TR-4

HDB/HDS/SDB/PDB/MRS

Listed Materials

5/11/2014

PPI Listing of
Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings For Thermoplastic Piping Materials or Pipe

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Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe

FOREWORD

This report lists thermoplastic piping materials with a Plastics Pipe Institute (PPI) recommended Hydrostatic Design Basis (HDB), Strength Design Basis (SDB), Pressure Design Basis (PDB) or Minimum Required Strength (MRS) rating for thermoplastic piping materials or pipe.

These listings have been established in accordance with PPI TR-3, *"Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Strength Design Basis (SDB), Pressure Design Basis (PDB) or Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe"*. Copies are available from the PPI website. Questions concerning any listing in this report should be referred to:

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www.plasticpipe.org

In the case of any deviation or circumstance not covered by a specific policy, a disposition will have to be made by the HSB (Hydrostatic Stress Board) in consultation with the manufacturer.

The Plastics Pipe Institute (PPI) as a service to the industry has prepared this report. Reasonable efforts are made by PPI, its members and staff to ensure that the required methods, policies, standards and procedures have been followed and that the presented test data are reliable. PPI expressly disclaims any warranty, expressed or implied, regarding the HDB, SDB, PDB or MRS values derived from submitted information, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Each product manufacturer that lists compositions with the Hydrostatic Stress Board does so voluntarily and with the express agreement that PPI assumes no liability in regard to the lists, and that it will hold PPI harmless from any claims or liability in connection with its listed pipe compositions. PPI does not endorse the proprietary products or processes of any manufacturer, and assumes no responsibility for compliance with applicable laws and regulations.

PPI offers various technical reports, technical notes and statements to assist engineers, code officials, specifiers, installers and users in proper selection and application of plastics piping. Copies of this report, as well as other publications, are available for download from PPI on the website www.plasticpipe.org.

This report was first published in September 1967. This update was issued in March 2011.

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NOTES TO THE READER
SOME RULES AND CONDITIONS

1. **Processing Techniques**: It is stressed that these policies and procedures are for development of recommended ratings for thermoplastics piping materials or pipe based on test data from good quality pipes (extruded or molded) made by specific processing techniques. These recommended ratings may or may not be valid for products made by differing processing techniques.

2. **Definitions and Acronyms:** Definitions and Acronyms are shown in the next section. The terminology of this report is in accordance with the definitions given in ASTM Standards D883, "Standard Definition of Terms Relating to Plastics," and F412, "Standard Terminology Relating to Plastic Piping Systems".

3. **Adjusting Recommended Ratings for Application-Specific Environments:** HDB/PDB/MRS/SDB recommended ratings issued by PPI are for conditions equivalent to those under which the test data were obtained, e.g., constant pressure, temperature and specific test environment. Various industry standards or regulations provide appropriate design factors or design coefficients to calculate the corresponding maximum allowable operating pressure for the piping system used in the desired application. Under some conditions, such as pressure cycling, higher temperature, more aggressive environment, or handling and installation quality, all of which may significantly reduce pipe durability, a more conservative design factor or design coefficient should be chosen. More information on design factors and design coefficients is given in PPI TR-9, "Recommended Design Factors and Design Coefficients for Pressure Applications of Thermoplastic Pipe Materials". ***Sustained pressure testing at elevated temperatures used to obtain these ratings may not be sufficient to fully evaluate either the thermal or oxidative stability performance of thermoplastic materials or pipe.***

4. **Product Standards:** An HDB/PBD/SDB/MRS recommended rating has been shown, through both scientific procedures and historical experience, to be a useful indicator of the relative long-term strength of a thermoplastic material when tested under the conditions set out in test method ASTM D2837 or ISO 9080. The performance of a material (or a piping product made with that material) under actual conditions of installation and use is dependent upon a number of other factors and conditions, which are not addressed in this report. These other factors and conditions are properly governed by the relevant product standard. The usefulness and adequacy of an HDB/PDB/SDB/MRS as an indicator of the strength of a material or pipe for use in any particular application is reflected in its incorporation in the applicable product standard, along with other appropriate performance parameters for the product and its component material. The appropriateness of an HDB/PDB/SDB/MRS for a specific application is also determined by the decision of a private or governmental entity to adopt such a standard as part of its own requirements for the product. The term "50-year strength value," as used in ASTM D2837, is a mathematical extrapolation that is useful in the context of developing an HDB. It does not necessarily constitute a representation that any material with such a value will perform under actual use conditions for that period of time.

