ASME NM.3.3-2020
(Revision of ASME NM.3.3-2018)

Nonmetallic Materials

Part 3 — Properties

ASME Standards for Nonmetallic Pressure Piping Systems

AN AMERICAN NATIONAL STANDARD

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The American Society of Mechanical Engineers
Two Park Avenue • New York, NY • 10016 USA

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ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Periodically certain actions of the ASME NPPS Committee may be published as Cases. Cases and interpretations are published on the ASME website under the Committee Pages at http://cstools.asme.org/ as they are issued.

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The American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990

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FOREWORD

In 2011, The American Society of Mechanical Engineers (ASME) established the Committee on Nonmetallic Pressure Piping Systems (NPPS) to develop standards for the construction of nonmetallic pressure piping systems. This Committee's goal was to specify construction[1] requirements for nonmetallic piping and piping products; such requirements were not adequately defined in existing standards.

Prior to the development of the ASME Standards for Nonmetallic Pressure Piping Systems, nonmetallic pressure piping requirements were contained within several existing standards. The nonmetallic piping requirements of the ASME B31 Code for Pressure Piping varied across Sections, with some Sections having no requirements for nonmetallic components at all. Other standards and codes, such as ASME RTP-1 and the ASME Boiler and Pressure Vessel Code (BPVC), Section X, included requirements for reinforced thermoset plastic (RTP) corrosion-resistant equipment but not for piping and piping components. ASME BPVC, Section III did have a few Code Cases that addressed requirements for some nonmetallic piping and piping components, including those made from glass-fiber-reinforced thermosetting resin (FRP) and a few thermoplastics, e.g., high density polyethylene (HDPE) and poly(vinyl chloride) (PVC). However, the scope of these Code Cases was very limited, and in some cases the methodology was nearly 30 years old. The ASME NPPS Standards now serve as a centralized location for NPPS requirements and are developed by committees whose members are experts in this field. The NPPS Committee's functions are to establish requirements related to pressure integrity for the construction of nonmetallic pressure piping systems, and to interpret these requirements when questions arise regarding their intent.

ASME NM.3.3 contains stress tables and physical properties tables for thermoplastic materials as well as data sheets for six reinforced thermoset plastic material constructions. The first edition, ASME NM.3.3-2018, was approved by the American National Standards Institute (ANSI) on August 16, 2018.

ASME NM.3.3-2020 was approved by ANSI on October 29, 2020.

[1] *Construction*, as used in this Foreword, is an all-inclusive term comprising materials, design, fabrication, erection, examination, inspection, testing, and overpressure protection.

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Nonmetallic Pressure Piping Systems

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CORRESPONDENCE WITH THE NPPS COMMITTEE

General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions or a case, and attending Committee meetings. Correspondence should be addressed to:

Secretary, NPPS Standards Committee
The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
http://go.asme.org/Inquiry

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

Proposing a Case. Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Standard and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Standard to which the proposed Case applies.

Interpretations. Upon request, the NPPS Standards Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the NPPS Standards Committee.

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at http://go.asme.org/InterpretationRequest. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt.

If the Inquirer is unable to use the online form, he/she may mail the request to the Secretary of the NPPS Standards Committee at the above address. The request for an interpretation should be clear and unambiguous. It is further recommended that the Inquirer submit his/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry in one or two words.
Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. Please provide a condensed and precise question, composed in such a way that a "yes" or "no" reply is acceptable.
Proposed Reply(ies):	Provide a proposed reply(ies) in the form of "Yes" or "No," with explanation as needed. If entering replies to more than one question, please number the questions and replies.
Background Information:	Provide the Committee with any background information that will assist the Committee in understanding the inquiry. The Inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in the format described above may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

Moreover, ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Standard requirements. If, based on the inquiry information submitted, it is the opinion of the Committee that the Inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Attending Committee Meetings. The NPPS Standards Committee regularly holds meetings and/or telephone conferences that are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of the NPPS Standards Committee.

