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Venting Gas Appliances with Polypropylene:

What Installers and Governing Authorities Need To Know

***Leaders** in-Venting Innovation™*

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This white paper is available for download at no cost at www.duravent.com

This paper is written with regard to applicable codes and standards and intended for use and application in the United States of America.

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Polypropylene plays a crucial role in just about every industry one can imagine from diaper manufacturing to healthcare. Its high-performance features make it widely applicable in all kinds of product manufacturing and its overall safety and sustainability has earned it a reputation for being one of the most environmentally friendly plastics. In Europe, polypropylene has been a go-to product for venting material for Category II and IV condensing gas appliances for decades, largely because it is non-corrosive and has the ability to withstand temperatures up to 230°F without compromising its structure or performance. The same is happening in the United States, albeit at a slower pace due to confusion over codes and evolving listing practices. This paper will address these points of confusion and demonstrate that polypropylene pipe (ULC-S636 or UL 1738 Listed) is perfectly safe and suitable for venting Category II and IV appliances.

A quick review of Category II and Category IV appliances is an appropriate place to start. Per the National Fuel Gas Code (ANSI 223.1), gas appliances that have a combustion efficiency of greater than 83% fall under either of these categories because they operate at temperatures low enough to permit the condensing of flue gases. Category II appliances operate at a negative static pressure. These devices have seen a major decline in manufacture in favor of Category IV appliances, which are 90% or higher in efficiency, operate at a positive pressure and produce excessive condensing in the vent. For the purpose of this article, we will mostly be addressing Category IV.

In nearly every jurisdiction throughout the United States, it is permissible to vent Category IV gas-fired appliances with unlisted plastic vents, as long as the vents have been tested and approved by the appliance manufacturer and the installation instructions adhere to the manufacturer's guidelines. In short, it is up to the authority having jurisdiction to make that determination, assuming the venting material is listed by the manufacturer for a specific appliance.

"In general, US codes permit Category IV gas-fired appliances to be vented using unlisted plastic vents where such vents are tested and covered under the specific appliance listing. These vents are to be installed in accordance with the appliance manufacturer's installation instructions." [1]

The first North American standards organization to utilize a listing for any type of plastic gas venting product was the Underwriters Laboratories of Canada (ULC). It utilizes the ULC-S636 standard, integrating plastic into their testing for condensing gas vent.

"ULC-S636 is a Canadian standard that provides some hope for a template of a U.S. or international standard, but it is noted that the temperature ratings listed in ULC-S636 exceed the working temperature ratings of many plastic pipe manufacturers." [2]

Working temperature is the most critical factor that ULC-S636 addresses with regard to venting gas appliances with plastic materials. The listing rates PVC, CPVC and polypropylene for applications based on their working temperatures:

- PVC is rated class A to operate with vent gases less than or equal to 149°F (65°C).
- CPVC is rated class B to operate with vent gases that are less than or equal to 194°F (90°C).
- Polypropylene is rated class C to operate with vent gases less than or equal to 230°F (110°C). [3]

Since the development of ULC-S636 all polypropylene manufacturers of gas vent have been listed to the ULC-S636 standard for operation up to 230°F, a temperature that is well above the normal maximum operating temperature of any condensing appliance. PVC pipes, rated for only 140°F, provide very little margin of error in condensing applications, especially when one factors in fouling on heat exchange surfaces and on the vent pipes themselves. Both can lead to higher temperatures in the flue which has been known to cause discoloration, weakening and even leaks in PVC pipe.

[1] John K. Taecker, "Venting Gas-fired Appliances." The Code Authority, Issue 1, 2012, 4-6.

[2] Doug Page, "Venting Systems," PHCP Pros, June 4, 2017, https://www.phcppros.com/articles/5249-venting-systems.

[3] Jim Malloy, "How Do You Vent?", Plumbing & Mechanical, January, 2011, 50-54.

Equivalency of ULC-S636 and UL 1738 Listings

As mentioned before, ULC-S636 was the first listing standard for plastic gas vent. Since that time, all manufacturers of polypropylene gas vent have had their products listed to that standard. Very recently, an independent testing laboratory has also listed at least one ULC-S636 listed polypropylene product to UL 1738, the US standard for Venting Systems for Categories II, III and IV Gas-Burning Appliances. Unfortunately, this recent listing development has given rise to even more confusion among those looking for safe alternatives to PVC. Because UL 1738 is a US standard, specifiers and even authorities having jurisdiction, may assume that this is the safety standard they should seek when considering plastic gas vent. The fact is, there is very little difference in the make-up and performance of any polypropylene material that is certified under either ULC-S636 or UL 1738. The test procedures, while not identical, set performance thresholds that are for the most part very similar. So any claims that one standard is overall more stringent (or more legitimate) than the other are not accurate.

Focusing on variations in test methods can prove misleading unless time is taken to thoroughly read the materials and consider them in the context of an actual application. For example, one might argue that the UL 1738 imposes higher test pressures on pipe samples when the fact is both tests involve very low pressures. After all, the standard is testing a product that is intended for an open application so a higher test pressure is of little relevance. It is likewise of little relevance that UL 1738 leak testing is performed at a pressure that is 24% higher than ULC-S636. Within the context of the overall tests, such differences are inconsequential.

What is more consequential is the comparative amount of leakage that the tests allow. UL 1738 requires that an 8 ft. pipe sample containing a minimum of three joints (excluding endcaps) be subjected to 0.50 in w.c. (water column) of pressure over a one-hour period. To pass the leak test the sample is required to maintain a constant pressure while an airflow meter is used to measure the amount of leakage that occurs under this pressurized condition. UL 1738 allows leakage up to 20 times the volume of the pipe before it is considered to fail. The larger the pipe, the more leakage that is allowed. Given that pipe leakage is one of the higher concerns when it comes to venting of gas appliances, this is a very forgiving standard.

