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THERMIFIC® GAS-FIRED BOILER



A.G.A. Designed-Certified
Complies with ANSI Z21.13
Low-Press. Boiler



ASME Code, Section IV
Certified by Patterson-Kelley



C.G.A. Approved
Complies with CAN1-3.1
Ind. & Comm. Boilers

DIRECT VENT INSTALLATION INSTRUCTIONS

SUPPLEMENT TO THE STANDARD INSTALLATION &
OWNER'S MANUAL (TBIG-Latest edition)



Patterson-Kelley
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East Stroudsburg, PA 18301
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INTRODUCTION

Direct vent, or sealed combustion, is a closed system method of ducting the combustion air directly from the outside of the building into the inlet compartment of the burner, and a sealed exhaust vent from the combustion chamber to the outdoors.

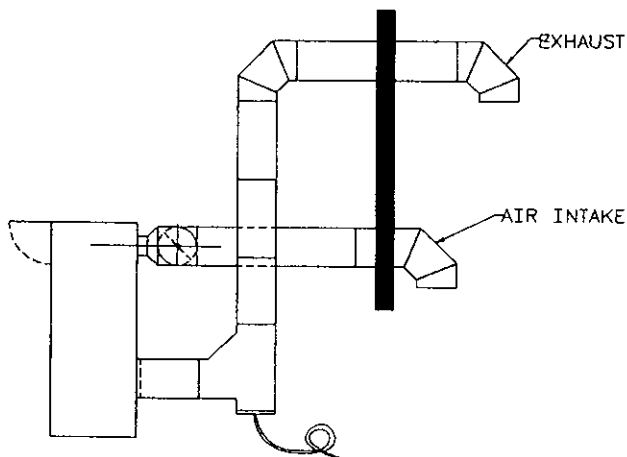
The direct vent/sealed combustion option is available on the Thermific boilers on models SN-700, SN-900, SD-900, SN-1200, SD-1200, SN-1500, SD-1500, SN-1700, SN-1900 & SD-1900 (The Canadian versions are also available).

Advantages are:

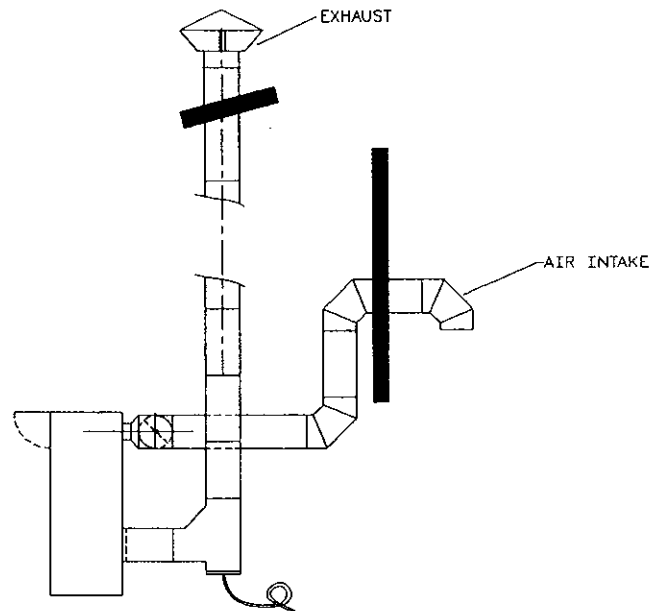
- Savings in energy costs due to the elimination of using conditioned air (heated and/or cooled building air) from going back up the stack.
- Isolation of the burner from pressure changes in the building which can cause erratic combustion performance.
- Combustion air is taken from the outside which is generally more clean than indoor air. Halide contaminants within a building, such as chlorides, can cause excessive corrosion in the burner, heat exchanger and venting system.

Direct venting to and from the boiler can be done in three basic configurations:

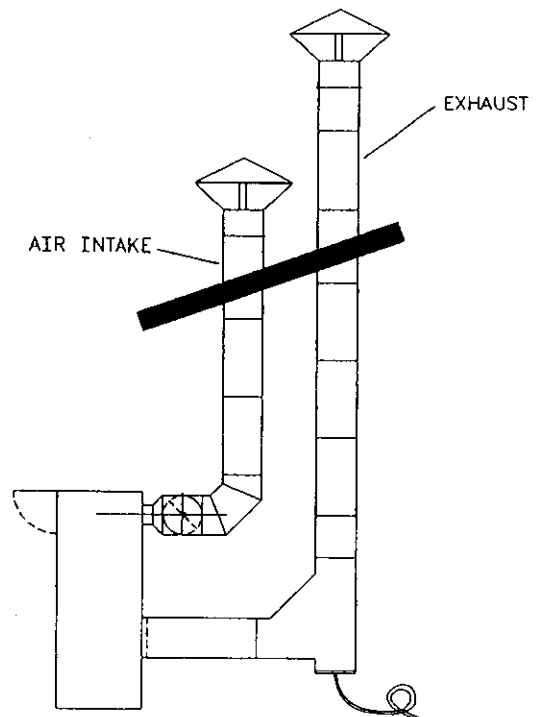
1. Combustion air inlet and flue gas exhaust duct through the sidewall.