5. **Sunlight (UV) Exposure:** These policies do not take into consideration the adequacy of a plastic composition's protection against sunlight exposure. Manufacturers may include in plastic pipe compositions suitable ingredients for the protection of properties against possible degradation by sunlight radiation during normal storage and use. The user should insure that sufficient protection has been incorporated into the selected piping composition should the application involve extended sunlight exposure during storage and/or use.

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6. **Recommended Ratings are Formulation Specific:** Each HDB/PDB/SDB/MRS issued by PPI is specific to that particular thermoplastic piping material formulation, including the procedure for mixing, which is represented by the data submitted to the HSB. Any changes in the mixing procedure, in the formulation, or in its ingredients, outside those permitted in TR-3 are considered to result in a new composition, which may have different long-term strength properties. The listed HDB/PDB/SDB/MRS does not apply to this new composition, unless the changes have been made, or validated, in accordance with one or more of the policies presented in this report; or have been ruled upon by the HSB as acceptable based on information provided to the HSB.

7. **Resin Changes:** An inherent assumption in the development of these policies and procedures is that the commercial pipe resin will be of equivalent chemical and molecular composition, insofar as these parameters influence long-term strength and durability, to the resin used in the composition on which the original long-term data supplied to PPI were obtained. Any modification of the resin composition is considered to result in a different material from the one on which the original listings were based. The Chairman of the HSB should be notified of such modifications and the applicable policy followed to maintain the listing. In the case of a change in manufacturing location of the resin used in a listed compound, the Chairman of the HSB should be notified and any applicable policy followed to maintain the listing. Also, in the case of any deviation or circumstance not covered by a specific policy, a disposition will have to be made by the HSB in consultation with the manufacturer.

8. **Disclaimer:** While every effort has been made by the Plastics Pipe Institute to assure that these policies are sound, reasonable and prudent, PPI expressly disclaims any guarantee or warranty regarding their application. Each manufacturer who lists compositions in accordance with the procedures in TR-3 does so voluntarily and with the express agreement that PPI assumes no liability in regard to the listed compositions, and that the manufacturer will hold PPI harmless from any claims or liability arising in connection with its listed pipe compositions.

9. **Manufacturer's Responsibility:** The manufacturer is responsible to insure that his product is continually manufactured in such a manner as to maintain the long-term strength and durability consistent with the long-term data supplied to the HSB. In the case of a deviation or circumstance not covered by a specific policy, a disposition will have to be made by the HSB in consultation with the manufacturer.

10. **Adoption of Policies and Procedures**: These policies and procedures have been adopted using standard letter ballot methods.

11. **Interpretations:** Questions pertaining to the interpretation of any policies in this report should be referred to the Chairman of the HSB, Plastics Pipe Institute, 105 Decker Court, Suite 825, Irving, TX 75063.

12. **Maximum Temperature for Listings:** The maximum temperature for which PPI will list an HDB/PDB/SDB/MRS for a material in accordance with the policies and procedures in TR-3 is 200°F (93°C). PPI listing for temperatures above 200°F may be requested as a "Special Case" (see note 13) for consideration by the HSB.

13. **Special Case Listings:** The policies and procedures in TR-3 are intended to cover HDB/PDB/SDB/MRS listings for most thermoplastic piping materials. PPI recognizes there may be unusual cases, issues or circumstances that are not covered in TR-3, and that may justify an exception to the standard policies. To allow manufacturers an opportunity to have their material(s) listed by PPI when this occurs, the HSB has provided a "Special Case" system. The manufacturer may present its "Case" to the HSB at one of their two annual meetings, usually in February and August, using the approved "**Checklist for HSB Submissions**" form in TR-3 Appendix A.1. All information provided to HSB in these special cases will be made available for review only by HSB members and PPI staff, and will be held by them in strict confidence, in accordance with PPI's written confidentiality procedures (available from the HSB Chairman). There is a PPI fee for each

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special case. You must contact the HSB Chairman well in advance of each meeting to arrange for your special case. A completed HSB submission form **must** be received at least two (2) weeks prior to the HSB meeting to permit HSB consideration at that meeting.