ULC-S636 requires a two-meter pipe sample that includes two 90-degree elbows and one other special fitting. Sealed at both ends, the sample is pressurized to 100 pascals (0.40 in w.c.). Regardless of the total volume of the pipe, the amount of air leakage must be below 0.3 liters/hour. This is significantly less leakage than what is allowed by the UL 1738 standard.

In time, it is all but inevitable that many other manufacturers of polypropylene gas vent will be listed to UL 1738, just as they obtained ULC-S636 listing. In the meantime, authorities having jurisdiction can be assured that any polypropylene product that is certified to either standard is a safe and acceptable venting material for Category II and IV appliances.

Manufacturers' Listings Are Critical

In addition to the above listings, it is imperative that a given brand of polypropylene venting be specifically listed by the appliance manufacturer as acceptable on a specific appliance. This is the stance taken by UL (as discussed earlier). It is also included in Section 501.4 of the International Fuel Gas Code (IFGC), which states,

"The design, sizing, and installation of vents for Category II, III, and IV appliances shall be in accordance with the appliance manufacturer's instructions." The code goes on to say that "Plastic vents for Category IV appliances shall not be required to be listed and labeled where such vents are as specified by the appliance manufacturer and are installed in accordance with the appliance manufacturer's instructions."

Some may argue that this leaves the door open for PVC, and indeed, this is a point of confusion. Numerous manufacturers do list PVC for venting their appliances but fall short when it comes to the installation "instruction" part. They may reference ASTM D1785 as a guideline, but as others have noted, this standard applies exclusively to the use of PVC pipe (Schedules 50, 80 and 120) in pressurized liquid applications--not flue gases. [4] This arguably puts many installers at risk when it comes to liability for a failed PVC installation. It also serves as yet another reminder of what PVC manufacturers have been saying for quite some time, that their products were never intended for the transport of flue gases. It is not, however, a reason to disregard the validity of manufacturers' listings of polypropylene systems that are manufactured specifically for venting gas appliances.

The Endgame: Safe, Economical Alternatives to PVC

Now that a number of US cites have passed policies to phase out the use PVC, including New York City where PVC has been outlawed as a venting material on gas appliance, finding a safe, economical alternative is the endgame. Excluding certain brands of polypropylene pipe because they are not yet listed under UL 1738 is counterproductive and only serves to limit customer options.

The following quote comes from a trade article published more than two years before any polypropylene products were ever listed to UL 1738.

"Component availability for polypropylene venting systems have [sic] 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°F." [5]

Polypropylene, by all accounts, is the best and most economical alternative for those who are spooked by the many downsides of PVC. It has been used extensively in Europe where PVC does not meet the minimum temperature requirement for condensing appliances per European test standards.

"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 Kevin Bernier, regional sales manager at DuraVent. *"Since we introduced it in the U.S., we've seen sales in the Northern region double each year."*

Conclusion

Polypropylene pipe is not only a far safer Category II and IV venting material than PVC, it is a higher performing and less expensive alternative to CPVC. As long as a brand is listed under ULC S636 or UL 1738 and is listed specifically by the manufacturer of the appliance, authorities having jurisdiction can be assured that these products are specifically engineered and tested for condensing applications.
A proven track record in Europe reinforces the safety story of polypropylene.

[4] Page, "Venting systems."
[5] "Variations in HVAC Venting: The Rigors of Making the Right Choice," Air Conditioning, Heating & Refrigeration News, September 28, 2015, https://www.achrnews.com/articles/130658-variations-in-hvac-venting-the-rigors-of-making-the-right-choice.

Advantages of ULC S636/ UL-1738 Listed Polypropylene Pipe for Use with High Efficiency Furnaces, Condensing Boilers and Tankless Water Heaters

- Higher sustained operating temperatures than PVC/CPVC - up to 230°F / 110°C
- Less expensive than CPVC and stainless steel
- Corrosion resistant
- Does not contain carcinogenic materials, chlorides or heavy metals
- 100% recyclable
- Lightweight, engineered construction
- Does not release hazardous gases during combustion
- Installs quickly and easily without the use of adhesives which require strict curing times
- Complies with LEED credit IEQc4.1 on VOC limits
- Withstands tough environmental conditions. (wind, rain, freezing) without flexing or cracking

PolyPro Manufacturer Appliance Approvals

DuraVent PolyPro® (ULC S636) vent materials have been approved for use as venting materials on the following brands of gas fired appliances: Aerco, Allied Engineering Co., Bosch, Buderus, Camus, ECO King, ECR, Energy Kinetics, Geminox, HTP, IBC, Laars, Lochinvar, Mestek, NY Thermal, Peerless Boilers, Pensotti, QHT/Biasi, Slant Fin, Rinnai, Triangle Tube, US Boiler/Burnham, Viessmann, Weil McLain, Westinghouse, American Water Heaters, AO Smith, Bock, Bradford White, Eternal, Giant, GSW, John Wood Water Heater, Navien, Nortiz, Rainsoft, Raypak, Reliance, Rinnai, State Water Heaters, Takagi, US Craft Master, Air-Flo, AirEase, Armstrong Air, ArcoAire, Bryant, Carrier, Comfortmaker, Concord, Day & Night, Ducane, Empire Comfort Systems, Gibson, Goodman & Amana, Keeprite, Lennox, Maytag, Modine, Nordyne, Payne, Rheem, Ruud, Tempstar, Trane, Wolf Steel, York Furnace.

For more information on PolyPro venting solutions, visit:
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