2. Combustion air inlet duct through the sidewall and the flue gas exhaust through the roof.



3. Combustion air inlet duct from the roof and the flue gas exhaust through the roof.



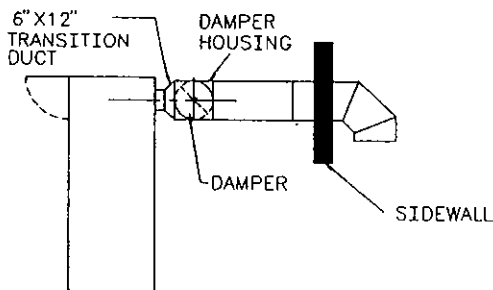
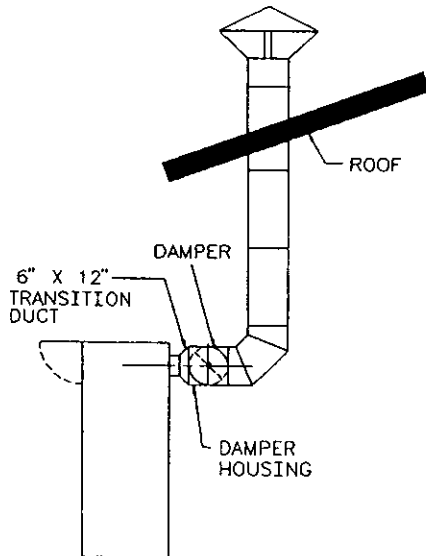
COMBUSTION AIR INLET

The air inlet duct system must be 12 inch diameter single wall galvanized duct (minimum thickness 26 gauge) or PVC duct tubing (0.187 inch wall thickness) only. No substitutions. See later sections for assembly instructions. The **maximum** allowable total length of the inlet duct system is **100 equivalent feet**. See Table 1 (p. 4) for the equivalent length of the fittings.

The direct vent style boiler is shipped with a separate box of accessories. This box contains the following items:

1. Custom 6 inch diameter to 12 inch diameter transition duct.
2. Intake damper assembly with actuator and limit switch mounted to the damper shaft.
3. Auxillary Control Panel to operate the intake damper assembly.

* The intake damper assembly and control panel will prevent the flow of cold air through the boiler during the off cycle and prevent freeze up and "off cycle" losses. These two items are optional but are strongly recommended in all installations.



Inlet Duct Assembly at the Boiler

The boiler is equipped with a special collar attached to the air intake opening on the back of the unit (at the blower housing on model #700, 900 and 1200; at the back of the cabinet on models #1500, 1700 and 1900). A separate box of accessories should be sent with the boiler.

These accessories should be mounted on the boiler as follows:

1. Attach the 6 inch diameter end of the custom transition duct to the collar using a minimum of 4 sheet metal screws spaced approximately at 90 degree intervals. This joint must then be wrapped with an aluminum tape backed on the contact side with an adhesive.
2. The damper assembly is to be installed within the remainder of the 12 inch duct system. Orient the damper such that the arrow points towards the boiler. The damper assembly can be mounted horizontally or vertically.
3. Refer to the appropriate section to attach the remainder of the air intake duct system.
4. See appropriate section for instructions to connect the Auxillary Control Panel to the damper assembly and the boiler.
5. The termination fitting for the air intake duct system must be as described in the next section.

Air Inlet Termination

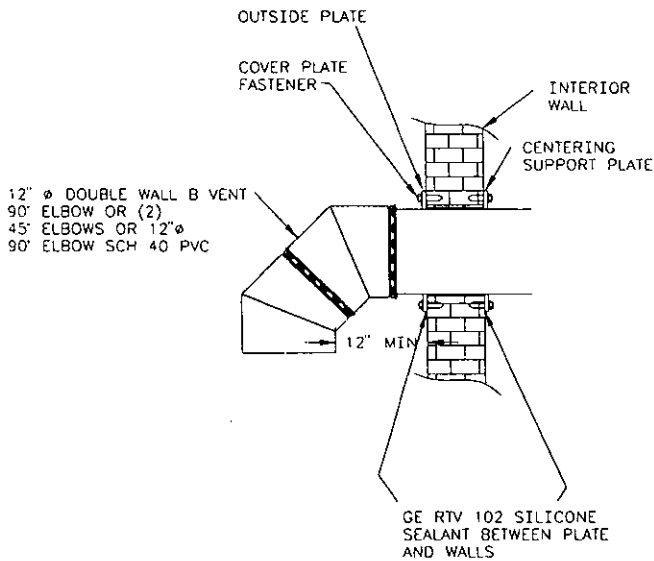
The boiler combustion air inlet duct must be fitted with a P-K recommended termination device. When installing a sidewall intake system, the termination must be either:

1. 12 inch diameter double wall B vent 90 degree elbow or (2) 45 degree elbows

or:

2. 12 inch diameter schedule 40 PVC 90 degree elbow.

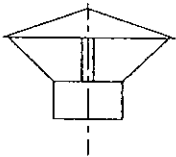
Whichever material is used, the termination must point down and must be backed by a metal plate secured to the wall. See diagram below.



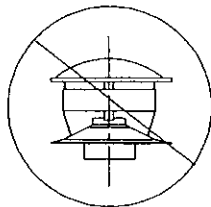
Air Intake Terminal, Sidewall

If the combustion air inlet duct is routed through the roof, the termination must be either the same type as described for a sidewall installation or a rain cap. The rain cap should be unrestrictive type similar to the illustration below.

