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THE HVACR CONTRACTOR'S WEEKLY NEWSMAGAZINE SINCE 1926

SEPTEMBER 28, 2015 | \$5.00 | ONLINE AT WWW.ACHRNEWS.COM | [f](#) [t](#) [v](#) [in](#) [g+](#)

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## Variations in HVAC Venting: The Rigors of Making the Right Choice

An in-depth examination of PVC, CPVC, and polypropylene venting options

**R**esidential gas-fired equipment is changing and so are the related codes. As efficiencies and energy factors creep up — whether organically or because of regulation — the installation processes and venting technologies evolve, as well. New material and techniques can toss installers a learning curve.

Installers and specifiers know a gas appliance is only as good as the venting system it's connected to. Poor venting can cause improper combustion, but, more importantly, can also lead to flue gas leakage into heated spaces — a problem with deadly consequences.

And, like the ever-changing regulation landscape, the topography's different for each appliance type. We'll look at venting as it applies to unit heaters, water heaters, boilers, furnaces, and also at some of the key differences between polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), and polypropylene venting.

### UNIT HEATERS

Though most often found in garage bays and semi-finished areas, unit heaters are commonly installed under or adjacent to living spaces. Among recent code changes, unit heaters have seen some of the biggest shifts.

Recently, Canadian Standards Association (CSA) International Requirement 10.96 and CR 96-005 were combined with American National Standards Institute (ANSI) Z83.8/CSA 2.6 to create one overarching standard for all unit heaters sold in the U.S. and Canada.

"The ANSI standard exemption for horizontally vented residential unit heaters that per-

mitted Category I venting was retracted as of July 1, 2011," said Jamie Tuinstra, product manager at Modine Mfg. Co. "Going forward, new installations are required to have Category III venting."

This means that all power-vented unit heaters installed in residential applications that require horizontal venting must now be gas-tight and meet certain construction criteria as defined in UL1738, "Venting Systems for Gas Burning Appliances, Categories II, III, & IV." Venting systems that are approved to meet the UL1738 standard will be clearly marked with UL approval.

Power-vented units installed in commercial or industrial applications may be installed with either a listed vent system, as described above, or with properly sealed single-wall metal vent pipe, as described in the respective installation and service manual. This applies to separated combustion units, as well. High-efficiency, separated combustion units are condensing appliances, meaning the vents must be gas- and water-tight and must include a means to drain condensate from the vent system.

There are a variety of simple rules to follow to ensure proper venting of most power-vented heating equipment. Perhaps most importantly is the need to keep vent runs as straight as possible, limiting the number of turns or bends. And, never use a vent size smaller than the size recommended by the heating equipment manufacturer.

Vertical vent systems must terminate vertically, must not have

a horizontal run that is more than 75 percent of the vertical rise in Category I installations (for example, if the vent height is 10 feet, the horizontal portion of the vent system cannot exceed 7½ feet), and it must terminate a reasonable distance above the roof to prevent snow buildup from blocking the vent.

Horizontal vent systems must terminate horizontally, must be pitched no less than ¼ inch per foot (either up or down), must not terminate near air inlet openings to the structure, and must be sufficiently high or guarded to prevent accidental contact made by people or equipment.

A drip leg is recommended with the cleanout cap located appropriately based on the installation to prevent condensate in the vent pipe from entering the heating equipment. Special attention must be paid to the maximum and minimum allowed vent lengths — be sure to consult the manufacturer's installation and service manual.

### WATER HEATERS

"There's a common misconception that the April 16, 2015, U.S. Department of Energy [DOE] regulations have eliminated atmospherically vented, tank-style water heaters," said Chad Sanborn, product marketing manager at Bradford White Corp. "This isn't the case. The most recent regulation changes affect water heater EF [energy factor], not necessarily the equipment's venting type. In regard to residential water heater efficiency, one of the biggest elements in that equation is standby heat loss, so tanks are now better insulated."

But, that's not to say that more efficient models aren't becoming more popular. If new, high-efficiency water heaters are planned as a retrofit, existing, single-wall B-vent must be replaced in favor of PVC, CPVC, acrylonitrile butadiene styrene (ABS) plastic, or polypropylene.

