Chapter 6

DRAFT & VENTING

IN THIS CHAPTER

• Draft—Why it is needed and how it is measured

•Why we regulate draft, and the effects of draft upon burner operation and efficiency

• Alternative venting systems: power-venting and direct-venting

Chapter 6

Draft and Venting

Introduction

Air is needed to burn oil cleanly and efficiently. We must understand how to supply air to the burner and how to ensure that all of the gases created in burning the fuel are vented to the outside. Additionally, for non-condensing appliances, we must make sure the water vapor created during combustion is vented to the outside prior to condensing.

What is draft?

Draft is a current of air in an enclosed area that is created by a difference in pressure. In practical terms, draft is a force that “pulls” or “sucks” the exhaust gases out of the heating unit and sends them up the chimney.

During the combustion process hot gases rise through the heating appliance to the flue pipe and travel up the chimney, creating negative pressure or suction, also known as “negative draft” at the bottom of the chimney.

The pressure difference is created because:

• When the burner is off and the chimney is cold, the air inside the combustion area, heat exchanger, flue pipe, and chimney is at atmospheric pressure.

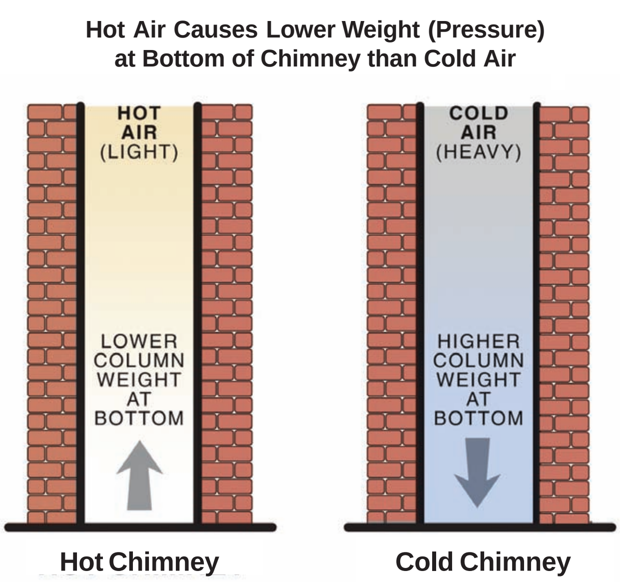
• When the burner starts, the burner fan creates “static pressure” as it pushes air into the combustion area where it combines with the fuel to create a fire.

• When the air and fuel burn, the temperature rises dramatically and the combustion gases expand to more than double their volume. This expansive pressure adds to the pressure created by the burner fan and pushes the combustion gases through the heat exchanger.

• As the hot combustion gases travel up the chimney they create a pressure drop behind them that sucks the combustion gases out of the heat exchanger, Figure 6-1.

Draft is the total effect of the positive pressures of the burner fan, the expansive pressure of the flame, and the negative pressure of the hot gases escaping the top of the chimney.

Figure 6-1: Chimney draft



Oilburners need steady draft for proper operation. Insufficient or variable draft can cause operational problems. For example, a fire that pulsates or a rumble in the appliance may result from insufficient draft.

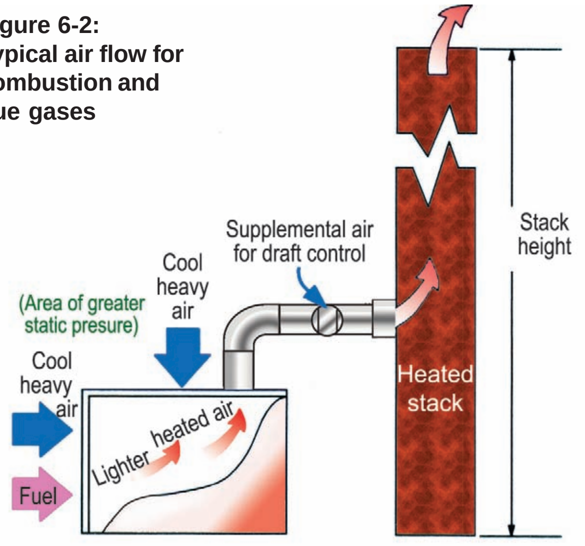


Figure 6-2: Typical air flow for combustion and flue gases

Chimney venting creates natural draft

There are two types of natural draft created in the chimney—thermal and currential.

Thermal draft is created when the air in the chimney is hotter, and therefore lighter (less dense), than the air outside. As the lighter air moves up the chimney, (See Figure 6-2), more air moves in from the surrounding room to replace it.

Currential draft is caused by the suction created as wind rushes over the chimney top, creating a negative pressure in the chimney. Because wind is variable, currential draft is unpredictable and must be controlled. Occasionally wind will blow down the chimney causing a ‘down draft.’ A variable draft is created by a pressure difference between the top and bottom of the chimney.

What affects draft

Draft is created by a pressure difference between the top and bottom of the chimney. The draft produced by a chimney is variable, not constant. The temperature of the outside air, the temperature of the flue gases, the barometric pressure, and humidity of the air all affect draft.

When the burner is first fired, the chimney is full of cool air and there is little or no thermal draft. As the chimney and gases warm, the draft will strengthen. As the outside air cools, the temperature difference increases, and draft increases.

Other conditions that affect draft include wind velocity across or into the top of the chimney and flow restrictions in the chimney, flue pipe, or heat exchanger. It is important that the chimney be properly constructed, clean, and have no air leaks through cracks and gaps.

The placement of the chimney and its construction can also affect draft. A chimney operates best when it is warm and dry. Therefore, a chimney with one or more of its walls outside the building does not work as well as an inside chimney.

The outside chimney heats up slowly and cools off rapidly. Additionally, the chimney must extend at least two feet above nearby objects, such as the roof peak, trees, and other buildings within 10 feet. Overhanging trees or high buildings can affect the draft and can cause wind

Table 6-1
Theoretical Chimney Draft for Various Conditions

Case 1 OUTSIDE AIR = 60°F

AVG CHIMNEY TEMP. °F	CHIMNEY HEIGHT IN FEET 10	15	20	25	30
100	0.01	0.02	0.02	0.03	0.03
200	0.03	0.05	0.06	0.08	0.09
300	0.05	0.07	0.09	0.12	0.14
400	0.06	0.09	0.12	0.14	0.17
500	0.07	0.10	0.13	0.17	0.20
600	0.07	0.11	0.15	0.19	0.22
700	0.08	0.12	0.16	0.20	0.24
800	0.09	0.13	0.17	0.22	0.26
900	0.09	0.14	0.18	0.23	0.27

Case 2 OUTSIDE AIR = 0°F

AVG CHIMNEY TEMP. °F	CHIMNEY HEIGHT IN FEET 10	15	20	25	30
100	0.03	0.04	0.05	0.07	0.08
200	0.04	0.05	0.09	0.11	0.13
300	0.06	0.09	0.12	0.14	0.17
400	0.07	0.10	0.14	0.17	0.20
500	0.08	0.11	0.15	0.19	0.23
600	0.07	0.12	0.17	0.21	0.25
700	0.09	0.13	0.18	0.22	0.27
800	0.09	0.14	0.19	0.23	0.28
900	0.10	0.15	0.19	0.24	0.29

Draft = 0.01467 X Height X (1 - ([OAT + 460] / [TEMP + 460]))

Where:
Draft = Inches Water Column
OAT = Outdoor Air Temperature
TEMP = Average Chimney Temperature = (Tin - Tout)/2

Based on information in the North American Combustion Handbook, Second Edition, 1978.

currents to tumble, causing down draft. (Figure 6-3).