TYPICAL CORRECT UNRESTRICTIVE



TYPICAL INCORRECT RAIN CAP



NOTE: The equivalent length of the chosen termination must be included in the calculation of the maximum allowable equivalent length. See Table 1 for equivalent lengths.

Equivalent Length of Air Inlet Duct Fittings

Table #1

Fitting Description	Equivalent Length
90° Elbow*	10 Feet
45° Elbow*	5 Feet
Rain Cap	10 Feet

* Same equivalent length for galvanized or PVC duct.

Single Wall Galvanized Duct Intake

Proper sealing of the tubing is necessary to prevent flow of combustion air from conditioned space. If single wall galvanized tubing is used, GE RTV-102 silicone sealant, or equivalent, must be used on each circumferential and horizontal joint before joining together. **At least 24 hours must be allowed for cure of this sealant and proper bond.** Cure time can be reduced through the application of heat (See instructions provided with the sealant). After the cure period, each joint must be wrapped with an aluminum tape which is faced on the contact side with an adhesive.

PVC Duct Intake

If PVC duct tubing is utilized, the pipe must be squarely cut to allow for proper interface of the pipe end and the fitting socket bottom. After cutting, use a knife, deburring tool, or file to remove burrs from the outside and inside of the pipe. To permit easier insertion of the pipe into the end of the fitting, it is recommended that a 10 or 15 degree chamfer be applied to the end of the pipe. Tapered fitting sockets are designed so that an interfaced fit should occur when the pipe is inserted about 1/3 to 2/3 of the way into the socket. Occasionally, when pipe fitting dimensions are at the tolerance extremes, it will be possible to fully insert dry pipe to the bottom of the fitting socket. When this occurs, a sufficient quantity of cement must be applied to the joint to fill the gap between the pipe and the fitting. The gap must be filled to obtain a strong, leak-free joint. Remove all dirt, grease and moisture from fitting sockets and pipe with a clean, dry rag or, if necessary, with a clean rag dipped in acetone solvent. Apply a Tetrahydrofuran (THF) primer or methyl ethyl ketone (MEK) cleaner to the surfaces of the pipe and fitting socket with a natural bristle brush. Apply the PVC solvent cement (do not use combination cements) quickly while the surfaces are still wet with primer. Insert the pipe into the fitting socket quickly and give the pipe or fitting a 1/4 inch turn to evenly distribute the cement. Hold the joint together for 15 seconds. Remove all excess cement from around the pipe and fitting with a dry rag. This must be done while the cement is still wet. The joint should not be disturbed immediately after the cementing procedure and sufficient time should be allowed for proper cure of the joint. The exact cure time is difficult to predict as it is dependent upon temperature, humidity and cement integrity. Contact the cement manufacturer for this specific information.

Sealing PVC Duct Tubing to the Intake Damper Assembly

Apply a 3/4" wide x 1/8" thick gasket to the outside surface edge of the entire circumference of the intake damper assembly inlet. A closed cell foam rubber gasket with pressure sensitive adhesive works very well. Insert 3/4" of the intake damper assembly into the PVC duct tubing so that the gasket lines up with the edge of the PVC tubing. Lay an approximate 3/8" wide bead of GE RTV-102 silicone sealant, or equivalent, along the gap between the gasket and inside wall of the tubing. Allow the silicone sealant to cure for 24 hours. The cure time can be shortened with the application of heat. Refer to the manufacturer's instructions. Wrap the joint with aluminum tape which is backed with an adhesive on the contact side.

Intake Damper and Auxillary Control Panel

The intake damper assembly and control panel will prevent the flow of cold air through the boiler during the off cycle and prevent freeze up. These two items are optional but are strongly recommended in all installations.

Sequence of Operation (Replaces #6 of the Sequence of Operation in the TBIG)

6. The programmer first energizes Terminal 4 which supplies power to the airflow switch and initiates the adjustable 120 sec. timer on the time delay relay. Terminal 4 also supplies power through the normally closed contacts on the time delay relay and energizes the coil on the relay in the Auxillary Control Panel. The relay will in turn energize the damper actuator to open the damper. When the damper is in the full open position, the limit switch will close and supply power to the contactor for the blower motor.

During this time (about 20 seconds), the air switch will indicate low air flow with the "Low Air" indicator. This indicator will remain on until sufficient air flow is sensed. If the air flow switch is not closed in 120 seconds, the time delay relay will open its normally closed contacts. This will turn off the blower motor and close the intake damper. The "Low Air" indicator will remain illuminated and the boiler will not operate.

Field Wiring to Auxillary Control Panel

The Auxillary control panel does not have to be mounted on or near the boiler. It can be remotely mounted. There are five (5) field run wires between the boiler and its auxillary control panel; three (3) for main power supply and wire #'s 19A and 19B.

1. The main power supply (G/H/N) should come from the same boiler that the damper is connected to.
2. Remove the blue jumper wire in the terminal block on the boiler when wiring to 19A and 19B.

There are also five (5) field run wires between the auxillary control panel and the intake damper assembly; three (3) to the damper actuator and two (2) to the limit switch.

1. Terminals for the damper actuator:
 - DO = Damper Open (CW)
 - DC = Damper Closed (CCW)
 - DN = Neutral/Common
2. Terminals for the limit switch
 - S1 = N.O. (Normally Open)
 - S2 = Common

Use 16GA MTW wire for all field wiring. See the back of this manual for the logic and wiring diagrams of this auxillary control panel and the sealed combustion boilers.

