



Centrotherm's InnoFlue line of polypropylene flue gas vent products is recyclable and corrosion-resistant.

What contractors must consider when selecting a vent system for a gas-fired boiler or other heating appliance.

# How do you vent?

The purpose of a gas vent for a heating appliance is to move noxious gases safely outside and allow for the disposal of caustic condensates, if present. As such, a gas vent is a safety device rather than a device to increase thermal efficiency or improve comfort. It is extremely important that an appropriate vent type, size and material be selected to assure that poisonous gases such as carbon monoxide do not build up in the living space.

In all situations, local building codes must be adhered to for acceptable vent materials and types. Before condensing appliances became widely available, most mechanical codes were very specific about what was acceptable venting practice. However, these codes are less clear on what is acceptable when venting condensing appliances. This article discusses what must be considered when selecting an appropriate vent system for a combustion-type heating appliance.

The following standards apply to appliance venting:

- NFPA 211;
- NFPA 54;
- ANSI Z223.1; and
- ICC 502.1 and many local building codes.

The National Fire Protection Association categorizes vents based upon the type of fuel used, the flue gas temperature the appliance generates, and whether the venting system operates at positive or negative pressure relative to the atmosphere.

Gas-fired appliances are divided into four categories (see chart on page 52):

1. Category I covers appliances that are less than 84 percent efficient, and therefore leave enough heat in their exhaust gases to create natural draft (negative vent pressure), as well as prevent the formation of flue gas condensation.

2. Category II appliances also operate at negative vent pressure, but are capable of operating with

flue gas condensation. They typically use a fan to move hot gases through a secondary heat exchanger but do not create positive pressure in the vent.

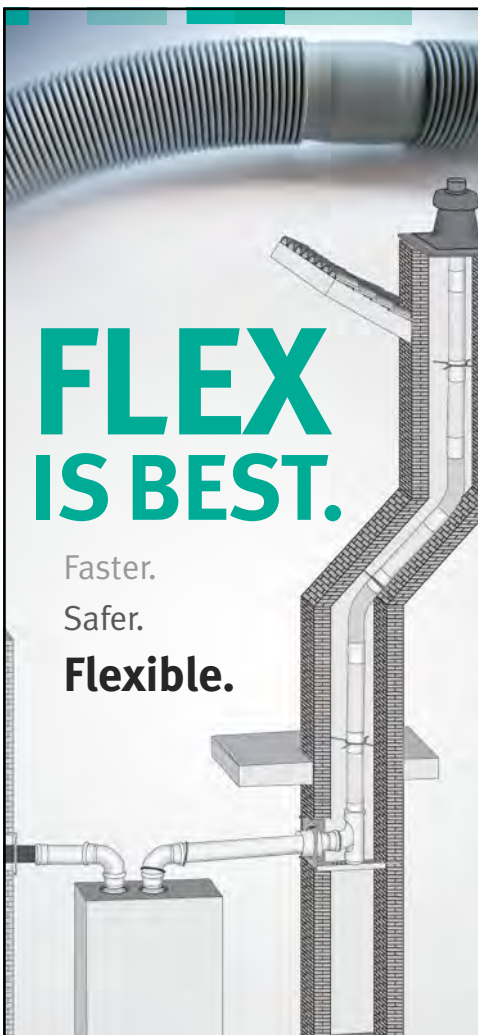
3. Category III appliances are noncondensing and operate with positive vent pressure. They typically use a more powerful exhaust gas fan that can handle high-temperature exhaust gases and create positive pressure in the vent.

4. Category IV appliances operate at positive vent pressure and are capable of operating at condensing conditions.

**Special gas vent:** Within the NFPA standards and International Code Council codes, Category II, III and IV vent recommendations refer to special gas vent or plastic vent as recommended by the appliance manufacturer and subject to approval by the “authority having jurisdiction” — typically, the local building codes.

Special gas vent is approved to UL C-S636 (in Canada) and/or UL 1738 (in the United States). Currently

Photos courtesy of Centrotherm Eco Systems.