Improper or variable draft can cause problems

Variations in chimney draft can change the amount of combustion air entering the burner. Low draft will cause the burner fan to push against higher air pressure resulting in less air for combustion and a smoky fire. High draft will cause too much air to rush into the combustion zone resulting in reduced efficiency. Excessive draft will also cause excess air to leak into the unit, further increasing stack temperatures. Table 6-1 (previous page) shows how draft is affected by outdoor temperature, chimney height and chimney temperature.

Changes in draft can cause severe problems with older units. Variations in draft have a strong effect on non-flame retention burners. These older burner fans produced very little static pressure and relied on the pressure drop created by the chimney to help draw in their combustion air. Because thermal draft is very weak during a cold start up with these burners, they tend to rumble and smoke until the chimney warms up.

Effects of draft on air leakage

High draft will draw air into the appliance through leaks. This air will cool the combustion products while increasing their volume, reducing the efficiency of the heating system.

Ensuring the draft is proper (See Draft Regulators) will help improve efficiency. Additionally, sealing all air leaks with furnace cement or high temperature silicone wherever possible will reduce the amount of air drawn through the appliance. Air flowing up the chimney is replaced by air being drawn into the building through windows, doors or other gaps in the building envelope.

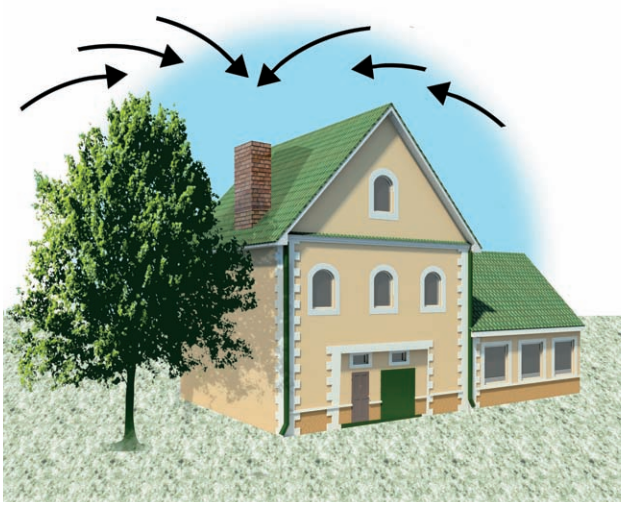
The most common locations for these air leaks are around the burner mounting flange, between the base and the floor, between the base and the heat exchanger, between the sections of a boiler, and around clean-out and inspection doors and plates. Figure 6-4 shows outdoor air infiltration caused by the heating system and chimney.

Effects of draft on stand-by losses

Whenever the air inside the chimney is warmer than the air outdoors, the chimney will create thermal draft. This is good when the burner is running, but not when the burner shuts off. Most pre-1970s heat exchangers have very large, open passages that offer very little restriction to air flow.

It is very easy for the draft from the still warm chimney to draw warmed air from the

Figure 6-3: Down draft



building into the burner air intake and up through the heat exchanger. As it does so, it also takes heat from the heat exchanger as it goes up the chimney. This new hot air keeps the chimney warm, which, in turn, keeps producing draft that cools the building.

Old equipment, especially boilers, have very high stand-by losses. New burner air intakes, air handling parts and combustion heads are not as wide open as the old ones, and new heat exchangers are much more restricted than the older types. The result is much higher efficiencies, less off-cycle heat loss and much lower oil consumption.

Draft regulators

It is necessary to regulate draft because natural draft is so variable. The most common draft regulator is the by-pass or air-bleed type. Since it responds to changes in barometric (atmospheric) pressure, it is also called a barometric draft regulator or damper (Figure 6-5).

The regulator consists of a counter weighted swinging door that opens to allow room air to flow into the flue and mix with the exhaust gases. The room air dilutes and cools the exhaust gas which reduces the temperature difference between the gases leaving the chimney and the outside air. This reduces the draft. When the draft drops below the draft regulator setting, the counterweight closes the draft regulator door.

It is important to understand that no draft regulator can cause an increase in draft, it can only decrease draft over-the-fire. It also cannot prevent down drafts caused by wind currents blowing down the chimney.

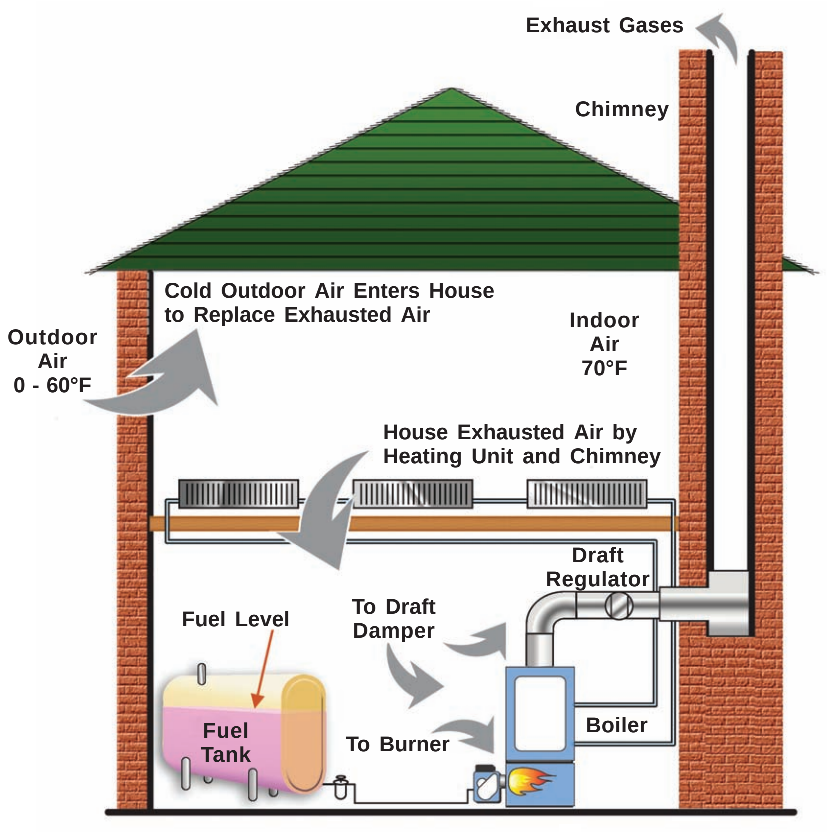


Figure 6-4: Outdoor air infiltration caused by the heating system and chimney

Figure 6-5: Draft regulators

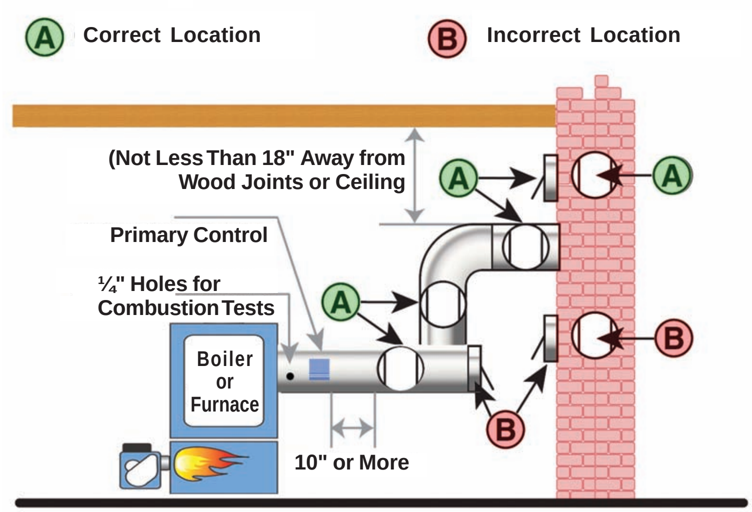


Figure 6-6: Draft regulator locations: Correct and incorrect

The draft regulator should be installed in the flue pipe between the chimney and the stack mounted primary control, if there is one. It should be at least 10 inches to 12 inches from the control and 18 inches is preferred. If installed closer to the control, the cool air from the regulator can cause the unit to shut off on safety even when the system is operating properly. See Figure 6-6 for draft regulator locations.