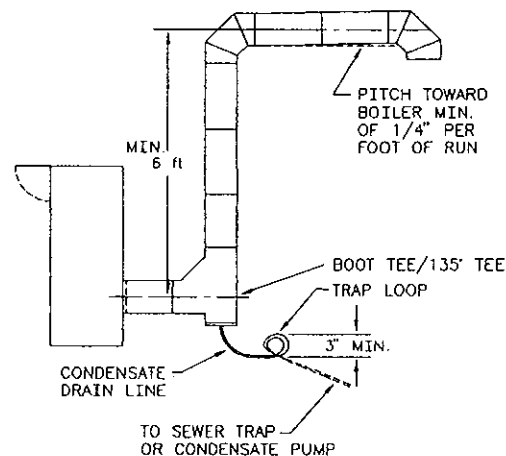
FLUE GAS OUTLET

The flue gas outlet must be 12 inch diameter double wall type vent certified under UL 1738 and ULC-636 or a positive pressure type vent (316SS) certified under UL103. Follow the vent manufacturer's instructions for proper joining of the tubing and fittings, clearances to combustibile materials and installation of firestops. The following instructions detail the correct method of attaching the tubing to the boiler and the proper termination. The **maximum** allowable length of the vent duct, including the boot tee/135° tee (not a standard tee) and the termination is **100 equivalent feet**. The exhaust vent can be run horizontally or vertically. See Table 2 (p. 6) for the equivalent length of the fittings.

Exhaust Vent Installation at the Boiler

The maximum allowable equivalent length of the 12 inch diameter tubing, including the boot tee/135° tee (not a standard tee) and termination is 100 feet if venting horizontally or vertically. See Table 2 (p. 6) for the equivalent length of the fittings.

At the outlet of the boiler, an adjustable or fixed length (minimum 2 feet for clearance from intake duct; maximum 3 feet for proper lift) section may be utilized. This section must be secured to the outlet collar by a minimum of 4 sheet metal screws spaced at approximately 90 degree intervals. The joint should be further secured by wrapping with an aluminum tape backed on the contact side with an adhesive. In transitioning from horizontal to vertical, a 12 inch diameter double wall boot tee/135° tee must be installed (not a standard tee). Even though the unit is classified as a Category I boiler (Non-pressurized-non condensing), there are certain abnormal conditions which may cause condensation in the flue vent. Therefore, it is recommended that a tee cover with a drain be provided at the bottom of the boot tee/135° tee. For proper disposal of the condensate, corrosion resistant tubing or plastic tubing should be connected to the drain nipple. Before connecting the tubing to the tee cover nipple, the trap loop must be primed by pouring a small quantity of water into the drain line. The condensate drain line can be routed to a sewer drain trap or pump. Consult vent manufacturer's instructions for proper installation of drain line.



If the flue gas exhaust is to be routed through the sidewall, a minimum vertical rise of 6 feet is required from the outlet of the

boot tee/135° tee to the inlet of the elbow. In addition, for sidewall venting, it is **VERY IMPORTANT** to provide a downward pitch of at least 1/4 inch per foot of run from the termination at the wall toward the boiler for proper drainage of the condensate and for buoyancy assist of the flue gas. Furthermore, **DO NOT LOCATE** sidewall terminations over area of pedestrian or vehicular traffic due to potential condensate drippage and ice buildup. See next Section on Clearances for more information.

When joining the double wall tubing and fittings, it is important to orient the male end of the section toward the boiler. The female end is positioned away from the boiler towards the vent terminal. Follow the vent manufacturer's instructions for proper installation.

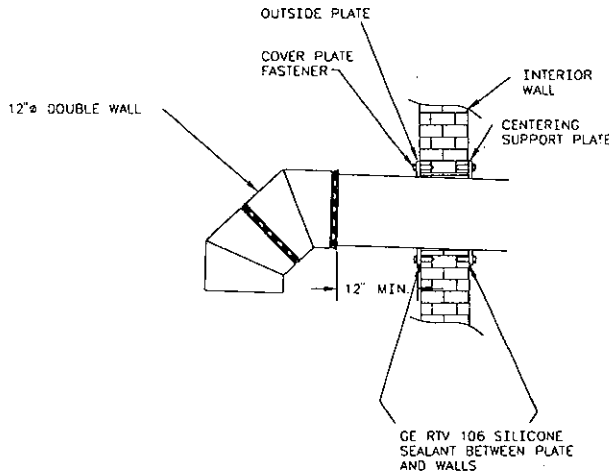
Flue Gas Termination

The boiler exhaust vent termination must be a P-K recommended device. There are three approved terminations:

1. 90 degree elbow or (2) 45 degree elbows pointing down
2. 45 degree elbow pointing down
3. Standard tee pointing up/down

Whichever termination is chosen, it must be 12 inch diameter double wall vent certified under UL1738, ULC-636 or UL103.

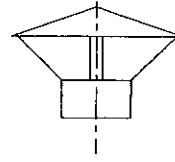
When installing a sidewall exhaust system the termination must be backed by a metal plate secured to the wall. See diagram below.



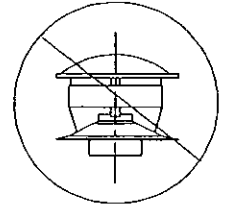
Exhaust Vent Terminal, Sidewall

If the exhaust vent is routed through the roof, the termination must be either the same type as described for a sidewall installation or a rain cap. The rain cap should be an unrestrictive type similar to the following illustration.

