pumps are powered from (C1). Total pump load must not exceed 7.4 amp rating of combination control pump switch.



Zone valve zoning system using Honeywell V8043F zone valves.



Pump zoning system using R8230C Relays.

*For zoning diagrams, combination controls without (T) (TV) (Z) terminals and non-combination control systems, consult Slant/Fin Zoning Tech. Bulletin.

NOTE: Pumps are powered from (C1). Total pump load must not exceed 7.4 amp rating of combination control pump switch.

BURNERS FAIL TO OPERATE

CAUSE	REMEDY
1. Safety pilot out, or flame too low.	1. Check, clean, re-light. See instructions.
2. Gas supply valve shut off.	2. Open gas valve(s).
3. Electric switch open.	3. Close switch.
4. Blown or defective line fuse.	4. Replace fuse.
5. Operating or limit control contacts open or dirty.	5. Check control. Clean contacts or replace control.
6. Defective gas valve or pressure regulator; or plugged bleed line.	6. Repair or replace.
7. Defective low voltage transformer.	7. Replace transformer.
8. Obstruction at main burner orifice.	8. Check, clean and reinstall.
9. Break in wiring or loose contact at control terminals.	9. Check with test-light and correct.
10. Improper wiring.	10. Check and correct in accordance with wiring diagrams included with appliance instructions.
11. Improper controls.	11. Install proper controls.
12. Rollout or blocked vent safety switch open.	12. Replace rollout switch (inspect flue passages prior to replacement) or reset blocked vent safety switch by depressing the reset button.

BURNERS WILL NOT SHUT OFF

CAUSE	REMEDY
1. Defective operating control, gas valve, or high limit control.	1. Check, repair or replace.
2. Improper wiring or short circuit.	2. Check wiring and controls.

FLASH BACK - BURNING AT ORIFICES

CAUSE	REMEDY
1. Manifold gas pressure too low.	1. Adjust to proper manifold pressure.
2. Improper primary air adjustment.	2. Adjust air to produce soft, clean flame.
3. Gas regulator bleed too slow.	3. Adjust bleed opening.
4. Burrs on orifice.	4. Remove burrs.
5. Improperly drilled orifice plugs.	5. Install orifice plugs with proper drilling.
6. Leaking automatic gas valve.	6. Repair or replace.
7. Adverse draft condition in boiler room.	7. Check air supply and venting system.
8. Low main gas pressure.	8. Contact utility.
9. Safety pilot improperly installed.	9. Correct to manufacturer's recommendations.

DELAYED IGNITION

CAUSE	REMEDY
1. Pilot flame too low.	1. Increase gas supply to pilot.
2. Pilot burner ports or pilot orifice clogged.	2. Clean ports or orifices.
3. Burners or orifices out of alignment.	3. Realign burners or manifold.
4. Excessive primary air.	4. Adjust primary air shutters.
5. Excessive burner input.	5. Check and reduce to input shown on rating plate.
6. Adverse draft condition in boiler room.	6. Check air supply and venting system.

FUMES AND GAS ODORS

CAUSE	REMEDY
1. Leaks in gas piping or accessories.	1. Locate leaks and repair.
2. Gas leaks in service line or meter connections.	2. Close service supply valve - shut down appliance and notify utility.
3. Blocked chimney.	3. Check and repair chimney.
4. Boiler flueways blocked with soot.	4. Clean flueways and adjust burners as described in the installation instructions.
5. Undersized breeching or too many turns in breeching.	5. Check manufacturer's recommendations.
6. Adverse draft condition in boiler room.	6. Check air supply and venting system.
7. Overfiring.	7. Adjust gas input to that shown on boiler rating plate.

CONDENSATION IN BOILER FLUES OR IN VENT SYSTEM

CAUSE	REMEDY
1. Underfiring.	1. Increase firing rate to that shown on rating plate.
2. Boiler water maintained at too low a temperature level.	2. Set low limit controls to maintain a higher water temperature. If boiler is not equipped with low limit replace with one which has a combination low limit/high limit aquastat.
3. Long horizontal run of smokepipe.	3. Relocate boiler or insulate breeching.
4. Inadequate chimney or venting system.	4. Check chimney and venting recommendations.

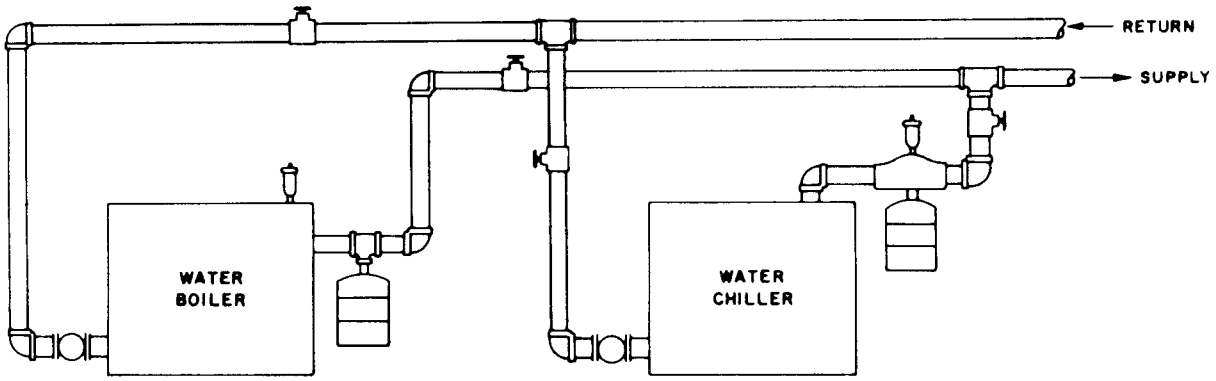
PIPING A HEATING - COOLING SYSTEM TO A WATER BOILER AND CHILLER

The chiller must be piped in parallel with the boiler. Figure below illustrates a method of piping a heating-cooling system to a water boiler and a chiller. Hand valves (shown) or automatic valves must be installed to prevent circulation of chilled water in the boiler or hot water in the chiller.

The air control system and pressure control system must operate with chiller only, or the boiler only, being valved to the piping system.

Separate control devices on the boiler and chiller may be used, or a single set of air and pressure controls on the common piping may be preferred.

If the boiler is used to supply hot water to heating coils in air handling units, flow control valves or other devices must be installed to prevent gravity circulation of water in the coils during the cooling cycle.



IF REPLACEMENT PARTS ARE NEEDED

When parts are needed, refer to boiler model and serial number shown on the boiler name/rating plate. Refer to publication number SE-10PL Sentinel Replacement Parts for part numbers. Whenever possible refer to the original order by number and date.

Control identification and replacement should not be attempted by unskilled personnel. Only simple, easily-identified controls and parts may be obtained locally. All other controls and parts should be identified by and ordered from Slant/Fin. Relief/Safety valves must be ASME rated for the pressure and gross output of the boiler.

For replacement parts, heating contractors should contact their Slant/Fin boiler distributor.

APPENDIX A
Removal of Existing Boiler from Common Vent System

"At the time of removal of an existing boiler, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation."

(a) Seal any unused openings in the common venting system.
(b) Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
(c) Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryer and any appliance not connected to the common venting system. 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.
(d) Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.
(e) Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar or pipe.
(f) After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-burning appliance to their previous conditions of use.
(g) Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1-latest edition. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Appendix G in the National Fuel Gas Code, ANSI Z223.1-latest edition.