Some newer heating appliances are designed to operate without a draft regulator. The burners create enough static pressure to move the combustion products up the chimney and the heat exchangers are tight enough to resist the effects of strong and variable negative draft.

As with all Oilheat appliances, always follow the manufacturers' instructions regarding draft.

Measuring chimney draft

We measure draft in 'inches of water column.' One inch of water column is the pressure difference required to lift a column of water one inch up a tube. Typically, chimney drafts required for oil-fired heating units are close to -.05 inches. Draft is checked at two places: over-the-fire (draft at the top of the combustion area) and in the flue pipe, as close to the breech as possible.

Before any measurements or adjustments are made, the condition of the draft regulator should be checked. The pivot shaft should be horizontal, not cocked, and the door should swing freely. Have burner run long enough to be sure that the chimney is warm.

Draft over-the-fire

Draft over-the-fire is the most important draft measurement and should always be measured first. The over-the-fire draft must be constant so burner air delivery will also be constant. The setting must be high enough to ensure that combustion products do not leak into the building, but are drawn through the heat exchanger. Normally, an over-the-fire draft of -.01" to -.02" will be sufficient.

If the over-the-fire draft is higher than manufacturers recommendations (typically -.02"), the draft regulator weight should be adjusted to allow the door to open more. If the draft is below manufacturer's recommendations, the weight should be adjusted to close the regulator door. However, some equipment is able to operate under very low or zero draft. In fact, some appliances operate under positive pressure, so that when an over the fire reading is taken, the draft is positive.

If the draft regulator door is already wide open, you may need to install a larger or second regulator.

Draft at the breech

After setting the over-the-fire draft, the draft at the breech should be measured. The draft in the flue pipe will be slightly higher than the over-fire draft due to the restric-

Draft over-the-fire is the most important draft measurement and should always be checked first

tion caused by the heat exchanger. This restriction, or the lack of it, is a clue to the design and condition of the heat exchanger. A clean heat exchanger of good design will normally cause the breech draft to be in the range of -.03" to -.07" when the over-the-fire draft is from -.01" to -.02". The difference between the breech draft and the over-the fire draft is often called the 'draft drop' or 'pressure drop' across the heat exchanger. If the breech draft is -.07" and the over-the-fire draft is -.02", the draft drop is .05".

Excessive draft drop may indicate heavy soot and scale deposits in the unit. It is important to understand that over-the-fire draft is indirectly controlled. It is a function, not only of the draft created by the chimney, but also of restrictions in the heat exchanger.

A burner operating at more than zero smoke will cause soot deposits to build in the heat exchanger. These deposits increase the draft drop, lowering over-the-fire draft, reducing combustion air, and creating more smoke. The increased smoke causes even more soot to build up, increasing draft drop even further. The result is a quickly plugged heat exchanger.

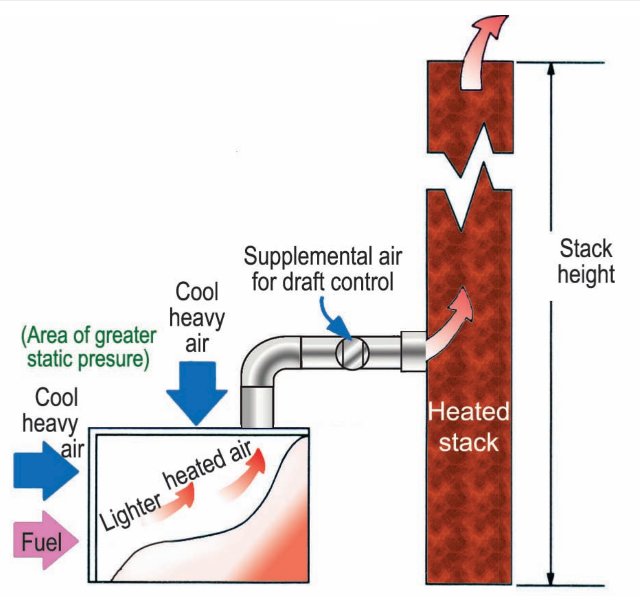
Sometimes there is little difference between the breech draft and the over-the-fire draft, usually with older units originally built for coal. If a boiler measures a low efficiency with a high stack temperature (600°F or more), it may be possible to install baffles in the heat exchanger passages. However, as with most older equipment, the best alternative is to recommend a new boiler or furnace of higher efficiency.

Chimney sizing

Proper chimney sizing is important for the safe and efficient operation of all heating appliances. As the requirement can vary depending upon the size and design of

How draft controls work

Static pressure of the cool air exerts pressure on the outside of the furnace or boiler, the breeching, and flue. The pressure difference between the room air and heated gas (air) causes products of combustion to flow (draft) through the unit and rise through the breeching and chimney. Room temperature air enters through the barometric draft control in the precise amount needed to overcome the excess drafts caused by temperature variations, wind fluctuations and barometric pressure changes. Combustion of fuel is complete and the process is stabilized. The velocity of combustion gases through the heat exchanger is slowed so more heat is extracted.



the appliance, the manufacturer's instructions must be followed.

Installing flue pipe

Be sure to check the condition of the flue pipe during each service call. If it looks questionable—replace it. The stack temperatures on new high efficiency units are much lower and are more likely to cause condensation and rusting of the flue pipe. This is extremely important because combustion gases can enter the building if the flue pipe is porous or disconnected.

The flue pipe must be at least 18 inches from a combustible wall or ceiling as a fire prevention measure. It should never be smaller than the flue pipe collar at the breech of the boiler or furnace. The flue pipe should be as short as possible and should not exceed 10 feet of horizontal run unless a draft fan is used. It should have a minimum of ¼" per foot pitch from the appliance up to the chimney and be run with minimum number of elbows. Use 45-degree elbows instead of 90's when possible.