TYPICAL CORRECT UNRESTRICTIVE



TYPICAL INCORRECT RAIN CAP



NOTE: The equivalent length of the chosen termination must be included in the calculation of the maximum allowable equivalent length. See Table 2 for equivalent lengths.

Equivalent Length of Exhaust Vent Fittings

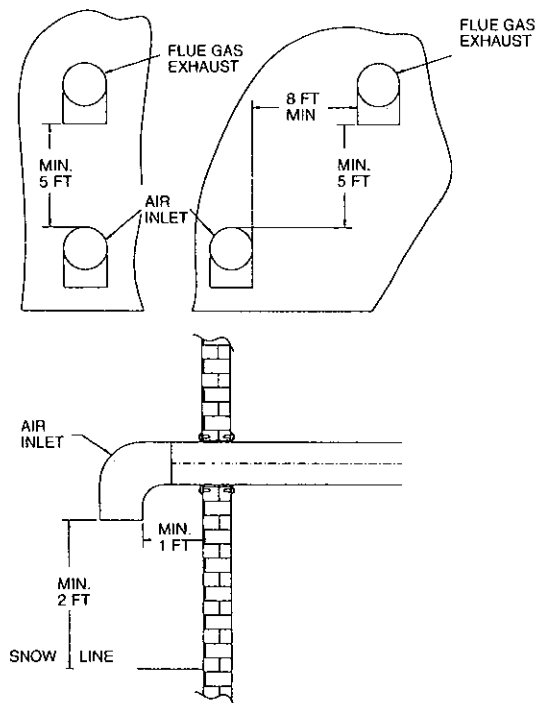
Table #2

Fitting Description	Equivalent Length
90° Elbow	10 Feet
45° Elbow	5 Feet
Rain Cap	10 Feet
Boot Tee/135° Tee	10 Feet
Std. Tee used as Vent Termination	10 Feet

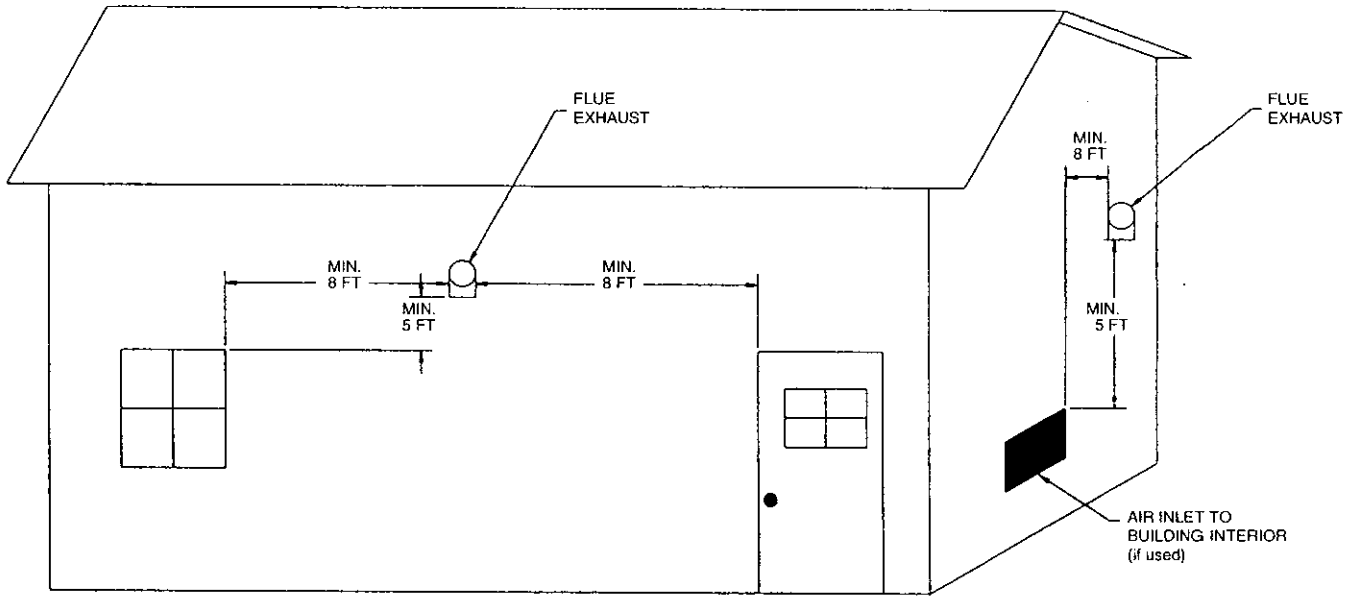
CLEARANCES

Sidewall Installation

If the air intake terminal is through the sidewall, clearances from the flue gas exhaust and snow line surface must be as described in the pictorial below.



If the **exhaust vent terminal** is through the sidewall, clearances from windows, doors and exhaust and inlet vents must be maintained as illustrated below.

