SUGGESTED TEMPERATURE LIMITS FOR THE OPERATION AND INSTALLATION OF PLASTIC PIPING IN NON-PRESSURE APPLICATIONS

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Foreword

This technical note was developed and published with the technical help and financial support of the members of the Plastics Pipe Institute (PPI). These members have shown their commitment to developing and improving quality products by assisting standards development organizations in the development of standards, and also by developing design aids and reports to help engineers, code officials, specifying groups, contractors and users.

The purpose of this technical note is to provide suggested temperature limits for the operation and installation of plastic piping in non-pressure applications.

The PPI has prepared this technical note as a service to the industry. The information in this note is offered in good faith and believed to be accurate at the time of its preparation, but is offered "as is" without any express or implied warranty, including WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Additional information may be needed in some areas, especially with regard to unusual or special applications. Consult the manufacturer or material supplier for more detailed information. A list of member manufacturers is available on the PPI website. PPI does not endorse the proprietary products or processes of any manufacturer and assumes no responsibility for compliance with applicable laws and regulations.

PPI intends to revise this technical note within five years, or sooner if required, from the date of its publication, in response to comments and suggestions from users of the document. Please send suggestions of improvements to the address below. Information on other publications can be obtained by contacting PPI directly or visiting our website.

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1.0 INTRODUCTION

This technical note is intended to provide general information about minimum and maximum installation and operating temperatures for the listed plastic pipe and fitting materials in non-pressure applications.

The temperature limits presented here are based on non-pressurized continuous exposure to high temperature aqueous (i.e., fluid) environments. Piping manufacturers should be consulted regarding the applicability of these limits in the presence of specific chemicals or conditions.

This Technical Note is not a design manual. Engineers, designers, and installers should refer to pipe, tubing and fitting manufacturer's technical data and design manuals for detailed design and installation information.

In addition, users should follow industry standards (e.g., standard specification, standard practices) such as those published by ASTM, AWWA, CSA and other standards development organizations, as well as applicable building and construction codes and local regulations.

Note 1: The materials included in this document are those which PPI and its members have the most knowledge and experience. Material or pipe manufacturers should be consulted for recommendations about other piping materials.

2.0 PRESSURE VS. NON-PRESSURE APPLICATIONS

2.1. Definition of Non-Pressure Service

For purposes of this document, non-pressure piping systems should be considered those piping systems which do not operate fully charged for their continuous length and for which the static head never exceeds 15 psig.

2.2. Rationale for use in Non-pressure Applications

Plastic piping materials are typically stress-rated for pressurized service at specific temperatures in accordance with industry-established procedures. PPI's TR-4 provides a listing of piping materials and their respective hydrostatic design stresses (HDS in accordance with ASTM D2837) or minimum required strengths (MRS in accordance with ISO 9080 and 12161) which are used to pressure rate a specific piping product. For more information, the reader is referred to PPI's TR-3 and TR-4.

Many of the variables considered in stress-rating a plastic pipe for pressurized service are less of a factor in the installation and use of these products in non-pressurized service. In these situations, it is feasible to install or operate a plastic piping under conditions above or below the temperature range for which the same piping material has been stress-rated for pressurized service. This document provides guidance on the use of many of the more common plastic piping products in those situations where pressurized service as defined herein is not a design consideration.

2.3. Information on Pressure Service

Whereas many of the pipe and fitting materials found within this document are intended and approved for pressurized service, the minimum and maximum operating temperatures for pressurized applications are not listed within this document.

Instead, users are referred to supplementary PPI publications on this topic as well as industry standards (e.g., standard specifications, standard practices) such as those published by ASTM, AWWA, CSA and other standards development organizations, as well as applicable building and construction codes and local regulations, and manufacturer's technical data.

3.0 PLASTIC PIPE IN NON-PRESSURE SERVICE

The following information and precautions should be considered before plastic non-pressure piping systems are designed to transport fluids at the minimum and maximum temperature limits suggested in this document.

3.1. Chemical Compatibility

It may be advisable in some cases to reduce these maximum temperature limits due to the chemical compatibility between the fluid and the piping material and/or other service conditions as may be determined by the designer.

Note 2: See PPI TR-19 *Chemical Resistance of Plastic Piping Systems* for information about chemical compatibility of plastic pipe and fitting materials.

3.2. Effects of High-Temperature Exposure

Some plastic pipe systems may be affected by the continuous exposure to higher temperature fluids. Therefore, while the guidelines presented in **Table 1** are generally accepted for the products described, not all piping compounds or materials are designed to sustain continuous exposure to high temperatures. The manufacturer should be consulted for specific information regarding thermal and oxidative stability of the piping product being considered.

3.3. Impact of Insulating Properties of Plastic Materials

It should be noted that as a result of the relatively low thermal conductivity of plastics, the outer surface of the pipe might be at a lower temperature than the hotter fluid inside the pipe. The maximum temperatures suggested in **Table 1** are for the fluids being transported, and not for the outer wall of the pipe itself.

The suggested temperature limits, which have been established under the assumption that the outer pipe surface is exposed to ambient temperatures, may need to be modified for cases where this assumption is essentially incorrect, such as with buried or insulated pipe.

3.4. Above Ground Installations

Above ground installations, in which a piping system conveys fluids at more traditional temperatures, but is in direct exposure to sunlight for extended periods of time, is of equal concern. In these situations, a conservative design and operating philosophy, in which continual exposure to the high temperature extremes associated with heating by sunlight of the piping system, is recommended.