Diameter of Flue or Breeching	If Chimney Height Is	Use This Size Control	If Chimney Height Is	Use This Size Control	If Chimney Height Is	Use This Size Control
4	15' or less	4"	16' or more	5"		
5	15' or less	5"	16' or more	6"		
6	15' or less	6"	16' or more	7"		
7	15' or less	7"	16' or more	8"		
8	15' or less	8"	16' or more	9"		
9	15' or less	9"	16'-30'	10"	31' or more	12"
10	20' or less	10"	21'-40'	12"	41' or more	14"
11	20' or less	12"	21'-40'	12"	41' or more	14"
12	20' or less	12"	21'-40'	14"	41' or more	16"
13	22' or less	14"	23'-45'	16"	46' or more	18"
14	22' or less	14"	23'-45'	16"	46' or more	18"
15	22' or less	16"	23'-45'	16"	46' or more	18"
16	30' or less	16"	31'-50'	18"	51' or more	20"
17	30' or less	18"	31'-50'	20"	51' or more	20"
18	30' or less	18"	31'-50'	20"	51' or more	20"
19	30' or less	20"	31'-50'	20"	51' or more	24"
20	30' or less	20"	31'-50'	20"	51' or more	24"
21	30' or less	20"	31'-50'	24"	51' or more	24"
22	30' or less	24"	31'-50'	24"	51' or more	24"
23	35' or less	24"	36'-60'	24"	61' or more	28"
24	35' or less	24"	36'-60'	24"	61' or more	28"
25	35' or less	28"	36'-60'	28"	61' or more	28"
26	40' or less	28"	41'-70'	28"	71' or more	28"
27	40' or less	28"	41'-70'	28"	71' -100'	28"
28	50' or less	32"	51'-100'	28"	100' or more	32"
29	50' or less	32"	51'-100'	32"	100' or more	32"
30	50' or less	32"	51'-100'	32"	100' or more	32"
31	50' or less	32"	51'-100'	32"	100' or more	Two 24"
32	50' or less	32"	51'-100'	32"	100' or more	One 24" One 28"
33	50' or less	32"	51'-100'	One 32" One 20"	100' or more	One 32" One 24"
34	50' or less	32"	51'-100'	One 32" One 24"	100' or more	One 32" One 24"

The flue pipe should be firmly joined with sheet metal screws and supported with straps or wire. It should be tightly fitted to the breeching and installed into a clay or metal thimble that is securely cemented into the chimney. Be sure the thimble and pipe do not protrude beyond the inside wall of the chimney tile.

No sort of dampers, except for the barometric damper (draft regulator) should be installed in the flue pipe or breeching. They are not needed and could cause problems if they close accidentally.

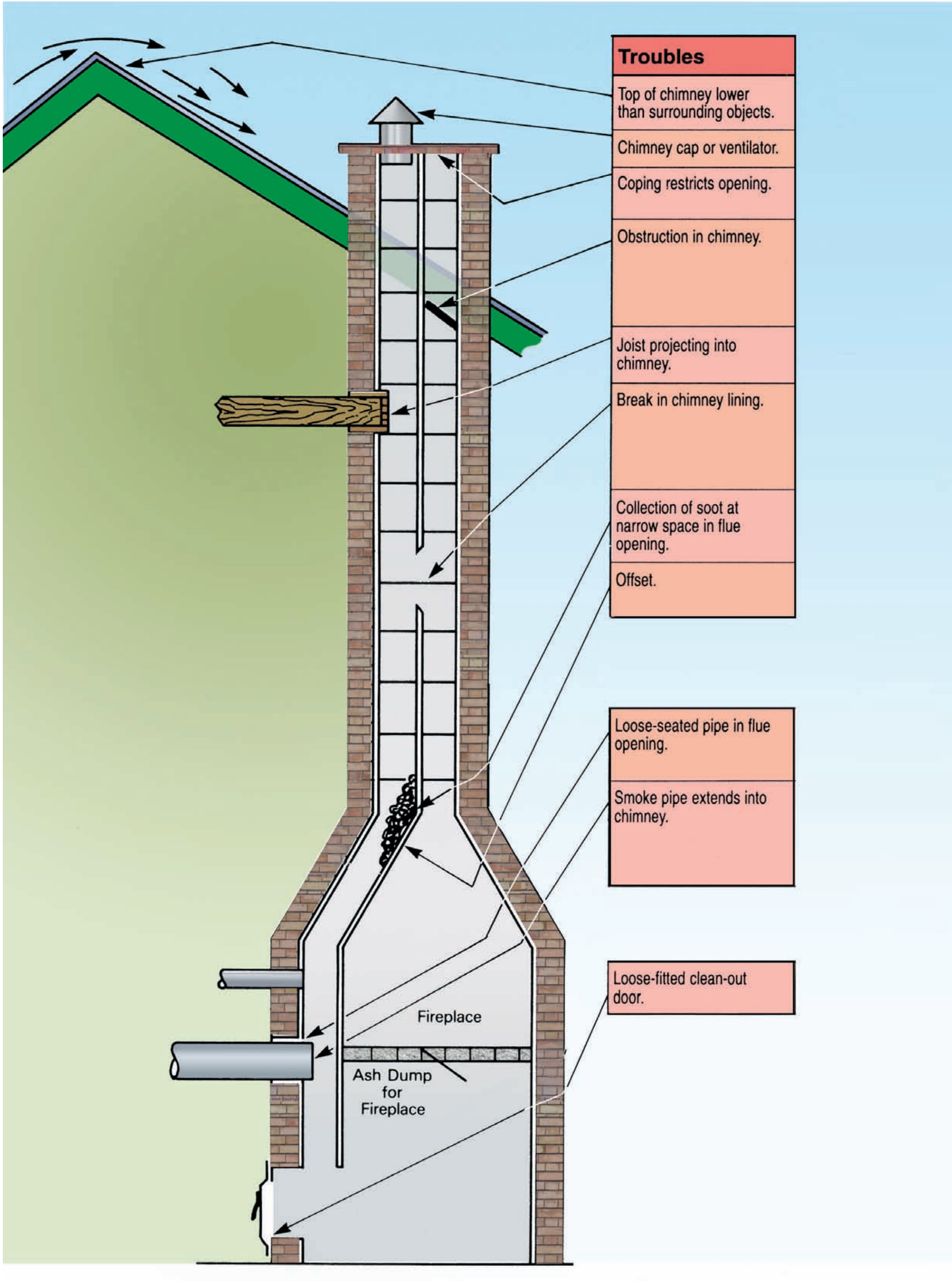
Chimney and draft problems

Insufficient draft can occur with too many appliances connected to a chimney. Whenever connecting two or more fuel burning appliances to a single chimney, verify that there is sufficient draft for safe operation of all units. Insufficient draft also occurs when obstructions such as soot, loose bricks, birds' nests or other foreign objects build up in the chimney and restrict flow. See Figure 6-7 for common chimney troubles and their corrections.

Lack of air in the furnace room

Insulation, tight windows and doors, and tight construction can prevent outside air from entering the building. As a result, the building cannot 'breathe.' Oilburner

Figure 6-7: Combustion chimney troubles



combustion requires a great deal of air to operate properly. It competes with the fireplace, exhaust fans and the clothes dryer for air. All of these appliances drawing on the air in a tight house make it difficult for the oilburner to draw in enough combustion air.

With the building so tight, the indoor air pressure drops below the outdoor air pressure and the appliance becomes back-vented. Odors, soot, smoke and carbon monoxide may be drawn into the building. 'Isolated combustion' (ducting outside air directly to the burner) is the best solution to this problem and there are many effective isolated combustion air options available. (See Figure 6-8)

Water heater and furnace stack connections

When an oil-fired water heater is installed, it is usually necessary to connect the flue to the same chimney as the furnace or boiler. This can be done in two ways:

1. The two flue pipes can be joined together with a Y connector, as shown in Figure 6-9. ('T' connectors should NOT be used as they often cause venting problems for both appliances.) The exit, or chimney side of the Y should be at least one size larger than the largest flue pipe.
2. If you do not use the Y fitting, you can make a second opening in the chimney.