INTRODUCTION

The ASME Standards for Nonmetallic Pressure Piping Systems (NPPS) are as follows:

NM.1 Thermoplastic Piping Systems: This Standard contains requirements for piping and piping components that are produced using thermoplastic resins or compounds. Thermoplastics are a specific group of nonmetallic materials that, for processing purposes, are capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature.

NM.2 Glass-Fiber-Reinforced Thermosetting-Resin Piping Systems: This Standard contains requirements for piping and piping components that are produced using glass-fiber reinforcement embedded in or surrounded by cured thermosetting resin.

NM.3 Nonmetallic Materials: This Standard includes specifications for nonmetallic materials (except wood, nonfibrous glass, and concrete) and, in conformance with the requirements of the individual construction standards, methodologies, design values, limits, and cautions on the use of materials. This Standard is divided into three Parts:

- NM.3.1, Nonmetallic Materials, Part 1 — Thermoplastic Material Specifications: This Part contains thermoplastic material specifications identical to or similar to those published by the American Society for Testing and Materials (ASTM International) and other recognized national or international organizations.
- NM.3.2, Nonmetallic Materials, Part 2 — Reinforced Thermoset Plastic Material Specifications: This Part contains reinforced thermoset plastic material specifications identical to or similar to those published by ASTM and other recognized national or international organizations.
- NM.3.3, Nonmetallic Materials, Part 3 — Properties: This Part provides tables and data sheets for allowable stresses, mechanical properties (e.g., tensile and yield strength), and physical properties (e.g., coefficient of thermal expansion and modulus of elasticity) for nonmetallic materials.

It is the owner's responsibility to select the piping standard that best applies to the proposed piping installation. Factors to be considered by the owner include limitations of the standard, jurisdictional requirements, and the applicability of other standards. All applicable requirements of the selected standard shall be met. For some installations, more than one standard may apply to different parts of the installation. The owner is also responsible for imposing requirements supplementary to those of the standard if such requirements are necessary to ensure safe piping for the proposed installation.

Certain piping within a facility may be subject to other codes and standards, including but not limited to the following:

ASME B31.1, Power Piping: This code contains requirements for piping typically found in electric power generating stations, industrial and institutional plants, geothermal heating systems, and central and district heating and cooling systems.

ASME B31.3, Process Piping: This code contains requirements for piping typically found in petroleum refineries; onshore and offshore petroleum and natural gas production facilities; chemical, pharmaceutical, textile, paper, ore-processing, semiconductor, and cryogenic plants; food- and beverage-processing facilities; and related processing plants and terminals.

ASME B31.4, Pipeline Transportation Systems for Liquids and Slurries: This code contains requirements for piping transporting products that are predominately liquid between plants and terminals, and within terminals and pumping, regulating, and metering stations.

ASME B31.5, Refrigeration Piping and Heat Transfer Components: This code contains requirements for piping for refrigerants and secondary coolants.

ASME B31.8, Gas Transmission and Distribution Piping Systems: This code contains requirements for piping transporting products that are predominately gas between sources and terminals, including compressor, regulating, and metering stations; and gas gathering pipelines.

ASME B31.9, Building Services Piping: This code contains requirements for piping typically found in industrial, institutional, commercial, and public buildings, and in multi-unit residences, which does not require the range of sizes, pressures, and temperatures covered in ASME B31.1.

ASME B31.12, Hydrogen Piping and Pipelines: This code contains requirements for piping in gaseous and liquid hydrogen service, and pipelines in gaseous hydrogen service.

National Fuel Gas Code: This code contains requirements for piping for fuel gas from the point of delivery to the connection of each fuel utilization device.

NFPA 99, Health Care Facilities: This standard contains requirements for medical and laboratory gas systems.

NFPA Fire Protection Standards: These standards contain requirements for fire protection systems using water, carbon dioxide, halon, foam, dry chemicals, and wet chemicals.