The designer may want to consider the application of an additional service factor in these situations, as may be recommended by the pipe or fitting producer.

3.5. Engineering Properties

The impact of service temperature on engineering properties (e.g., ring stiffness, apparent modulus, etc.) should be considered. Refer to the *PPI Handbook of Polyethylene Pipe*, other PPI publications or manufacturer's information.

4.0 INSTALLATION NOTES

4.1. Pipeline Support

Transporting fluids near the maximum temperature limit may require a continuously supported pipeline. For lower temperatures and intermittent flow, it may be acceptable to support the pipe with hangers spaced at appropriately close intervals.

The impact of thermal expansion and contraction of pipe should be considered.

The reader is referred to PPI's *PPI Handbook of Polyethylene Pipe*, other PPI publications or the manufacturer for more information on these subjects.

4.2. CPVC Solvent Cement Joints

When solvent cement joints are made at temperatures below 32°F (0°C), special precautions are needed to obtain adequate joint strength. Additional drying time may be required for solvent cement permeation and cure time of the joint. Solvent cement manufacturers should be consulted regarding precautions that should be taken at the temperature extremes indicated.

Refer to ASTM D2855 *Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets* and/or consult piping manufacturers for details.

4.3. Thermal Fusion Joints

Fusion joining of thermoplastic pipe under the extreme temperatures presented in the tables may not be possible, or may require special consideration and handling. Allow for extremes in weather when making field joints. Heating times, dimensional changes, etc., are affected by extreme weather conditions.

Fusion joining at cold temperature extremes may require sheltering of the fusion apparatus and the fusion crew. For extreme cold temperatures, the use of temporary construction heater/s within the work environment to allow all materials and equipment to reach their minimum acceptable temperature for fusion processes. Care should also be taken at elevated temperature extremes as these may impact fusion parameters and appropriate PPE may be necessary accommodate pipe handling in a safe manner.

Note 3: See ASTM F2620 *Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings* and PPI TR-33 *Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe* for information about proper joining practices, including temperatures.

Note 4: See ASTM F3372 *Standard Practice for Butt Fusion Joining of PA12 Pipe and Fittings* and PPI TR-50 *Generic Butt Fusion Joining Procedures for PA12* for information related to polyamide pipe joining.

Note 5: Also see ASTM D2657 *Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings*, ISO 21307 *Plastics pipes and fittings — Butt fusion jointing procedures for polyethylene (PE) piping systems* and DVS 2207 *Welding of Plastics series for additional information regarding fusion joining of thermoplastic materials*.

4.4. Personal Safety with High Temperatures

Handling of any construction material~~s~~ at the temperature extremes presented in the tables should be done with extreme caution. Any pipe or fitting left in direct sunlight at very high ambient temperatures will increase in temperature significantly.

Caution should be exercised in handling pipe and fittings in these situations so as to avoid any potential for personal injury. Appropriate personal protective equipment (PPE) such as gloves, arm and body protection, etc. should be considered in these situations.

4.5. Cold Temperatures

The effects of low temperatures are different on various piping materials. As temperatures drop, the tensile strength and modulus of elasticity for most pipe materials increases, thus increasing the potential of low-temperature embrittlement. As such, piping should be handled in accordance with specific manufacturer's recommendations at these low temperature extremes, such as those in Table 1.

Of equal concern is the reduced flexibility that is associated with handling plastic pipe at lower temperatures which may be a consideration during installation.

Table 1: Recommended Operating Temperature Guidelines for Non-Pressure Applications

Note 6: These temperatures do not apply to heat fusion or solvent cement joining procedures. See previous notes in those sections.

Pipe Material	Minimum Operating Temperature	Maximum Operating Temperature
Polyamide (PA)		
PA12116	40°F (-40°C)	140°F (60°C)
PA32312	40°F (-40°C)	140°F (60°C)
PA32316	-40°F (-40°C)	180°F (82°C)
PA42316	-40°F (-40°C)	180°F (82°C)
Polyethylene (PE)		
PE1404	-40°F (-40°C)	100°F (38°C)
PE2406	-40°F (-40°C)	180°F (82°C)
PE2708	-40°F (-40°C)	180°F (82°C)
PE3408	-40°F (-40°C)	180°F (82°C)
PE3608	-40°F (-40°C)	180°F (82°C)
PE4710	-40°F (-40°C)	180°F (82°C)
PE100	-40°F (-40°C)	180°F (82°C)
Polyethylene of Raised Temperature (PE-RT)		
PE2708	-40°F (-40°C)	180°F (82°C)
PE4710	-40°F (-40°C)	180°F (82°C)
Crosslinked Polyethylene (PEX)	-57°F (-50°C)	200°F (93°C)
Polyvinyl Chloride (PVC)	0°F (-18°C)	150°F (66°C)
Chlorinated Polyvinyl Chloride (CPVC)	-40°F (-40°C)	220°F (104°C)
Polypropylene (PP)		
PP-H	32°F (0°C)	195°F (90°C)
PP-B	14°F (-10°C)	195°F (90°C)
PP-R	14°F (-10°C)	195°F (90°C)
PP-RCT	14°F (-10°C)	195°F (90°C)
Polyvinylidene-fluoride (PVDF)	0°F (-18°C)	250°F (120°C)

Note 7: The temperatures indicated are guidelines for non-pressure applications where hydrostatic stress is not a concern. Temperature limits are based on manufacturer input on performance considering material integrity and resistance to oxidative degradation.