If two or more openings are provided into one chimney flue, they must be at different levels. The flue pipe from the unit with the lower firing rate should enter at the highest level consistent with available headroom and clearances to combustible material (see Figure 6-10). A separate draft regulator should be installed for each appliance.

Developments affecting chimneys and exhaust

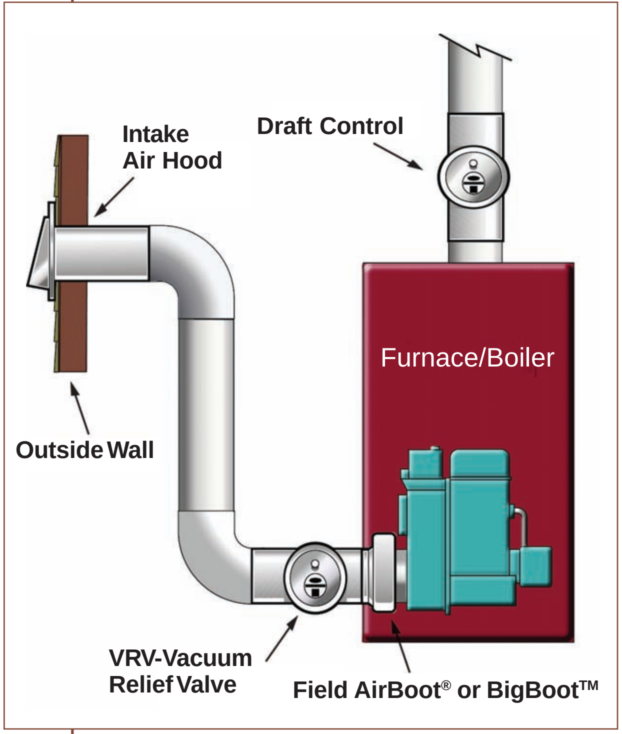
High efficiency equipment has brought about changes that can affect chimney draft. Some of these developments, such as lower flue gas temperatures, reduced firing rates, and cold start boilers, will reduce the draft produced by chimneys, and can cause operational problems.

The most serious consequence of lowered flue gas temperatures is condensation. The water vapor in the combustion products can drop below the dew point, and turn into water. Because of the sulfuric oxides present in the gases, this water is acidic. It creates scale in the heat exchanger, corrodes the flue pipe and attacks the cement in the chimney. A net flue gas temperature of at least 350°F is recommended to avoid this problem. Corrosion resistant chimney liners also help.

Chimney check

The objective of a chimney check is to identify obvious and serious chimney problems. It is not intended to be a detailed

Figure 6-8: Typical installation of an outside air kit



inspection. If any chimney damage or deterioration that would inhibit the safe operation of the heating appliance is found, the owner of the building should be notified immediately. A qualified chimney professional should be called-in for a follow-up inspection. See Figure 6-11 on following page.

The chimney check should include the following:

• If there is one, visually inspect the clean-out at the base of the chimney for excessive or abnormal debris. Be sure the clean out door is shut tight and sealed when you are finished.

• Remove the flue pipe from the chimney breech and inspect the inside of the chimney with a light and a flame mirror for signs of damage or deterioration. Debris, mortar, brick, and pieces of liner material at the base of the chimney are signs of trouble.

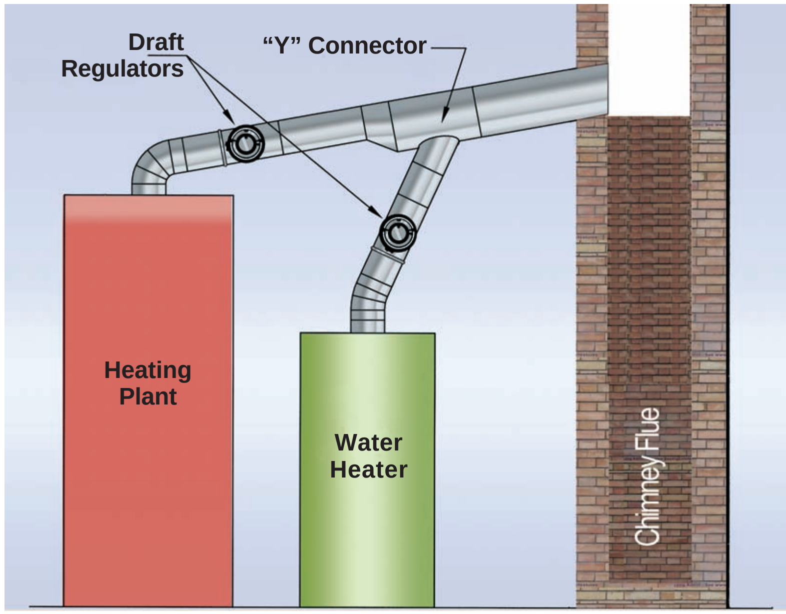
• Go outside, walk around the building, and observe the exterior of the chimney. If you observe damage, deterioration, or that the chimney is leaning to one side; further inspection by a chimney professional is required.

Chimney caps and draft inducers

Chimneys may suffer variable draft due to changes in wind or air turbulence A simple and inexpensive solution to this problem is to install a cap (Figure 6-12) or hood over the top of the chimney. However, these caps can rust and discolor roofs, so ensure that a high grade stainless steel is used.