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Definitions and Acronyms

ANSI	American National Standards Institute 1430 Broadway New York, NY 10018
API	American Petroleum Institute 211 North Ervay Suite 1700 Dallas, TX 75201
ASTM	American Society for Testing and Materials 100 Barr Harbor Drive West Conshohocken, PA 19428
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235
CSA	CSA, International 178Rexdale Boulevard Etobicoke, Ontario CANADA M9W 1R3
HSB	Hydrostatic Stress Board c/o Plastics Pipe Institute, Inc. 105 Decker Court, Suite 825 Irving, TX 75062
ISO	International Organization of Standardization Central Secretariat Geneva, Switzerland USA Contact: American National Standards Institute 1430 Broadway New York, NY 10018
NSF	NSF International 789 Dixboro Road Ann Arbor, MI 48113-0140 P. O. Box 5059 2600 GB Delft, Netherlands
PPI	Plastics Pipe Institute, Inc. 105 Decker Court, Suite 825 Irving, TX 75062

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Brittle	A failure mode which exhibits no visible (to the naked eye) material deformation (stretching, elongation, or necking down) in the area of the break.
Composite pipe	Pipe consisting of two or more different materials arranged with specific functional purpose to serve as pipe.
CRS $_{\theta,t}$	The Categorized Required Strength, CRS $_{\theta,t}$, is the categorized lower prediction limit (LPL) of the long-term hydrostatic strength at a temperature (θ) and a time (t) as determined in accordance with ISO 9080 and ISO 12162. CRS $_{\theta,t}$, at 20°C and 50 years equals MRS.
Dependent Listing	A separate listing of a formulation that has previously been established as an independent listing under another owner's designation. Refer to Part D.3 of TR-3.
Ductile	A failure mode which exhibits material deformation (stretching, elongation, or necking down) in the area of the break.
E-X	The data level of an experimental grade listing where 'X' is the number of the grade level. e.g.: E-2 covers data out to at least 2,000 hours, E-8 covers data out to at least 8,000 hours, etc.
Experimental Grade (E)	A PPI HSB recommended rating that is valid for a limited duration, given to those materials covered by data that do not yet comply with the full requirements of the Standard Grade, but satisfy the applicable minimum preliminary data requirements that are detailed in TR-3. **The owner of an experimental listing must understand there is a potential risk in commercial sale of an experimental product in case it does not meet all the TR-3 requirements for a standard grade.**
HDB	The term HDB (Hydrostatic Design Basis) refers to the categorized long-term hydrostatic strength (LTHS) in the circumferential or hoop direction, for a given set of end use conditions, as established by ASTM Test Method D 2837, "Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials." Hydrostatic Design Basis (HDB) – one of a series of established stress values (specified in Test Method D 2837) for a plastic compound obtained by categorizing the long-term hydrostatic strength determined in accordance with ASTM Method D 2837.
Independent listing	A listing that has been established by a formulation owner under the provisions of Part A of TR-3.
LCL Ratio	The ratio of $\frac{LCL}{LTHS}$ expressed as a percentage. This ratio is a measure of the amount of scatter in the data and must be at least 85%.
LCL	Lower Confidence Limit - The lowest value of the LTHS, based on a statistical analysis of the regression data that can be expected at 100,000 hours.
LTHS	Long-term hydrostatic strength - the estimated tensile stress in the wall of the pipe in the circumferential orientation that when applied continuously will cause failure of the pipe at 100,000 hours. This is the intercept of the stress regression line with the 100,000-h coordinate.

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MRP	Minimum Required Pressure – one of a series of established pressure values for a plastic piping component (multilayer pipe, fitting, valve, etc.) obtained by categorizing the long-term hydrostatic pressure strength in accordance with ISO 9080.
MRS	The term MRS (Minimum Required Strength) refers to the categorized long-term hydrostatic strength in the circumferential, or hoop direction, for a given set of end use conditions, as established by ISO 9080, "Determination of Long-Term Hydrostatic Strength of Thermoplastic Materials in Pipe form by Extrapolation." Minimum Required Strength – one of a series of established stress values for a plastic compound obtained by categorizing the long-term hydrostatic strength determined by hydrostatic testing in accordance with ISO 9080 and ISO 12162.
Multilayer pipe	Multilayer is a type of composite TYPE 1: A pressure rated pipe having more than one layer (bonded together) in which at least 60% of the wall thickness is polymeric material that has an HDB (Hydrostatic Design Basis) or MRS (Minimum Required Strength), from which the pressure rating of the pipe is determined. **DISCUSSION: An example of this is coextruded plastic pipe with an outer layer for barrier or color purposes. If this outer layer has the same HDB/MRS as the bulk wall, the entire wall thickness is used for pressure calculations; if not, only the bulk wall that has an HDB/MRS rating is used for pressure calculations.** **TYPE 2: A pressure rated pipe having more than one layer (bonded together) where at least 60% of the wall thickness is polymeric material, where the pipe pressure rating is determined by pipe size and pipe wall construction, and this pipe rating is listed by a PDB (Pressure Design Basis) or MRP (Minimum Required Pressure).** **DISCUSSION: An example of this is PEX/AL/PEX pipe.** TYPE 3: non-pressure rated pipe comprising more than one layer in which at least 60% of the wall thickness is polymeric material. NOTE: the different layer(s) of multilayer pipe may provide color, barrier, stiffness or other properties according to the intended application.
PDB	The term PDB (Pressure Design Basis) refers to the categorized long-term pressure strength for multilayer pipes or other complex piping components, as established by ASTM Test Method D 2837, "Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials." Pressure Design Basis – one of a series of established pressure values for a plastic piping component (multilayer pipe, fitting, valve, etc.) obtained by categorizing the long-term hydrostatic pressure strength determined in accordance with an industry test method that uses linear regression analysis. Although ASTM D 2837 does not use "pressure values", the PPI Hydrostatic Stress Board uses the principles of