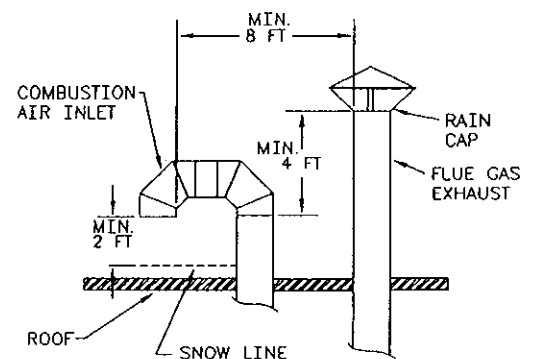
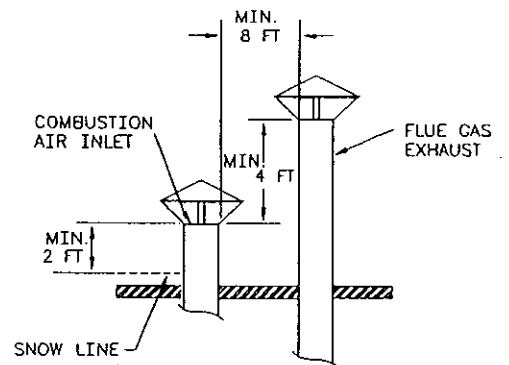
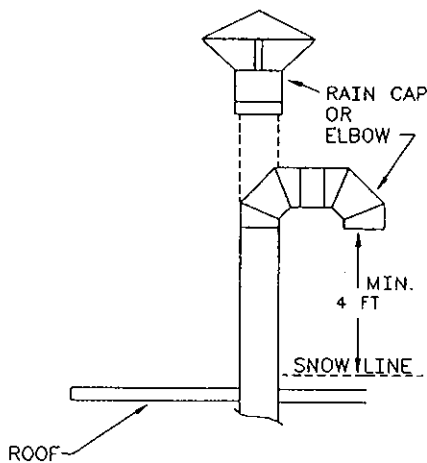


The exhaust vent terminal must be 7 feet above grade when located adjacent to a public walkway. It must also have a minimum clearance of 4 feet horizontally from, and in no case above or below, unless a 4 foot horizontal distance is maintained, from electric meters, gas meters, regulators and relief equipment

Rooftop Installation

The preferred method to terminate the exhaust vent is with a rain cap to minimize the drippage of condensate onto the roof and ice build-up.

Clearances which must be maintained when both intake and exhaust are through the roof are shown below..

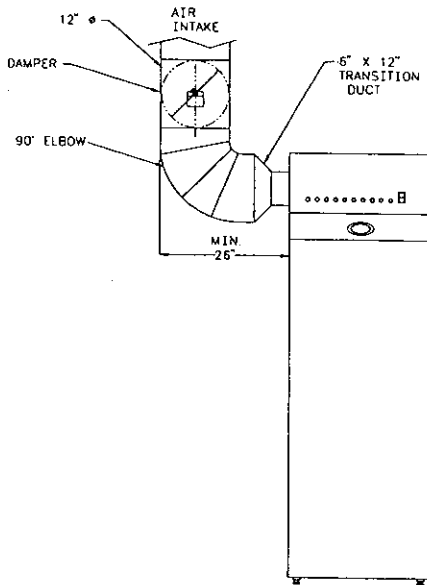


Minimum Clearance for Boiler Connections

There are special considerations needed when installing the air intake and exhaust duct systems because of the orientation of these connections on the boilers. A minimum of 44 inches is required behind the boiler to fit the intake and exhaust connections.

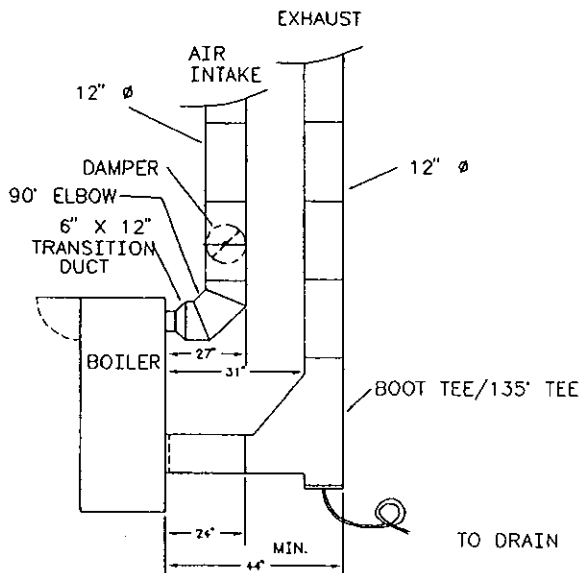
Models SN-700, SN-900, SD-900, SN-1200, SD-1200

A minimum clearance of 26 inches is required on the left side of the boiler to permit the connection of the air intake duct to the boiler.



Models SN-1500, SD-1500, SN-1700, SN-1900, SD-1900

The illustration below suggests a duct arrangement using standard duct pieces that will maintain this minimum clearance of 44 inches.



COMBUSTION OPERATING CONDITIONS

The combustion air characteristic of the burner in this boiler is factory set at a condition of utilizing approximately 50% excess air at room temperature (70°F). Therefore, when taking combustion air from the outdoors in a direct vent system, adjustment of the combustion air damper linkage should not be made until the carbon dioxide or oxygen reading is referred to this condition.