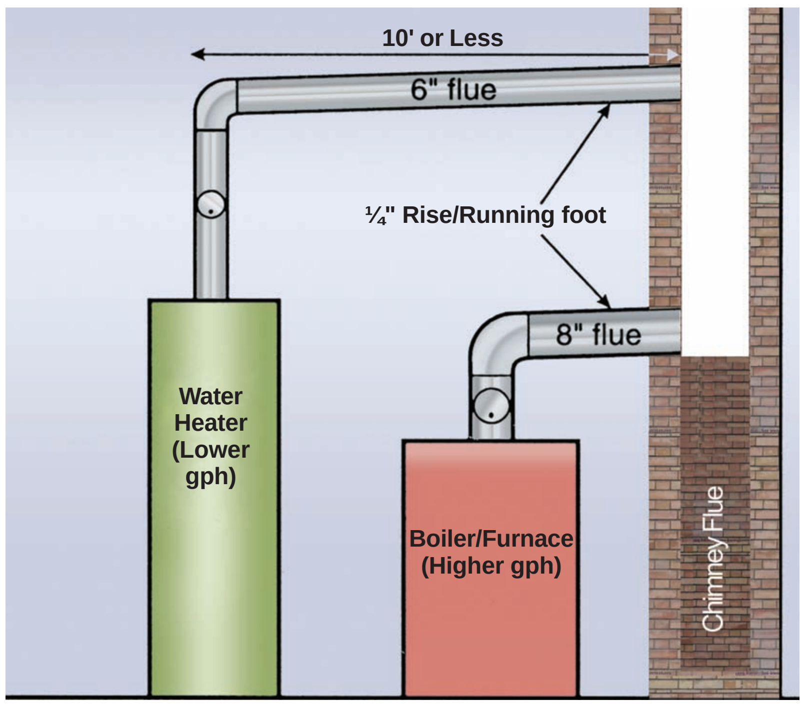
Figure 6-12: Chimney cap

Figure 6-9: Water heater stack connections



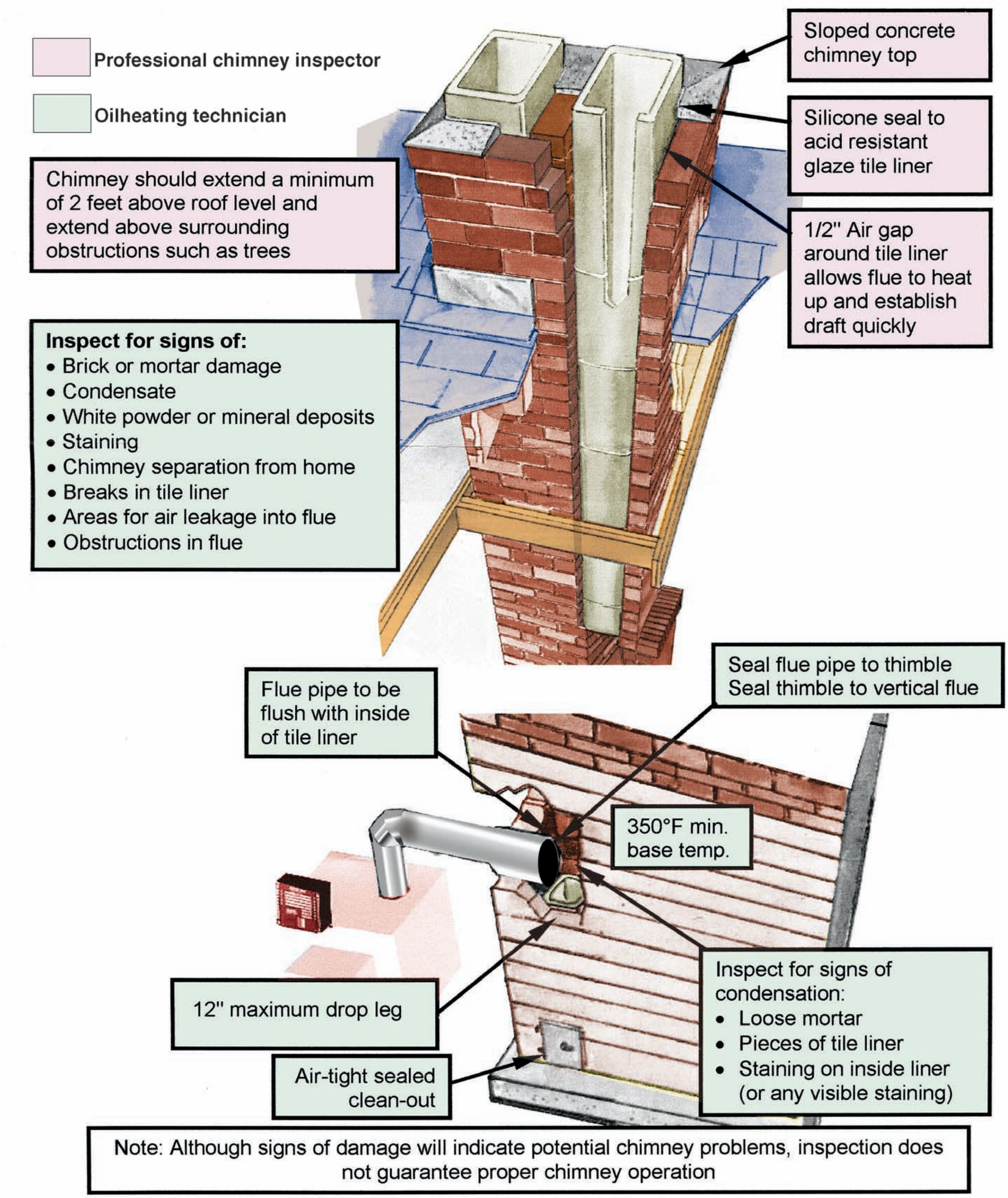
Each section sized to handle combination of all appliances attached

Figure 6-10: Water heater stack connections



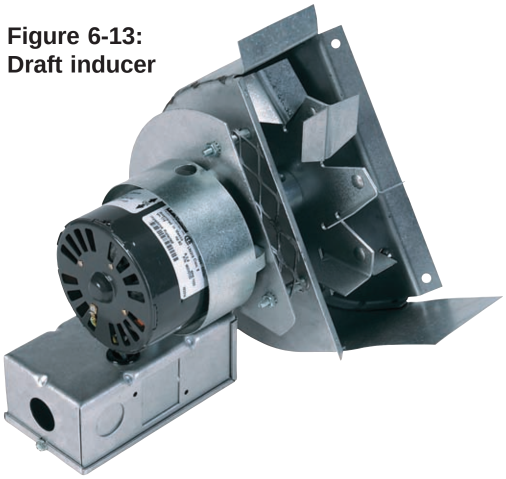
The larger appliance firing rate enters the chimney below the smaller appliance firing rate

Figure 6-11: Chimney check



Another alternative is to use a draft inducer, Figure 6-13. Draft inducers are electrically powered fans installed in the flue pipe. They help to pull the air from

Figure 6-13: Draft inducer



the unit and push it up the chimney. They can also be used to boost the draft if the natural chimney draft is too weak. A draft inducer can also solve the loss of draft from the rapid cooling of combustion products in the chimney.

Poorly insulated metal flues and over-sized or unlined chimneys can cause a rapid cooling of combustion products and lead to a loss of draft. A draft inducer can offer a reasonable temporary solution but the ideal solution is to line and insulate the chimney.

Induced draft has the advantage of developing controlled draft under most conditions. It can help to provide a clean start with no rumbles and it can provide adequate draft in a chimney that is too small, too low, or too large. Installation of a pressure or draft-proving switch is required by codes and is strongly recom-mended with an induced draft installation. See Figure 6-14, the draft proving switch is DIP-1.

Alternative venting systems

In recent years, manufacturers have created alternative forced draft venting systems that do not use a chimney for oil-fired heating systems. The technology takes two different approaches: power- venting and direct-venting.

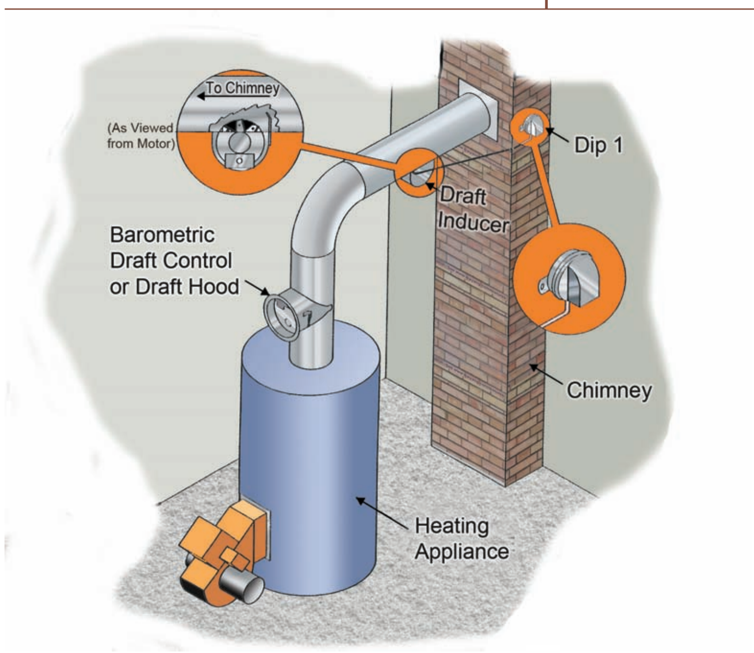
Power-venting: a fan is attached to the flue pipe at the exit terminal from the building to pull the products of combustion out of the heating unit. Power-venters do not need a chimney and are usually sidewall vented.