The majority of venting lines

are 3-4 inches in diameter and are precisely matched to the design requirements of new blower motor assemblies that discharge from the top of water heaters.

Some changes are coming next year in regard to the type of plastic pipe that's approved for venting applications.

As of April 1, 2016, cellular-



ALASKAN AD'VENT'URE: Proper venting for this high-efficiency Laars water heater was a key consideration by Weldin Construction pros when designing this mechanical space on a military base in Alaska.

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core (foam-core) PVC pipe will no longer be approved to vent water heaters with a capacity of 75,000 Btuh or less, per ANSI Z21.10.1/CSA 4.1. The same will apply to water heaters above 75 MBtuh as of June 1, 2016, per ANSI Z21.10.3/CSA 4.3.

The need to improve flexibility of installation and placement of the water heater has driven the development of power-direct, through-roof, and side-wall venting options. Some new water heater systems offer key advantages through their ability to vent through the roof and pull air in for combustion through the wall.

"Being able to draw combustion air, either from an adjacent room or from outside [fresh air], offers a lot of flexibility for the installer," continued Sanborn. "Typically, there are spacing requirements between intake, exhaust, and other appliance vents. Then, there's consideration for available cfm, if there are other appliances in the room such as a clothes dryer or an atmospherically vented furnace or boiler."

Dust, debris, or chemical vapors are also important factors in the mechanical space. If an appliance can draw cleaner air from elsewhere, it will help limit the amount of maintenance the burner may need.

Though uncommon, the risk of chemical vapors entering atmospherically fired equipment is very real. There are plenty of well-documented horror stories that begin with improperly sealed or stored swimming pool chlorine containers found within easy reach of an appliance routinely exposed to the chemicals through atmospheric combustion air. Acidic accumulation within heat exchangers and through the venting path is a dead-ringer for trouble.

Finally, if the application offers abundant atmospheric combustion air, some water heater models require only one pipe — for venting. Drawing combustion air from the building eliminates the need for a second pipe. This can be an advantage in some situations.

"Another great capability that has been introduced is common, or cascaded, venting," said Sanborn. "Our Infiniti Tankless™ gas-fired water heaters can be vented and piped together to operate in unison with the use of vent kits sold by Bradford White."

While the average American home doesn't typically have a demand that surpasses the Infiniti's 199-MBtuh capacity, homes with large, multi-head showers may benefit from a multi-unit installation. Up to four Infiniti units can be piped and plumbed together, totaling roughly 800-MBtuh capacity and a combined 20:1 turndown ratio.

While this approach offers great efficiency and redundancy, it also means numerous units can share common exhaust vents, needing only one roof or wall penetration.

## BOILERS

"In terms of gas-fired boiler installations, we're seeing more Category IV venting," said Nate Warren, hydronic sales manager at Bradford White. "Not long ago, there was a wide variety of venting on new installations — everything from Category I to IV. That's changing quickly. At Bradford White, the bulk of our boiler line requires Cat IV venting, but we do have a few models featuring Cat I, II, and III."

Category I appliances feature less than 84 percent efficiency and operate with a neutral or negative vent pressure. The higher stack temp — though less than 550°F — means flue gas condensate is not an issue.

While Category II appliances often use a small fan to move gases through a secondary heat exchanger, the force is not enough to pressurize the flue, thus operating at neutral or negative vent static pressure. With vent gas temperatures below 140° over dew point, Category II appliances can cause excessive condensation in the vent.

Category III, often called power-vented, operates with a positive vent pressure through the use of a more powerful exhaust fan. The appliance is noncon-

densing because it creates a vent gas temperature of 140° or higher above the dew point temperature.

Category IV applies to high-efficiency condensing units that produce a much cooler exhaust stream. As with Category II venting, vent condensate must be eliminated.

"The basic explanations of each category that you might find in any number of resources are a good overview of different venting requirements, but are by no means intended to be an installation guideline," said Joan Mishou, inside sales manager at Laars Heating Systems. "For any boiler that falls under Categories II, III, or IV, you must consult the installation manual for that specific piece of equipment."

"One thing we've seen recently is a big move toward polypropylene vent system instead of PVC and CPVC," she continued.