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ASTM D2837 in plotting log pressure vs. log time to determine a "long-term hydrostatic pressure strength" and the resulting "Pressure Design Basis" for multilayer pipe that is listed in PPI TR-4.

PHR — Parts by weight of a specified ingredient per hundred parts by weight of the base resin.

PR — Pressure Rating – the estimated maximum pressure that the medium in the pipe can exert continuously with a high degree of certainty that failure of the pipe will not occur.

PR = 2 (HDB) x (design factor) / (SDR-1),

SDR = Standard Dimension Ratio

= Average outside diameter / minimum wall thickness

Or

PR = (PDB) (design factor)

Private Listing — Manufacturer's listing that is held privately within PPI and is not published in PPI TR-4.

SDB — Strength Design Basis – one of a series of established stress values (specified in Test Method D 2837) for a plastic molding compound obtained by categorizing the long-term strength determined in accordance with ASTM Test Method F 2018. The term SDB (Strength Design Basis) refers to the categorized long-term strength for a plastic molding compound obtained by ASTM F 2018, "Standard Test Method for Time-to - Failure of Plastics Using Plane Strain Tensile Specimens."

NOTE: The SDB is used only for a material intended for molding applications. The SDB shall not be used for pipe applications.

Standard Grade (S) — A PPI HSB recommended rating that is valid for a five year period, given to those materials that comply with the full data requirements of TR-3.

Substantiation — A requirement of ASTM D 2513 for PE materials to show that extrapolation of the 73°F stress regression curve is linear to the 438,000-hour intercept.

Thermoplastic — A plastic that repeatedly can be softened by heating and hardened by cooling through a temperature range characteristic of the plastic, and that in the softened state can be shaped by flow into articles by molding or extrusion.

TR — Technical Report

TR-X — A PPI Technical Report where 'X' is the number of the report. e.g.: TR-3/2002 is the 2002 edition of TR-3, *"Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB) and Minimum Required Strengths (MRS) Ratings for Thermoplastic Piping Materials or Pipe".*

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UCL	Upper Confidence Limit - The highest value of the LTHS, based on a statistical analysis of the regression data that can be expected at 100,000 h.
UV	Ultra-Violet radiation from solar exposure.
Validation	The process of ensuring that, for those materials that exhibit a transition from ductile to brittle failure mode, this transition occurs after 100,000 h at the rated temperature.

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Common Plastics Abbreviations

CPVC	Chlorinated Poly (vinyl chloride)
PA	Polyamide (aka nylon)
PB	Polybutylene
PE	Polyethylene
PEX	Crosslinked polyethylene
PFA	Perfluoro (alkoxy alkane)
POM	Polyoxymethylene (aka polyacetal)
PP	Polypropylene
PVC	Poly (vinyl chloride)
PVDF	Poly (vinylidene difluoride)

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SECTION I

MATERIALS WITH PPI RECOMMENDED HYDROSTATIC DESIGN BASIS (HDB), MAXIMUM HYDROSTATIC DESIGN STRESS (HDS) OR STRENGTH DESIGN BASIS (SDB) ESTABLISHED IN ACCORDANCE WITH PPI TR-3 (ASTM D 2837).

PART A - MATERIALS EVALUATED FROM DATA DEVELOPED ON EXTRUDED PIPE SPECIMENS (HDB) – THESE MATERIALS MAY BE USED FOR EITHER EXTRUDED PIPE OR MOLDING APPLICATIONS

The tables that follow present PPI recommended HDB's in effect on the date of issue of this report. Information on subsequently listed materials may be obtained by contacting the Plastics Pipe Institute. Each table has been divided into dependent listings and independent listings. A resin manufacturer or pipe manufacturer may have an independent listing in which they provide all the stress rupture data required by TR-3. A resin manufacturer may transfer their listing to the pipe manufacturer using the protocol in TR-3. In this case, the pipe manufacturer has a dependent listing.

