VENTILATION SYSTEM DESIGN

In the past 10 years thermoplastic materials have started to be used for ventilation applications. A thermoplastic vent system provides many features that standard sheet metal cannot in terms of functionality, ease of installation, and corrosion resistance.

In designing a thermoplastic water system, the following items need to be considered:

- Materials of Construction
- Operating Parameters
- Codes
- Layout Recommendations
- Thermal Expansion
- UV Exposure
- Hanging
- Welding Methods

Materials of Construction

For the construction of ventilation systems, Asahi/America provides the ProVent system. ProVent components are now available in Polypropylene and PVDF. The system is designed specifically for ventilation and transport of hazardous fumes and potentially corrosive gases. Both polypropylene and PVDF offer different resistance to chemical applications that should be verified prior to purchase.

Operating Parameters

The ProVent system is available in multiple wall thickness in polypropylene. The selection of material pressure rating shall be based on the following criteria:

- Operating temperature
- Media to be transported
- Operating pressure, positive or negative
- Economics
- Required fire codes
- Size to be installed

By evaluating the above parameters, the proper system can be chosen. In many applications polypropylene will more than exceed the application; however, if the media to be transported is at an elevated temperature PVDF may be required.

In general, PP systems are available in a larger selection of sizes and pressure rating options. Refer to Asahi/America's *ProVent Dimensional Guide* for availability of components.

Codes

In designing a ventilation system, the most pertinent code may be the fire code or the need for Factory Mutual approval. ProVent systems made of polypropylene can be installed according to FM regulations and the final installed product can meet FM requirements. The use of PP in systems requiring FM approval will require the use of an internal sprinkler head system. In case of a fire, the sprinkler system would eliminate the possibility of the vent system spreading the fire.

There are sprinkler systems on the market that are specifically designed for this application and dramatically reduce the installation labor, as well as the required sprinkler head inspection process after installation. Figure D-39 shows a detail of a typical flexible sprinkler head and the mounting component offered by Asahi/America.

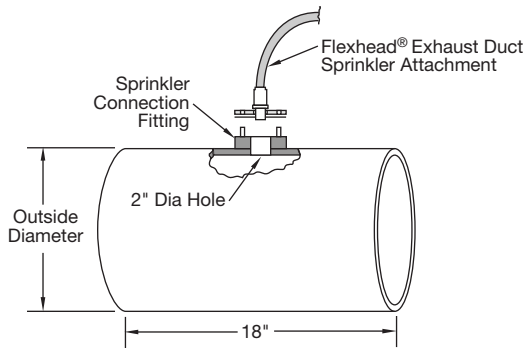

Figure D-39. Detail of a flexible sprinkler head and mounting component

ProVent PVDF is a material that is considered self-extinguishing. PVDF has significantly better smoke and flame ratings as compared to most other thermoplastic materials. PVDF material offered by Asahi/America is an FM approved material according FM 4910 Standards.

Contact Asahi/America for further information on installation requirements for PVDF systems. In addition, Asahi/America has on file the test results according to multiple smoke and flame standards for both polypropylene and PVDF.

In short, there may be a need or requirement for internal closed-head sprinklers in a ProVent system if combustible materials can accumulate inside the pipe line.

Layout Recommendations

Ventilation systems are often the most custom design of any pipe system in the factory. They are large in diameter and generally need to be connected to multiple equipment vents. Asahi/America offers a wide range of standard components for assembling a system.

However, many systems cannot be accomplished using standard components. A skilled installer can make special fabrications in the field to accomplish the layout requirement of a system. In addition, Asahi/America can design and prefabricate pipe systems and ship them ready for installation. Figure D-40 shows a detail of a component that could not be made with standard fittings, but can easily be produced in Asahi/America's fabrication shop and shipped to the job-site ready to be installed.

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P.O. Box 653 • 35 Green Street, Malden, MA 02148 • Tel: (800) 343-3618, (781) 321-5409
Fax: (800) 426-7058 • Internet: http://www.asahi-america.com • Email: asahi@asahi-america.com

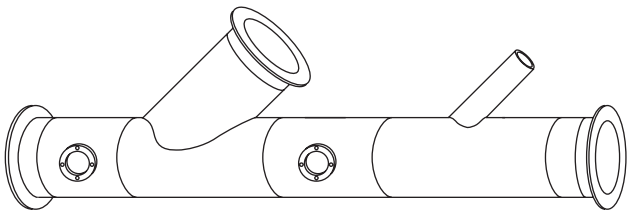

Figure D-40. Asahi/America prefabricated assembly

For more information on fabrication assistance, contact Asahi/America's Engineering Department.

Thermal Expansion

Based on a system's operating criteria, thermal expansion must be considered. For systems maintained at consistent temperatures, compensation for thermal effects may not be required. It is, however, important to review all aspects fo the the operating environment such as:

- Is it outdoors where it will be exposed to changing weather?
- Is the system spiked with a high temperature cleaning solution?
- Will the system run at a significantly higher temperature than the installation temperature?