The ASME NPPS Standards specify engineering requirements deemed necessary for safe design and construction of nonmetallic pressure piping. These Standards contain mandatory requirements, specific prohibitions, and nonmandatory guidance for construction activities. These Standards do not address all aspects of these activities, and those aspects that are not specifically addressed should not be considered prohibited. While safety is the overriding consideration, this factor alone will not necessarily govern the final specifications for any piping installation. With few exceptions, the requirements do not, of practical necessity, reflect the likelihood and consequences of deterioration in service related to specific service fluids or external operating environments. These Standards are not design handbooks. Many decisions that must be made to produce a safe piping installation are not specified in detail within these Standards. These Standards do not serve as substitutes for sound engineering judgment by the owner and the designer. The phrase *engineering judgment* refers to technical judgments made by knowledgeable designers experienced in the application of these Standards. Engineering judgments must be consistent with the philosophy of these Standards, and such judgments must never be used to overrule mandatory requirements or specific prohibitions of these Standards.

To the greatest possible extent, Standard requirements for design are stated in terms of basic design principles and formulas. These are supplemented as necessary with specific requirements to ensure uniform application of principles and to guide selection and application of piping elements. These Standards prohibit designs and practices known to be unsafe and contain warnings where caution, but not prohibition, is warranted.

These Standards generally specify a simplified approach for many of their requirements. A designer may choose to use a more rigorous analysis to develop design and construction requirements. When the designer decides to take this approach, he or she shall provide to the owner details and calculations demonstrating that design, fabrication, examination, inspection, testing, and overpressure protection are consistent with the criteria of these Standards. These details shall be adequate for the owner to verify the validity of the approach and shall be approved by the owner. The details shall be documented in the engineering design.

The designer is responsible for complying with requirements of these Standards and demonstrating compliance with the equations of these Standards when such equations are mandatory. These Standards neither require nor prohibit the use of computers for the design or analysis of components constructed to the requirements of these Standards. However, designers and engineers using computer programs for design or analysis are cautioned that they are responsible for all technical assumptions inherent in the programs they use and for the application of these programs to their design.

These Standards do not fully address tolerances. When dimensions, sizes, or other parameters are not specified with tolerances, the values of these parameters are considered nominal, and allowable tolerances or local variances may be considered acceptable when based on engineering judgment and standard practices as determined by the designer.

Suggested requirements of good practice are provided for the care and inspection of in-service nonmetallic pressure piping systems only as an aid to owners and their inspectors.

The requirements of these Standards are not to be interpreted as approving, recommending, or endorsing any proprietary or specific design or as limiting in any way the manufacturer's freedom to choose any method of design or any form of construction that conforms to the requirements of these Standards.

It is intended that editions of the ASME NPPS Standards not be retroactive. Unless agreement is specifically made between contracting parties to use another edition, or the regulatory body having jurisdiction imposes the use of another edition, the latest edition issued at least 6 months prior to the original contract date for the first phase of activity covering a piping installation shall be the governing document for all design, materials, fabrication, erection, examination, inspection, testing, and overpressure protection for the piping until the completion of the work and initial operation. Revisions to material specifications included in ASME NM.3.1 and ASME NM.3.2 are originated by ASTM and other recognized national or international organizations, and are usually adopted by ASME. However, those revisions do not necessarily indicate that materials produced to earlier editions of specifications are no longer suitable for ASME construction. Both ASME NM.3.1 and ASME NM.3.2 include a Mandatory Appendix, "Guideline on Acceptable ASTM Editions," that lists the

latest edition of material specifications adopted by ASME as well as other editions considered by ASME to be identical for ASME construction.

Users of these Standards are cautioned against making use of revisions to these Standards without assurance that they are acceptable to the proper authorities in the jurisdiction where the piping is to be installed.

ASME NM.3.3-2020
SUMMARY OF CHANGES

Following approval by the ASME NPPS Committee and ASME, and after public review, ASME NM.3.3-2020 was approved by the American National Standards Institute on October 29, 2020.

ASME NM.3.3-2020 includes the following changes identified by a margin note, **(20)**.