The listings of HDB's have been sub grouped in accordance with the material's standard pipe material designation code. In this designation system, which is widely used by major national product standards, the plastic is identified by its standard abbreviated terminology in accordance with ASTM D 1600, "Standard Terminology Relating to Abbreviations, Acronyms, and Codes for Terms Relating to Plastics", followed by a four or five digit number. The first two or three digits, as the case may be, code the material's ASTM classification (short-term properties) in accordance with the appropriate ASTM standard specification for that material. The last two digits of this number represent the PPI recommended HDS at 73°F (23°C) divided by one hundred. Three examples of this pipe material designation code are as follows:

- CPVC 4120 is a chlorinated polyvinyl chloride (the CPVC abbreviation is in accordance with ASTM D 1600) classified as Type 4, Grade 1 (in accordance with ASTM F 441) which has a 2,000 psi maximum recommended HDS utilizing a 0.5 design factor at 73°F (23°C) for water.

- POM 21110 is a polyoxymethylene (the POM abbreviation is in accordance with ASTM D 1600) classified as Group 2, Class 1, Grade 1 (in accordance with ASTM D 4181) which has a 1,000 psi maximum recommended HDS utilizing a 0.5 design factor at 73°F (23°C) for water.

- PE 3408 is a polyethylene (the PE abbreviation is in accordance with ASTM D 1600) classified as a grade PE 34 with a density cell class of 3 and a slow crack growth cell class of 4 (in accordance with ASTM D 3350). It has an 800-psi maximum recommended HDS utilizing a 0.5 design factor at 73° F (23°C) for water.

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The standard pipe material designation codes covered by this report are:

Pipe Material Designation Code	Maximum HDS at 73^0F (23^0C) psi	HDB at 73^0F (23^0C) psi	ASTM Specification
	Polyvinyl Chloride (PVC)		
PVC 1120	2,000	4000	D 1785
PVC 2116	1,600	3150	"
	Chlorinated Polyvinyl Chloride (CPVC)		
CPVC 4120	2,000	4000	F 441
	Polyethylene (PE)		
PE 1404	400	800	D 3350
PE 2406	630	1250	"
PE 2708	800	1250	"
PE 3408	800	1600	"
PE 3608	800	1600	"
PE 3708	800	1600	"
PE 3710	1000	1600	"
PE 4608	800	1600	"
PE 4708	800	1600	"
PE 4710	1000	1600	"
	Crosslinked Polyethylene (PEX)		
PEX 0006	630	1250	F 876
PEX 1006	630	1250	"
PEX 3006	630	1250	"
PEX 5006	630	1250	"
PEX 5206	630	1250	"
PEX 0008	800	1600	"
PEX 1008	800	1600	"
	Polyacetal (Polyoxymethylene - POM)		
POM 21110	1,000	2000	D 4181
	Polyvinylidene Fluoride (PVDF)		
PVDF 2016	1600	3150	D 3222
PVDF 2020	2000	4000	"
PVDF 2025	2500	5000	"
	Polyamide (PA)		
PA 32312	1250	2500	D 6779
PA 32316	1600	3150	"
PA 42316	1600	3150	"

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TABLE I.A.1 - PVC 1120 MATERIALS[1]

The following materials carry a recommended HDB of 4,000 psi and a maximum recommended HDS of 2,000 psi at 73°F (23°C) for water.