Direct vent: the static pressure created by the burner fan pushes the combustion gases through the heat exchanger and out of the building. A direct-vented system is a positive pressure system. No chimney is needed with a direct vent system.

The advantages of alternative venting systems are:

- More positive control of draft
- No chimney warm-up problems
- Lowered cost in new building con struction and electric to oilheat conversions (eliminates the chimney)
- There is a significant reduction in burner noise with direct venting

Figure 6-14: Draft inducer with draft proving switch, typical installation

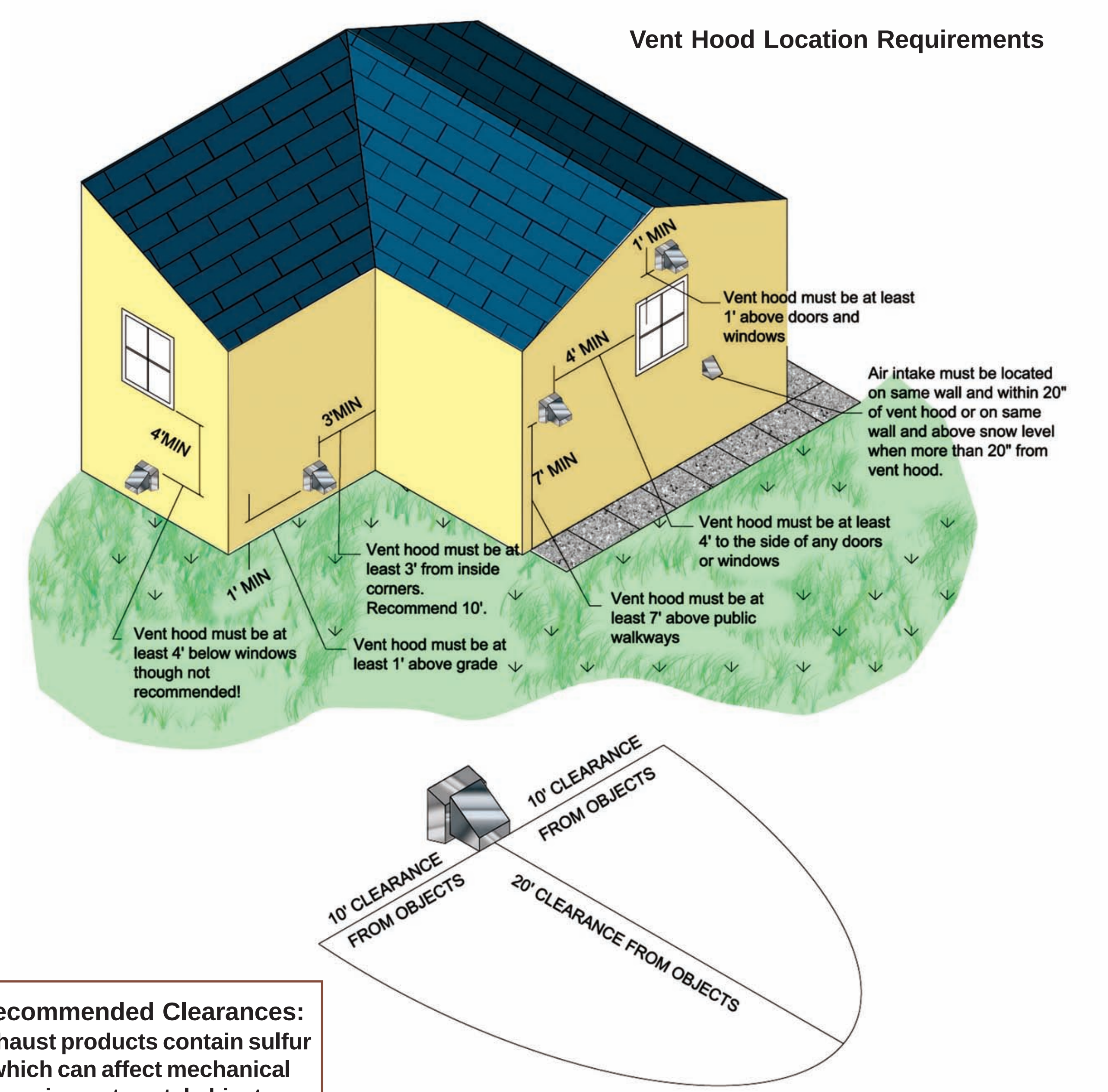


- Eliminate back drafts caused when a nearby structure is above the top of the chimney
- Reduction in system standby losses by eliminating off-cycle chimney draft

When installing or servicing either of these systems, it is very important that you read and understand the manufacturer's instructions. When you are finished, be sure to leave the instructions in an obvious place for the next technician.

The installation and use of any alternative venting system must not only follow the manufacturers' instructions, but also comply with all local and state building codes. Most of the instructions and codes conform to the following guidelines for the location of the exit terminal of the system. See Figure 6-15.

Figure 6-15: Vent hood location



Recommended Clearances:
Exhaust products contain sulfur which can affect mechanical equipment, metal objects and vegetation

The following guidelines are often required by code:

• Direct vent systems can be placed on any wall, but if possible they should not be located on the wall facing the prevailing wind (the prevailing wind generally comes from the north and the west; if possible, locate on the south or east side of the building).

• The vent terminal must be at least one foot above grade level, and three feet away from any inside corner. It may need to be higher in areas with snowfall.

• The vent terminal shall not be less than three feet above any forced air inlet into the building that is located within 10 feet of the terminal.

• The vent terminal shall not be less than four feet below, four feet horizontally, or one foot above any door, window, or gravity inlet into any building. The vent shall not be installed in a window well.

• The vent terminal shall not be less than two feet from an adjacent building.

• The vent terminal shall not be less than seven feet above grade when located adjacent to public walkways.

• The vent terminal shall be located so that flue gases are not directed to jeopardize people, overheat combustible structures or materials, or enter buildings.

• All positive pressure joints in the vent system (all joints in direct-vent, all joints on the exhaust side of the power-venter) are to be sealed with Permatex #81164 high temperature sealer or equivalent to prevent leakage of the products of combustion into the building. We are referring here to both the joints between pieces of pipe and the slip joints on elbows.

• The minimum distance to combustible materials from any single wall, vent system component is 18 inches.

• The vent termination should not be mounted directly above or within three feet horizontally from a gas meter, electric meter or air conditioning condenser.