Page	*Location*	*Change*
4	Table 1-1-1	(1) Entries for PEX and Polyamide-12 and Notes C02 and M25 through M31 added (2) General Note (b) revised
22	Table 1-1-2	(1) Entries for PEX and Polyamide-12 and Notes C02 and M25 through M31 added (2) General Note (b) revised
30	Table 1-1-3	(1) Entries for PEX and Polyamide-12 and Notes C02 and M24 through M30 added (2) General Note (b) revised
56	Table 1-1-Y	(1) Entries for PEX and Polyamide-12 and Notes M07 through M09 added (2) General Note (d) revised
63	Table 1-2.1-2	Under "Other Property Data," values for 0.2-in thickness revised
71	Table 1-2.2-3	(1) Values under "Allowable Stress Data" and "Ultimate Stress Data" revised (2) Note (5) added
74	Table 1-1-1M	(1) Entries for PEX and Polyamide-12 and Notes C02 and M25 through M31 added (2) General Note (b) revised
92	Table 1-1-2M	(1) Entries for PEX and Polyamide-12 and Notes C02 and M25 through M31 added (2) General Note (b) revised
100	Table 1-1-3M	(1) Entries for PEX and Polyamide-12 and Notes C02 and M24 through M30 added (2) General Note (b) revised
126	Table 1-1-YM	(1) Entries for PEX and Polyamide-12 and Notes M07 through M09 added (2) General Note (d) revised
133	Table 1-2.1-2M	Under "Other Property Data," Density value for 5-mm thickness revised
135	Table 1-2.1-3M	Under "Other Property Data," last column revised
139	Table 1-2.2-2M	Under "Other Property Data," values for 5-mm thickness revised
141	Table 1-2.2-3M	(1) Values under "Allowable Stress Data" and "Ultimate Stress Data" revised (2) Note (5) added

Page	*Location*	*Change*
146	Table 2-1	PEX XX06, PEX XX08, and Polyamide-12 data added
148	Table 2-2	(1) PEX XX06, PEX XX08, and Polyamide-12 data added (2) Note (3) added and subsequent Notes renumbered
151	Table 2-3	PEX XX06, PEX XX08, and Polyamide-12 data and Notes (4) and (5) added
156	Table 2-4	PEX XX06, PEX XX08, and Polyamide-12 data added
158	Table 2-1M	PEX XX06, PEX XX08, and Polyamide-12 data added
160	Table 2-2M	(1) PEX XX06, PEX XX08, and Polyamide-12 data added (2) Note (3) added and subsequent Notes renumbered
163	Table 2-3M	PEX XX06, PEX XX08, and Polyamide-12 data and Notes (4) and (5) added
168	Table 2-4M	PEX XX06, PEX XX08, and Polyamide-12 data added

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SUBPART 1
STRESS TABLES

STATEMENT OF POLICY ON INFORMATION PROVIDED IN THE STRESS TABLES

The purpose of this Statement of Policy is to clarify which information in the stress tables is mandatory and which is not. The information and restrictions provided in the Notes found throughout the various stress tables provided in this Subpart are mandatory. It is vital to recognize that lines of information in Tables 1-1-1, 1-1-2, and 1-1-3 (Tables 1-1-1M, 1-1-2M, and 1-1-3M) frequently have essential information referenced in the Notes column. These Notes are organized as follows:

(a) General Notes. These notes are applicable to all materials presented in the specific table.

(b) MXX — Material Notes. These notes are applicable to materials of a specific material nominal composition (e.g., polyethylene), product form (e.g., extruded pipe), and/or type/grade (e.g., PE4710).

(c) CXX — Construction Standard Notes. These notes are applicable to requirements for a specific construction standard (e.g., ASME NM.1).

The specifications and grades or types, coupled with the assigned Notes for each line, provide the complete description of material in the context of the allowable stresses or allowable stress ranges. Additional requirements for particular types of construction must also be obtained from the requirements governing the construction.

In Tables 1-1-1, 1-1-2, and 1-1-3 (Tables 1-1-1M, 1-1-2M, and 1-1-3M), the information in the nominal composition column is nonmandatory and is for information only. However, these nominal compositions are the primary sorting used in these tables.