1. Pipe Listings Dependent on PPI Generic Range Composition

Company Name	Material Designation	Temp °F	HDB (psi)	Grade	Expiration Date
Aurora Plastics Inc	AP2397B	73	4000	S	9/23/2018
Axiall LLC	Axiall / Georgia Gulf 3152 Gray 434	73	4000	S	12/31/2014
Axiall LLC	Axiall / Georgia Gulf 3350 White 125	73	4000	S	12/31/2016
Charlotte Pipe	CP-110-P	73	4000	S	12/31/2016
Cresline Plastic Pipe Company	CRESLINE 7802	73	4000	S	12/31/2016
Diamond Plastics	DPC B-1	73	4000	S	12/31/2016
Diamond Plastics	DPC B-2	73	4000	S	12/31/2016
Diamond Plastics	DPC B-3	73	4000	S	12/31/2016
Diamond Plastics	DPC-ST1	73	4000	S	12/31/2016
Durman Esquivel	DURECO 7N	73	4000	S	12/31/2016
Formosa Plastics Corp	FORMOLON-550	73	4000	S	12/31/2016
Formosa Plastics Corp	FORMOLON-AW02	73	4000	S	12/30/2016
Formosa Plastics Corp	FORMOLON-AW04	73	4000	S	12/30/2016
Formosa Plastics Corp	FORMOLON-AW09	73	4000	S	12/30/2016
Formosa Plastics Corp	FORMOLON-AW11	73	4000	S	12/30/2016
Georg Fischer Harvel, LLC	HARVEL 707	73	4000	S	12/31/2016
Heritage Plastics South	CPC 1	73	4000	S	12/31/2016
Hoffman Plastic Compounds	117-110	73	4000	S	12/31/2016
IPEX Technologies Inc	S907	73	4000	S	12/31/2016
JM Manufacturing	JM SERIES 30	73	4000	S	12/31/2016
JM Manufacturing	JMR90	73	4000	S	12/31/2016
JM Manufacturing	PW 1000	73	4000	S	12/31/2016
K-Bin Inc	KBD-4000	73	4000	S	12/31/2016
National Pipe and Plastics	N/O	73	4000	S*	12/30/2016
National Pipe and Plastics	NATIONAL 1185	73	4000	S	12/31/2016
North American Bristol Corp.	N. AMERICAN BP (1, 2 or 4)	73	4000	S	12/31/2016
North American Pipe Co.	FREEDOM PLASTICS FG	73	4000	S	12/31/2016
North American Pipe Co.	N. AMERICAN M	73	4000	S	12/31/2016
North American Pipe Co.	NORTH AMERICAN M	73	4000	S	12/31/2016
North American Specialty Products	CERTAVIN BC-54	73	4000	S	12/31/2016
Northern Pipe Products	NPP301R	73	4000	S	12/31/2016
Pipelife Jet Stream, Inc	JS 21085	73	4000	S	12/31/2016
PolyOne	GEON E 1353	73	4000	S	12/31/2016
PolyOne	GEON E 1354	73	4000	S	12/31/2016
PolyOne	GEON E 1356	73	4000	S	12/31/2019
Ridgeline Pipe Manufacturing	RL H2O	73	4000	S	12/31/2018
Rocky Mountain Colby	RMCP-CO	73	4000	S	12/31/2016
Royal Pipe Systems	ROYAL NSF PW	73	4000	S	12/31/2016
Sanderson Pipe Corporation	PP1	73	4000	S	12/31/2016
Sekisui Industrial Piping Co.	ESLON SCH80 PVC Pipe	73	4000	S	12/31/2014
Shoreline Plastics	SLP 1	73	4000	S	12/31/2014
Silver-Line Plastics	SL-1000	73	4000	S	12/31/2016
Texas United Pipe	U-G-1	73	4000	S	12/31/2016

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Company Name	Material Designation	Temp °F	HDB (psi)	Grade	Expiration Date
Univ 100 Prod	UP-4000-G	73	4000	S	12/31/2016
Vinylplex Inc	VPX	73	4000	S	12/31/2016
Vinyltech Corporation	V1	73	4000	S	12/31/2016
Vulcan Plastics	S-203	73	4000	S	12/31/2016

2. Independent Listings – PVC 1120

Company Name	Material Designation	Temp °F	HDB (psi)	Grade	Expiration Date
Axiall LLC	Axiall / Georgia Gulf 3152 White125	73	4000	S	12/31/2015
Axiall LLC	Axiall / Georgia Gulf 3401 White125	73	4000	S	12/31/2015
Axiall LLC	Axiall / Georgia Gulf 3450 White125	73	4000	S	12/31/2015
Axiall LLC	Axiall / Georgia Gulf CM-2	73	4000	S	12/31/2015
Gulf Plastic Industries	GPI 031	73	4000	S	12/31/2017
IPEX Technologies Inc	PVC E05	73	4000	S	12/31/2014
IPEX Technologies Inc	S1007	73	4000	S	12/31/2016
JM Manufacturing	JM SERIES 90	73	4000	S	12/31/2016
North American Specialty Products	CERTAVIN BC-16	73	4000	S	12/31/2016
North American Specialty Products	CERTAVIN BC-30A	73	4000	S	12/31/2016
Omya North America	Omya PVC 1120 Range Formulation	73	4000	S	12/31/2016
Plastics Pipe Institute	PPI - PVC 1120 Range Formulation	73	4000	S	12/31/2020
Axiall LLC	Axiall / Georgia Gulf 6907 BLUE 83	73	4000	E-2	6/30/2014
PolyOne	GEON 87431	73	4000	S	12/31/2016

TABLE I.A.2 PVC 2116 MATERIALS[1]

The following materials carry a recommended HDB of 3,150 psi and a maximum recommended HDS of 1,600 psi at 73°F (23°C) for water.