The occurrence of any thermal change in a plastic system will cause the material to expand or contract. As an example of the effect, Polypropylene will grow roughly one inch for every 100 linear feet at 10° F ΔT.

Ventilation systems will often reach an equilibrium with the temperature of the ambient environment. Therefore, if the pipe is to be hung in a ceiling where the temperature will vary in summer and winter, the change in temperature that most affects the pipe may be due to the ambient temperature changing rather than media temperature changing. This is almost always the case in systems installed outdoors.

ProVent systems can be used in hot applications and applications where the temperature is cyclical; it just requires analysis of the thermal expansion effects. Section C in this guide walks through the steps of calculating thermal expansion, end loads, and expansion compensating devices. In most cases, the use of expansions, offsets, and proper hanging techniques are all that is required to ensure a proper design.

Hot systems also reduce the rigidity of thermoplastic piping, which, in turn, decreases the support spacing between pipe hangers. In smaller dimensions it is recommended to use continuous support made of some type channel or split plastic pipe. Review hanging requirements that are based on the actual operating temperatures.

Finally, the use of hangers as guides and anchors becomes important. As the design procedures in Section C indicate, certain hangers should be used as guides to allow the pipe to move back and forth in-line, while other hangers shall be anchoring locations used to direct the expansion into the compensating device. The anchors and hangers should be designed to withstand the end load generated by the thermal expansion.

For calculation of allowed stresses and design of expansion compensation devices, refer to Section C, *Engineering Theory and Design Considerations*.

UV Exposure

As a rule, PVDF material is UV resistant and can be installed in direct exposure to sunlight without protection. In certain applications with Chlorine content this may not be true. Free radical Chlorine can cause a breakdown of PVDF when exposed to UV light. For these applications it is best to protect the pipe by wrapping or insulating it. Contact Asahi/America for information on chemicals that can cause this effect.

Polypropylene is not 100% UV stable. Over time, the outer surface of a standard gray Polypropylene pipe will change color and will become brittle. The surface becomes chalky to the touch. Generally if the surface is left untouched, the effect of the UV change will stop and not continue through the pipe. A pipe with a heavy wall thickness may not require protection as the change will only occur on the outer most surface. The effect to the mechanical strength of the pipe will be minimal. However, most ventilation systems operate at low pressures and use thin walled pipe for cost savings. Therefore, the ProVent PP, in most cases, should be wrapped or protected from UV exposure.

Hanging

Since plastic reacts differently than metal, varying hanger styles are required. The designer of a system should specify the exact hanger and location and not leave this portion up to the installer.

See Appendix A (Pro 45) for the hanging distance required on ProVent systems.

Welding Methods

There are several options for installing a ProVent system. Most projects will incorporate two or three different joining techniques. The methods are

- Conventional butt fusion
- Hot air welding
- Extrusion welding

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Fax: (800) 426-7058 • Internet: http://www.asahi-america.com • Email: asahi@asahi-america.com

ProVent is made to the same outer wall dimensions (DIN Standards) as all other polypropylene and PVDF pipe systems offered by Asahi/America. The same butt-fusion equipment and methodology can be used to assemble these systems. Butt fusion provides full pressure rated welds and offers a high degree of reliability for ventilation welding. However, depending on the size of pipe and location of the welds, butt fusion can be cumbersome. To conduct a weld in a ceiling of 24" pipe will be difficult and will consume a significant amount of time to lift the pipe, the tool, and an operator into position.

In many cases, it is recommended to prefabricate a system on the ground or in a workshop and then conduct final assembly using flange connections. In addition to using flange connections for final hook-up, couplings and slip flanges can be used. These components can be hot air welded or extrusion welded depending on the size of the pipe and the required system operating pressure.

Hand welding, (hot air or extrusion welding) is a convenient method for welding in place or in prefabrication. Below is a detail of a slip coupling being hand welded. This method, while convenient, is highly reliant on an operator's skill. Hot air welding is simple and requires minimal practice to become proficient; however, extrusion welding is more complicated and a more extensive training course is required. Once these skills are mastered, they will prove highly useful during installation. It is recommended on all ProVent projects to buy at least one hot air welding tool as there is always a need for it.

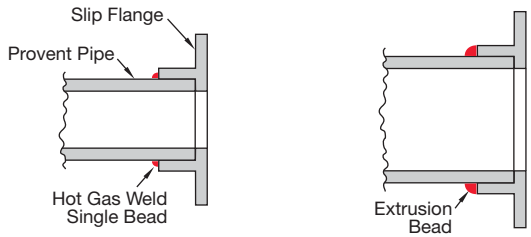

Figure D-41. Weld option