Where provided, the information in the columns for product form, specification number, type/grade, size/thickness, and external pressure chart number is mandatory. The information in the material grouping column is also mandatory; however, the primary source for this information is ASME BPVC, Section IX, Table QF-422. When there is a conflict between the material grouping information in these stress tables and that in ASME BPVC, Section IX, the numbers in Section IX shall govern.

The information in the minimum tensile strength and minimum yield strength columns is nonmandatory. These values, as well as the temperature-dependent values provided in Table 1-1-Y (Table 1-1-YM) may be invoked by the construction standard in the determination of some form of allowable stress values (e.g., a short-duration load) but do not typically form the basis for long-term allowable stress values for nonmetallic materials. When there is a conflict between the tensile and yield strength values in the stress tables and those in the material specifications in ASME NM.3.1 and ASME NM.3.2, the values in ASME NM.3.1 and ASME NM.3.2 shall govern.

The information in the applicability and maximum temperature limits columns is mandatory. Different construction standards often have different use-temperature limits for the same material and condition. Where a material is permitted for use in the construction code or standard, and is in the SI units version of these tables, the maximum use-temperature limit in these columns is critical. Further, in the SI units version of the stress tables, values may be listed in the table at temperatures above the maximum use-temperature limit. These stress values are provided solely to permit interpolation to be used to determine the allowable stress or allowable stress range at temperatures between the next lowest temperature for which stress values are listed and the maximum use-temperature limit listed in these columns.

GUIDELINE ON LOCATING MATERIALS IN STRESS TABLES, AND IN TABLES OF MECHANICAL AND PHYSICAL PROPERTIES

1 INTRODUCTION

The goal of this Guideline is to assist the users of ASME NM.3.3 in locating materials in the thermoplastic stress tables, tables of thermoplastic mechanical properties, tables of thermoplastic physical properties, and thermoset data sheets. This Guideline defines the logic used to place materials within these tables.

Tables and data sheets whose designators have a prefix of "1-" or "2-" can be found in Subpart 1 or Subpart 2, respectively. Stress tables and mechanical property tables have prefixes of "1-1-," data sheets have prefixes of "1-2-," and physical property tables have prefixes of "2-." The suffix "M" indicates that SI units (metric) are used.

2 STRESS TABLES

Tables 1-1-1 and 1-1-2 (Tables 1-1-1M and 1-1-2M) cover allowable stresses, while Table 1-1-3 (Table 1-1-3M) covers allowable stress ranges. Although Subpart 1 also covers (where applicable based on material type) yield strength, the organization of those mechanical property tables is discussed separately in section 3. A table-by-table explanation of the materials organization logic used to place materials within the designated tables follows.

2.1 Table 1-1-1 (Table 1-1-1M)

Table 1-1-1 (Table 1-1-1M) provides allowable stresses for thermoplastic[1] materials used in ASME NM.1 construction. Within this table, the first step in ordering materials is to use their nominal compositions. These nominal compositions are nothing more than widely recognized designators for each thermoplastic material. These nominal compositions are arranged as follows:

(a) chlorinated poly(vinyl chlorides) (CPVCs)
(b) polyamides (PAs)
(c) polyethylenes (PEs)
(d) polyethylenes of raised temperatures (PE-RTs)
(e) poly(vinyl chlorides) (PVCs)
(f) poly(vinylidene fluorides) (PVDFs)

For a given nominal composition, this table is arranged by increasing yield strength. For a given nominal composition and yield strength, stress listings are provided in order of increasing specification number.

Sometimes, for a given nominal composition, yield strength, specification number, and grade or type, there may be more than one line of stresses. At this point, the Notes referenced will define why there are two or more lines of stresses and when each applies.

2.2 Table 1-1-2 (Table 1-1-2M)

Table 1-1-2 (Table 1-1-2M) provides allowable compressive stresses for thermoplastic materials used in ASME NM.1 construction. This table is organized in the same manner as Table 1-1-1 (Table 1-1-1M); see para. 2.1.