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## InnoFlue® Flex Polypropylene Vent System

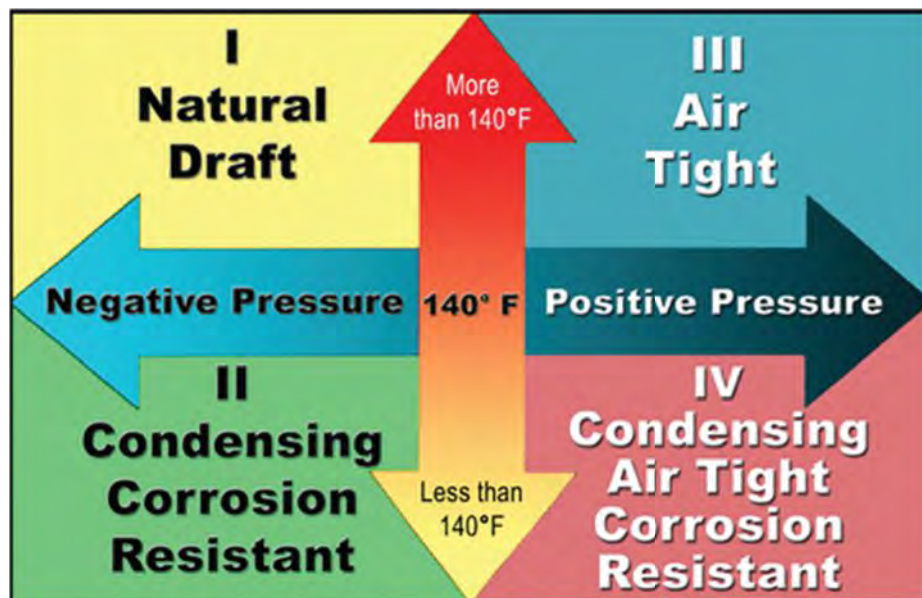
- **Faster.** Light-weight and available in continuous lengths up to 150', InnoFlue® can be installed without any tools or expensive couplers.
- **Safer.** Featuring EPDM Gaskets in every joint, InnoFlue® is pressure rated to 20" of water column.
- **Flexible.** Combining InnoFlue® Flex and Rigid provides more installation options for side wall venting, relining B-Vents or masonry chimneys.
- **Green.** 100% recyclable and gasketed, InnoFlue® eliminates VOC containing adhesives.
- **Listed.** ULC-S636 listed to 230°F (110°C), InnoFlue® can be installed at zero clearance to combustibles

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## How do you vent?



Gas-fired appliances are divided into four categories for venting purposes.

two PVC and CPVC manufacturers and two polypropylene vent manufacturers have achieved UL C-S636 certification; none have been certified to UL 1738. UL 1738 mandates a test at 464 degrees F be performed on nonmetallic vent. While this is appropriate for category III appliances, category II and IV appliances should never have flue gas temperatures this high.

Most appliance manufacturers have recommended PVC as being satisfactory for venting their appliances. However, these manufacturers do not state a temperature limit for the PVC or CPVC vent they approve. Installers will no longer find flue gas temperature limits in manufacturers' installation instructions because such temperatures vary depending on the operating conditions of the appliance. So selecting the safe material becomes difficult.

Both UL and UL C (Canada) apply safety margins to their standards that limit the maximum temperature the vent can be exposed to based on the materials used for the vent and related components.

UL C-S636 venting is divided into temperature classes:

- PVC is rated class A (can operate with vent gases less than or equal to 65 degrees C (149 degrees F)).
- CPVC is class B (rated to operate with vent gases less than or equal to 90 degrees C (194 degrees F)).

- Polypropylene is class C (rated to operate with vent gases less than or equal to 110 degrees C (230 degrees F)).

- Class D is for other materials rated to operate above 130 degrees C (266 degrees F). Stainless-steel venting is an example of a Class D material.

**A gas vent is a safety device rather than a device to increase thermal efficiency or improve comfort.**

So what does this mean for an installer? It means that if you are using PVC for venting, there are many things to consider. If you go by the PVC manufacturers' installation instructions, you are limited to 140 degree F flue gas temperatures. If you operate the boiler or water heater with a low-enough supply water temperature, or if the dilution air mixed into the vent is cool enough, you can use PVC with no worries.

Otherwise, you must step up to CPVC with allowable operating temperatures of 180-220 degrees, depending on the

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grade of CPVC. Again, you would need to be certain that the correct grade of pipe is used based on the supply water temperature used in a given application. You also must take special care when handling the pipe in temperatures below 50 degrees F, because pipe manufacturers state that PVC/CPVC becomes brittle below this temperature and can crack “from relatively minor impacts.”