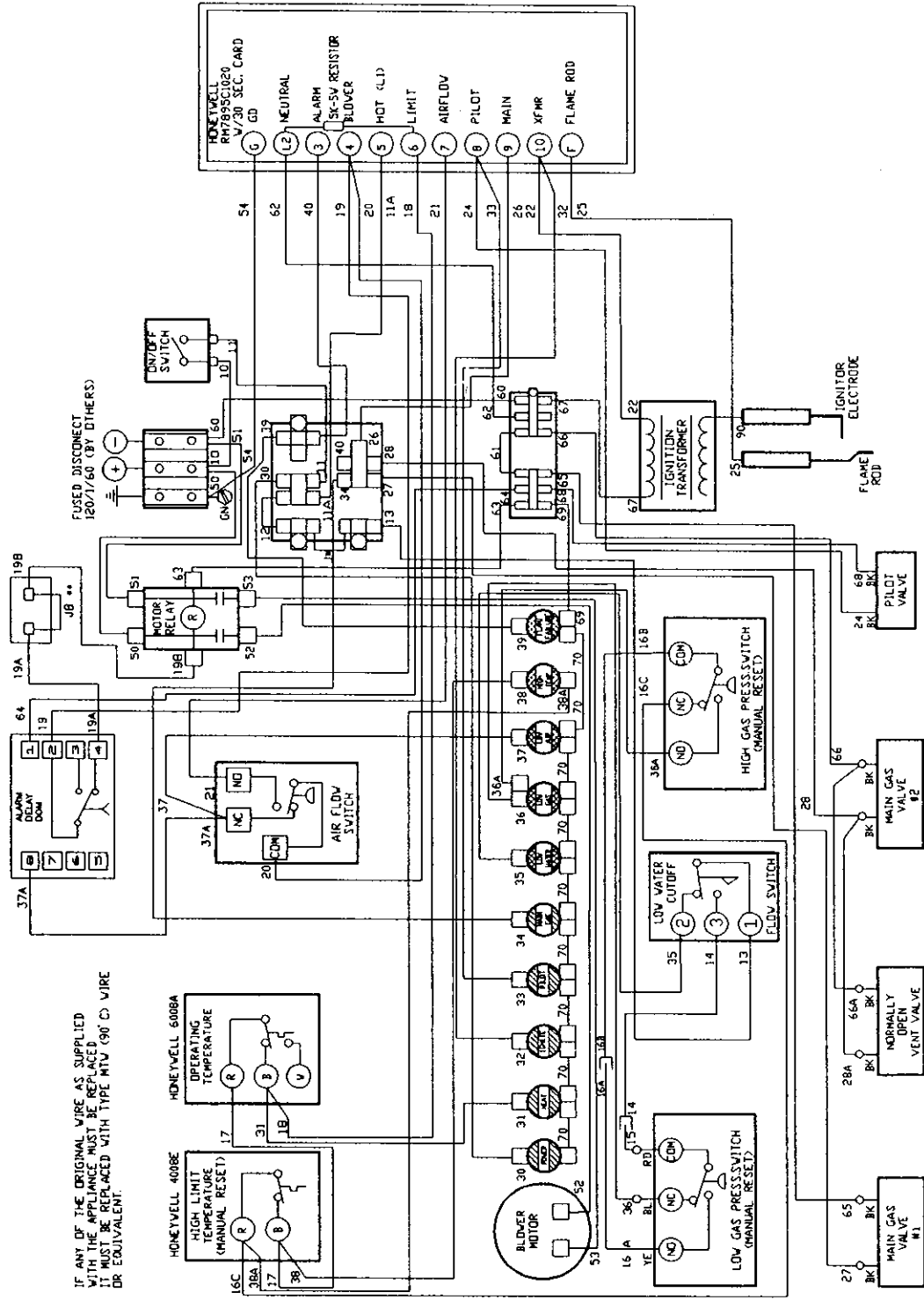
The density of cold outdoor air will be greater than warm air taken from inside the building. Thus, the combustion air blower with outdoor air will deliver a higher air density flow to the burner. This flow is proportional to the temperature of the air, i.e., the colder the air, the greater the number of air molecules delivered.

When determining the composition of the flue gas with a carbon dioxide or oxygen analyzer, the reading obtained can be referenced to combustion air at room temperature through use of the table below.

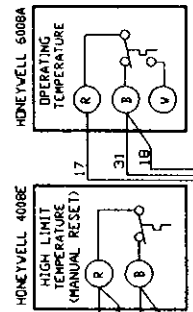
Outdoor Air Temperature (F°)	%Carbon Dioxide	%Oxygen
0	6.7	9.1
5	6.8	8.9
10	6.8	8.9
15	6.9	8.7
20	7.0	8.6
25	7.0	8.6
30	7.1	8.4
35	7.2	8.2
40	7.3	8.0
45	7.3	8.0
50	7.4	7.9
55	7.5	7.7
60	7.5	7.7
65	7.6	7.5
70	7.7	7.3
75	7.8	7.2
80	7.9	7.0
85	7.9	7.0
90	8.0	6.8

The carbon dioxide and oxygen values above correspond to the readings which should be obtained at the outdoor temperature indicated when referenced to 7.7% carbon dioxide, 7.3% oxygen, at 70°F. However, they do not take into consideration the normal variation that can occur with sampling, instrument error, rate variation, etc. The O₂ or CO₂ variation can be as great as ± 0.2% of 1% from the values listed in the table above.

For example, assume that the outdoor temperature is 17° F, and the combustion analyzer indicated a carbon dioxide reading of 6.7%. In rounding to the nearest 5° F interval (select 15° F), the table indicates that a value of 6.9% could be expected. Since the reading of 6.7% is within the normal range of variation, adjustment to the combustion air damper linkage is not required.



IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED IT MUST BE REPLACED WITH TYPE MTV (90 C) WIRE OR EQUIVALENT.



TERMINAL CODE

- SCREW TERMINAL
- PUSH-ON CONNECTOR
- ▭ PUSH-ON CONNECTORS

HEAVY LINES 14 GA.
LIGHT LINES 16 GA.

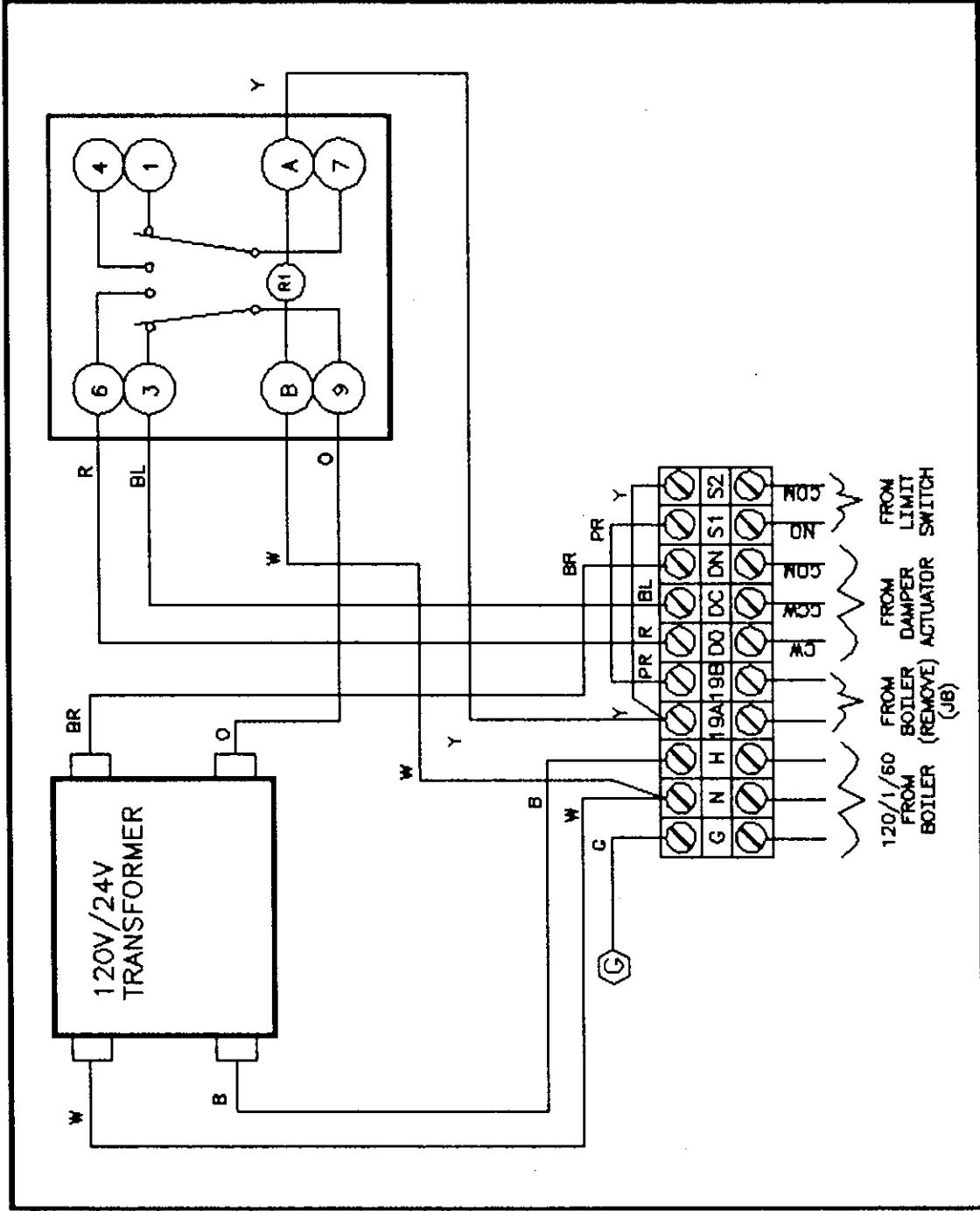
LAMP COLOR CODE

- GREEN
- RED

REPLACE RED JUMPER BEFORE INSTALLING EXTERNAL LIMIT CONTROL (ON/OFF)

HERMETIC ON/OFF, IRI
SEALED COMBUSTION
PATTERSON-KELLEY CO.
Div. of HARSCO Corporation
EAST STROUBURG, PA. 18301

1001100396



1001100397

AUX. CONTROL PANEL, THERMIFIC ON/OFF
SEALED COMBUSTION W/INTAKE DAMPER

PATTERSON-KELLEY CO.
Div. of HARSCO Corporation
EAST STROUBSBURG, PA. 18301

- NOTES:
- 1) SEE DWG. 1001100390 OR 1001100391 FOR LOGIC DIAGRAM
 - 2) REMOVE BLUE JUMPER (JB) ON BOILER BEFORE CONNECTING WIRES 19A & 19B
 - 3) THE 120/1/60 POWER SOURCE MUST BE FROM THE SAME BOILER WHERE WIRES 19A & 19B ARE FROM.
 - 4) USE 16 GA MTR WIRE FOR ALL FIELD WIRING.