Company Name	Material Designation	Temp °F	HDB (psi)	Grade	Expiration Date
PolyOne	GEON M1200/M3200	73	3200	S	12/31/2016

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TABLE I.A.3 - CPVC 4120 MATERIALS[1]

The following materials carry a recommended HDB of 4,000 psi and a maximum recommended HDS of 2,000 psi at 73ï,°F (23°C) for water.

1. Dependent Listings – CPVC 4120

Company Name	Material Designation	Temp °F	HDB (psi)	Grade	Expiration Date
Axiall LLC	PROTHERM 4303 GRAY 165	73	4000	S	12/31/2014
		180	1000	S	12/31/2014
Axiall LLC	PROTHERM 4303 ORANGE 25	73	4000	S	12/31/2014
		180	1000	S	12/31/2014
Axiall LLC	PROTHERM 4303 TAN 01	73	4000	S	12/31/2014
		180	1000	S	12/31/2014
Axiall LLC	PROTHERM 4305 GRAY 165	73	4000	S	12/31/2019
		180	1000	S	12/31/2019
Charlotte Pipe	ReUze made with FlowGuard	73	4000	S	12/31/2017
		180	1000	S	12/31/2017
PolyOne	Geon EC900 Tan 3189	73	4000	S	12/31/2014
		180	1000	S	12/31/2014
PolyOne	Geon EC920 Tan 3189	73	4000	S	12/31/2014
		180	1000	S	12/31/2014
PolyOne	Geon EC950 Gray 2777	73	4000	S	12/31/2019
		180	1000	S	12/31/2019
Spears Manufacturing	Spears SP2300	73	4000	S	12/31/2016
		180	1250	E-10	12/31/2016
		180	1000	S	12/31/2016
Spears Manufacturing	Spears SP2400	73	4000	S	12/31/2016
		180	1250	E-6	12/31/2016
		180	1000	S	12/31/2016

2. Independent Listings – CPVC 4120

Company Name	Material Designation	Temp °F	HDB (psi)	Grade	Expiration Date
Axiall LLC	PROTHERM 4345 Gray 165	73	4000	S	12/31/2015
		180	1000	S	12/31/2015
Axiall LLC	PROTHERM 4345 Orange 25	73	4000	S	12/31/2015
		180	1000	S	12/31/2015
Axiall LLC	PROTHERM 4345 Tan 01	73	4000	S	12/31/2015
		180	1000	S	12/31/2015
Axiall LLC	PROTHERM 4353 Gray 165	73	4000	S	12/31/2015
		180	1000	S	12/31/2015
Axiall LLC	PROTHERM 4353 Orange 25	73	4000	S	12/31/2015
		180	1000	S	12/31/2015
Kaneka North America LLC	KANEKA KNK-5007	73	4000	S	12/31/2016
		180	1000	S	12/31/2016
KEM ONE - Innovative Vinyls	LUCALOR PEY 792	73	4000	S	12/31/2014
		180	1000	S	12/31/2014
KEM ONE - Innovative Vinyls	LUCALOR PEY 795	73	4000	S	12/31/2014
		180	1000	S	12/31/2014