Component availability for polypropylene venting systems have improved a lot over the past year or two, and the cost has become more competitive. While the reliability of these pipes has been proven by years of use in furnace applications, polypropylene may be a better option for condensing boiler systems where flue temperatures tend to fluctuate. Most manufacturers of polypropylene vent systems, like Centrotherm and DuraVent, offer products rated for sustained operating temperatures up to 230°.

## FURNACES

"The heating and cooling needs of every community are unique," said Tom Archer, product manager at Carrier Corp. "For example, local codes often impact specific materials and exhaust locations. We recom-

mend working with an independent dealer to determine the most appropriate system for your application. But, there are some broad-brush changes that appear to be coming for installers to keep their eye on."

The DOE has proposed a rule to increase the national minimum energy-efficiency standard for gas furnaces to 92 percent AFUE. This would require vent changes when replacing conventional 80 percent AFUE furnaces. These vent changes would significantly increase the price of replacement installations to homeowners.

Replacement installation costs would further increase for furnaces installed in a finished basement or a utility closet, especially when not located on an exterior wall. Noncondensing furnaces vented through a fireplace chimney would require the installation of a chimney liner to



**FUNCTIONALITY, ACCESSIBILITY:** Venting becomes an important function and design element when laying out a mechanical room that assures not only proper function of all equipment, but easy access to all systems.

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contain condensing exhaust. In addition, homes with common vents for the noncondensing furnace and water heater may require a new vent for the water heater. Multifamily applications with a common vent chimney will require a change to a dedicated vent; one per furnace.

a member of the M&G Group, PVC is rated for temperatures up to 140°, while temps up to 190° are acceptable for CPVC. Unlike PVC, CPVC is approved for venting use. Chemically, the main difference between the two is that CPVC contains more chlorides than PVC. Polypropylene, a different com-

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## VERSATILE POLYPROPYLENE VENTING

New York City has outlawed the use of PVC for gas appliance venting, and some towns in Connecticut have followed suit. A bill that would accomplish the same is currently sitting with the New Hampshire legislature.

This action comes in part from PVC failures in the field, but also in reaction to state-ments from manufacturers, like Charlotte Pipe, stating their PVC product is meant for drain-age, not for venting applications, which would void pipe warranty. This leaves two key options — CPVC and polypropylene.

According to Howard Berman, regional sales manager at DuraVent,

pound all together, is approved for temperatures up to 230°.

“While we’ve only been selling polypropylene vent pipe in the U.S. for five or six years, it’s been used extensively in Europe for 25 years,” explained Berman. “Since we introduced it in the U.S., we’ve seen sales in the Northern region double each year.”

DuraVent also produces metal venting products, and, as their poly products have gained ground, sales for the B-vent line have slumped.

“We don’t see nearly as many condensing furnaces vented with poly products as we do boilers and water heaters,” Berman continued. “Flue gas temperatures on high-efficiency furnaces



■ BIG OR SMALL: Proper venting for this small, Modine Effinity 93 unit heater is just as important as for larger systems.

tend to top out at 100°-110°. But, with boilers — even condensing models — it’s not rare to see stack temperatures crest 180° at some point during a cycle. What you’ll often get is browning of the PVC vent pipe.”

Berman believes the adoption of poly venting will continue to grow steadily over the next few years as more installers grow comfortable with the system. While there are some differences, most are benefits.

Polypropylene piping is often more expensive than PVC, but it’s often roughly half the cost of CPVC, as well. Because poly pipe is joined by gasket fittings, disassembly and reassembly is possible after a flue has been installed. It’s also lighter and available in a flexible form. This is ideal for using existing chimneys or B-vent as a chase for high-efficiency venting during a retrofit.

Today, most poly manufacturers offer wind- and rain-tested vent terminations. A wide variety of configurations are available, including concentric and single-vent, sidewall, and roof configurations. No shortage of other accessories exists, like fittings, straps, and wall penetrations.

As efficiency standards push installers to learn new techniques, tools, and products in the name of energy conservation, contractors aren’t left to go it



■ MAKING A LIST: As technicians button-up a completed light commercial hydronic system, satisfactory venting is on the checklist.

alone. Across the board, manufacturers are stepping up their games to provide the training and material to make the transition as smooth as possible. [N](#)

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