Alternative venting materials are polypropylene and AL-29-4C special gas vent. Although polypropylene has only been used in North America for a couple of years, it has a 20-year history as a combustion gas vent in Europe. Centrotherm's InnoFlue polypropylene vent is rated to operate at temperatures up to 248 degrees F under CE EN-14471 (European Code) and up to 230 degrees F under UL C-S636. These rating temperatures allow higher supply water temperatures from Category II and IV appliances without exceeding the temperature limits of the venting material.

Polypropylene and metal special gas vent systems use integral gaskets between mating components. This eliminates the need of primers and glues as required with other venting systems. Gaskets also accommodate the expansion and contraction movement of the venting system without disengaging mating parts.

Stainless-steel special gas vent is certified for categories II, III and IV appliances and, with the addition of new materials, pricing has stabilized and even come down in a few cases. Will pricing eventually be comparable with plastic venting, and will the new materials have the same life expectancy as AL 29-4C? Only time will tell.

**Other venting systems:** Oil appliances are not divided into categories because until very recently, only noncondensing oil-fired appliances have been available. However, condensing-capable boiler technology is now making its way from Europe to North America. Because there are currently no specific venting standards for these high-efficiency oil-fired appliances in North America, some manufacturers are allowing PVC and CPVC to be used as the vent material.

Although special gas vent (AL-29-4C) is considered the material of choice for gas-fired condensing appliances which

contain chlorides and hydrochloric acid, it actually corrodes from the sulfuric acid created by condensing oil-fired appliances. Polypropylene and SS316 are the best materials for this application.

Other venting systems are straightforward with safety standards specifically called out within the fuel gas codes. Low-efficiency gas-fired appliances are vented with B-vent, an aluminum inner vent with a galvanized outer wall, tested to UL-441. Oil-fired

formation of condensates and minimizes their corrosive effects.

The same is not true for the aluminum liner routed through a masonry flue, especially if that chimney is significantly exposed to cold outside temperatures. The latter situation allows condensation to form, which can quickly corrode the liner. This can lead to further degradation of the chimney and the possibility of toxic gases entering the living spaces with lethal consequences.

**Code interpretation can be a matter of life or death. Look for the UL certification and verify it is applicable.**

appliances use L-vent, a stainless-steel inner vent with a galvanized outer wall, tested to UL-641. Low-efficiency gas- and oil-fired appliances, with the appropriate connector, can be vented in a masonry chimney with clay flue lining.

**Chimney integrity:** However, before replacing an appliance that has been vented into a masonry chimney, that chimney should be inspected for integrity. If the chimney does not meet the requirements of NFPA 211, it must be relined with a liner certified to UL-103 or UL 1777.

SS316 stainless steel is generally considered the “all fuel” vent material. Some manufacturers add titanium (SS316Ti) for improved properties at higher temperatures, while others use low carbon SS316L for better resistance to chlorides and hydrochloric acid produced by gas appliances. The grades of stainless steel used can be low-end — such as 304, 430, 439, 444 (generally used with solid/bio-fuels) — or higher grades, such as 321, super-ferritic stainless steel (AL 29-4C) and super-austenitic stainless steels (AL-6XN).

Aluminum liners can be used for relining chimneys for gas-fired appliances. While aluminum is used in B-vent, keep in mind that B-vent is typically run through a chase that stays relatively warm. This prevents the

A direct-vent method for both gas- and oil-fired appliances, currently accepted in Europe but not incorporated in many North American codes, routes the exhaust vent pipe up a chimney and then uses the sealed chimney as the intake air path. Several appliance manufacturers approve this method using coaxial vent and are working to get codes updated.

I once had a supervisor who often used the phrase, “Let your conscience be your guide.” When it comes to appliance venting, these are very appropriate words. Code interpretation can be a matter of life or death. When in doubt, look for the UL certification and verify the specific UL certification is applicable to the appliance and operating conditions you are planning or call a vent manufacturer who can guide you through your options.

*About the author: Jim Molloy is the vice president of business development at Centrotherm Eco Systems of Albany, N.Y., a subsidiary of Germany-based Centrotherm Systemtechnik GmbH, which was formed in January 2010. Molloy has spent five years in the heating exhaust vent/prefab chimney/chimney liner/special gas vent industry. He has 17 years experience in manufacturing complex exotic sheet metal aerospace assemblies, and spent eight years as a reactor plant supervisor and instructor in the U.S. Navy's nuclear power program.* **PM**