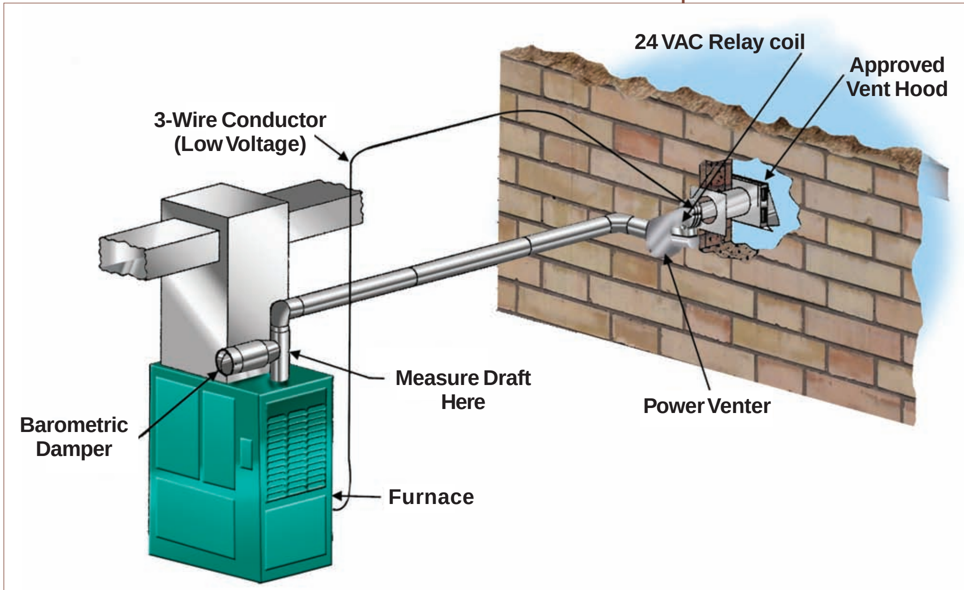
Power-venting

Power-venting is an economical alternative to conventional chimney venting. Power-venters use a motor and fan to vent the products of combustion from the appliance to the outdoors.

Power-venters are designed with the fan located either outdoors or indoors just before the outside wall, as in Figure 6-16. This insures that combustion gases in the flue pipe are always under negative pressure, so if there are any leaks, air will leak into the pipe and the combustion gases will not spill into the building.

The flue gases are discharged through a double wall vent termination piece and an

Figure 6-16: Power venter, indoor fan

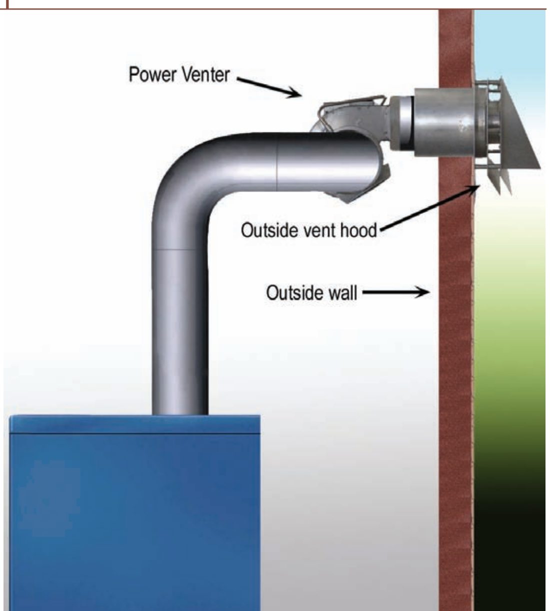


outside vent hood (Figure 6-17). Although these models have operated successfully for years, they often cause noise and vibrations in the building. They should be fastened securely to the outside wall or hung from the floor joists to reduce the transmission of noise.

Some power-vented systems use a double wall exhaust connection that draws cooler outside air into the outer pipe, and the hot exhaust gases are contained in the inner pipe (concentric venting). This provides a layer of safety between the hot exhaust gases and the combustible wall and floor joist materials and pre-heats the combustion air.

System operation: Power-venting requires that the oilburner primary control has delayed valve-on and burner motor-off delay features, similar to pre-purge and post-purge. When the thermostat or aquastat calls for heat, the power-venter motor starts. After the power-venter motor has come up to speed, the pressure switch closes (in one to two seconds). This closes the circuit to the burner primary, allowing

Figure 6-17: Outside vent hood



the burner to operate. After the heating requirement is satisfied, the thermostat or aquastat circuit opens, activating the burner motor off delay (post-purge) cycle. During this cycle, the oil valve closes shutting off the flame, but the power-venter and the burner motor continue to run for a period of time, venting the last of the combustion products and cooling the burner compo-nents.

Inspection and maintenance: The power-venter should be inspected once a year.

- Check to be sure the motor and fan rotate freely.
- To prolong the life of the motor, lubricate it as directed by the manufacturer.
- Inspect the power-venter wheel to clear out any soot, ash, or coating that inhibits either rotation or air flow.
- Remove and clean the air sensing tube.
- Remove all foreign materials before operating. Inspect all vent connections for looseness, for evidence of corrosion, and for flue gas leakage.
- Replace, seal, or tighten all of the pipe connections as necessary.
- Check the choke plate to insure it is secured in place.
- Check the barometric draft control to insure the gate swings freely.
- Check the safety system devices—start the heating system, and then disconnect the pressure sensing tube from the pressure switch. This should stop the burner. Reconnecting the tube should restart the burner.

For proper system installation, set-up and testing, you must follow the manufacturer's instructions exactly. It is also a good idea when installing a power-venter, that you also install a fresh air kit to bring combustion air to the burner from outdoors. Many power-venters integrate a fresh combustion air intake into their system. If they do not, you should ensure that the pipes are spaced so that they do not interfere with each other—at least 12 inches apart. Fresh air should be brought in from the same wall as the power-venter exhaust to equalize air pressure within the vent and intake system.

Direct venting

Direct-vent systems use the power of the burner fan to push the products of combustion out of the building. Direct-vent provides sidewall venting without the use of a power-venter, extra motors, fans, or wiring. Direct-vent systems feature sealed combustion, utilizing clean outside air for combustion. The direct vent system normally uses a stainless steel combination vent hood. Figure 6-18 shows an example of a sealed combustion system.

Unlike chimney venting and power-venting, with direct-vent the air pressure inside the boiler or furnace and flue pipe is greater than the pressure in the building. If there is a leak in the heat exchanger or the flue pipe, products of combustion will leak into the building. Direct-vent systems are sold as a complete package. You should only use components that are supplied with the manufacturer's direct-vent system. Mixing and matching, or do-it-yourself engineering may void the manufacturer's warranty and may create a hazardous condition.

Other drawbacks to a direct-vent system are:

• Surface discoloration of the building may occur due to improper burner and control adjustment.

• The residential units can only push the exhaust gases and pull combustion air from about 20 feet maximum. This means that you must locate the boiler, furnace, or water heater as close to an outside wall as possible.

Things to consider when installing direct-vent systems are:

• Seal all joints on the venting system with a high temperature sealant.

• Combustion efficiency tests should be taken at the port provided on the unit by the manufacturer. Do not puncture the stainless steel vent tubing. Adjust the burner combustion with a 'window of tolerance.' Set the air to produce a trace of smoke. Take the CO_2 reading at a trace of smoke and reduce the CO_2 by 1.5% to 2%. For instance, if the CO_2 reading with a trace is 13%, reduce it to 11% to 11.5% CO_2. This will compensate for variations in fuel and outdoor temperatures, and other variables over the year. See Chapter 7 on combustion for more details.

Figure 6-18: Direct side-wall venting and outside combustion air