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Company Name	Material Designation	Temp °F	HDB (psi)	Grade	Expiration Date
Lubrizol Advanced Materials	TEMPRITE 3105 TAN 309	73	4000	S	12/31/2017
		180	1000	S	12/31/2017
Lubrizol Advanced Materials	TEMPRITE 3107 PURPLE 795	73	4000	S	12/31/2017
		180	1000	S	12/31/2017
Lubrizol Advanced Materials	TEMPRITE 3107 TAN 309	73	4000	S	12/31/2017
		180	1000	S	12/31/2017
Lubrizol Advanced Materials	TEMPRITE 3115 TAN 309	73	4000	S	12/31/2015
		180	1250	S	12/31/2015
Lubrizol Advanced Materials	TEMPRITE 3118 GRAY 245	73	4000	S	12/31/2017
		180	1000	S	12/31/2017
Lubrizol Advanced Materials	TEMPRITE 3120 GRAY 245	73	4000	S	12/31/2014
		180	1000	S	12/31/2014
Lubrizol Advanced Materials	TEMPRITE 3135 BLUE 470	73	4000	S	12/31/2015
		180	1250	S	12/31/2015
Lubrizol Advanced Materials	TEMPRITE 3140 GRAY 245	73	4000	S	12/31/2015
		180	1250	S	12/31/2015
Lubrizol Advanced Materials	TEMPRITE 3212 GRAY 245	73	4000	S	12/31/2014
		180	1000	S	12/31/2014
Lubrizol Advanced Materials	TEMPRITE 3215 TAN 309	73	4000	S	12/31/2014
		180	1000	S	12/31/2014
Lubrizol Advanced Materials	TEMPRITE 3235 BLUE 470	73	4000	S	12/31/2014
		180	1000	S	12/31/2014
Lubrizol Advanced Materials	TEMPRITE 88065 ORANGE 734	73	4000	S	12/31/2014
		180	1000	S	12/31/2014
Lubrizol Advanced Materials	TempRite 88096 Tan 309	73	4000	S	12/31/2014
		180	1000	S	12/31/2014
Lubrizol Advanced Materials	TEMPRITE 88610 TAN 309	73	4000	E-6	9/30/2014
		180	1000	E-6	9/30/2014
Lubrizol Advanced Materials	TEMPRITE 88615 TAN 309	73	4000	S	12/31/2014
		180	1000	S	12/31/2014
Lubrizol Advanced Materials	TempRite 88616 Gray 245	73	4000	E-2	9/30/2014
		180	1250	E-2	9/30/2014
Lubrizol Advanced Materials	TempRite 88616 Tan 309	73	4000	E-2	9/30/2014
		180	1250	E-2	9/30/2014
Lubrizol Advanced Materials	TEMPRITE 88620 TAN 309	73	4000	S	12/31/2015
		180	1000	S	12/31/2015
Lubrizol Advanced Materials	TEMPRITE 88628 GRAY 245A	73	4000	S	12/31/2018
		180	1000	S	12/31/2018
Lubrizol Advanced Materials	TEMPRITE 88628 TAN 309A	73	4000	S	12/31/2018
		180	1000	S	12/31/2018
Lubrizol Advanced Materials	TEMPRITE 88708	73	4000	S	12/31/2017
		180	1000	S	12/31/2017
Lubrizol Advanced Materials	TEMPRITE 88709	73	4000	S	12/31/2017
		180	1000	S	12/31/2017
Lubrizol Advanced Materials	TEMPRITE 88738 ORANGE 734	73	4000	S	12/31/2017
		180	1250	S	12/31/2017
Lubrizol Advanced Materials	TEMPRITE 88756 BLUE 470	73	4000	S	12/31/2017
		180	1000	S	12/31/2017
Lubrizol Advanced Materials	TempRite 89307 GRAY 245	73	4000	E-2	9/30/2014

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Company Name	Material Designation	Temp °F	HDB (psi)	Grade	Expiration Date
		180	1250	E-2	9/30/2014
Lubrizol Advanced Materials	TempRite 89307 TAN 309	73	4000	E-2	9/30/2014
		180	1250	E-2	9/30/2014
North American Bristol Corp.	BP-C1	73	4000	S	12/31/2014
		180	1000	S	12/31/2014
Spears Manufacturing	Spears SP2500 Gray	73	4000	S	12/31/2017
		180	1000	S	12/31/2017
Spears Manufacturing	Spears SP2500 Orange	73	4000	S	12/31/2017
		180	1000	S	12/31/2017
Spears Manufacturing	Spears SP2500 Tan	73	4000	S	12/31/2017
		180	1000	S	12/31/2017
Spears Manufacturing	Spears SP2600 Gray	73	4000	S	12/31/2017
		180	1000	S	12/31/2017
Spears Manufacturing	Spears SP2600 Orange	73	4000	S	12/31/2017
		180	1000	S	12/31/2017

TABLE I.A.4 - PE 1404 MATERIALS[1]

The following materials carry a recommended HDB of 800 psi and a maximum recommended HDS of 400 psi at 73°F (23°C) for water.

Company Name	Material Designation	Temp °F	HDB (psi)	Grade	Expiration Date
Dow Chemical Company	DFDA 6080 BK 1404	73	800	S	12/31/2017

TABLE I.A.5. - PE 2406 MATERIALS[1]

The following materials carry a recommended HDB of 1,250 psi and a maximum recommended HDS of 630 psi at 73°F (23°C) for water. (*) - Indicates the material meets policy in TR-3 and ASTM D2513 requirement for substantiation. Stress rupture data confirm that the 73°F (23°C) regression islinear to 50 years.Note: In 2002 ASTM D3350 was revised and many PE2406 compounds were reclassified at PE2708.

1. Dependent Listings – PE 2406

Company Name	Material Designation	Temp °F	HDB (psi)	Grade	Expiration Date

2. Independent Listings – PE 2406

Company Name	Material Designation	Temp °F	HDB (psi)	Grade	Expiration Date

TABLE I.A.6. - PE 2708 MATERIALS[1]

The following materials carry a recommended HDB of 1250 psi and qualify for a 0.63 design factor to establish a

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