2.3 Table 1-1-3 (Table 1-1-3M)

Table 1-1-3 (Table 1-1-3M) provides allowable secondary stress ranges for thermoplastic materials used in ASME NM.1 construction. This table is organized in the same manner as the preceding tables; see para. 2.1.

3 MECHANICAL PROPERTY TABLES

Yield strength values (where applicable based on material type) are to be used in design calculations according to the requirements of the construction standards. However, they are not to be construed as minimum strength values at temperature. This is explained in the General Notes to these tables. Paragraph 3.1 explains the materials-organization logic.

3.1 Table 1-1-Y (Table 1-1-YM)

Table 1-1-Y (Table 1-1-YM) provides yield strength values for thermoplastic materials. The ordering of yield strength lines parallels the logic described for thermoplastic materials in para. 2.1. It is important to note that yield strength typically does not form the basis for long-term allowable stress values for thermoplastic materials; values of yield strength should therefore only be used in design where allowed by the construction standard.

[1] ASME uses the current ASTM definition of *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.

4 PHYSICAL PROPERTY TABLES

Physical properties (thermal conductivity, thermal diffusivity, thermal expansion, and density), modulus of elasticity, and Poisson's ratio values are presented in the tables in Subpart 2 and are based on nominal composition (e.g., polyethylene), product form (e.g., extruded pipe), and/or type/grade (e.g., PE4710). Paragraphs 4.1 through 4.4 describe how these tables are organized.

4.1 Table 2-1 (Table 2-1M)

Table 2-1 (Table 2-1M) covers thermal expansion behavior, presented in terms of A (instantaneous coefficient of thermal expansion), B (mean coefficient of thermal expansion), and C (linear thermal expansion). It covers numerous individual thermoplastic materials and thermoplastic material groupings (as applicable). Notes at the end of the table list the materials covered by the designated groupings. Groupings may be by nominal composition (e.g., polyethylene), product form (e.g., extruded pipe), and/or type/grade (e.g., PE4710), as applicable.

4.2 Table 2-2 (Table 2-2M)

Table 2-2 (Table 2-2M) provides both thermal conductivity (TC) and thermal diffusivity (TD) values. It covers numerous individual thermoplastic materials and thermoplastic material groupings (as applicable). Notes at the end of the table list the materials covered by the designated groupings. Groupings may be by nominal composition (e.g., polyethylene), product form (e.g., extruded pipe), and/or type/grade (e.g., PE4710), as applicable.

4.3 Table 2-3 (Table 2-3M)

Table 2-3 (Table 2-3M) provides moduli of elasticity for materials. For some materials, moduli of elasticity may vary significantly with stress and/or load duration, in addition to temperature; for such materials, moduli of elasticity values are provided in terms of stress and/or load duration, in addition to temperature. The table covers numerous individual thermoplastic materials and thermoplastic material groupings (as applicable). Notes at the end of the table list the materials covered by the designated groupings. Groupings may be by nominal composition (e.g., polyethylene), product form (e.g., extruded pipe), and/or type/grade (e.g., PE4710), as applicable.

4.4 Table 2-4 (Table 2-4M)

Table 2-4 (Table 2-4M) provides Poisson's ratio and density for thermoplastic materials.

5 THERMOSET DATA SHEETS

Allowable stress values, mechanical properties, and physical properties required for all constructions are provided in data sheets. Data sheets are provided for the following thermoset[2] constructions:

(a) Type I unsaturated polyester resin [Table 1-2.1-1 (Table 1-2.1-1M)]

(b) Type II unsaturated polyester resin [Table 1-2.1-2 (Table 1-2.1-2M)]

(c) 55-deg wind angle unsaturated polyester resin (Type III) [Table 1-2.1-3 (Table 1-2.1-3M)]

(d) Type I vinyl ester resin [Table 1-2.2-1 (Table 1-2.2-1M)]

(e) Type II vinyl ester resin [Table 1-2.2-2 (Table 1-2.2-2M)]

(f) 55-deg wind angle vinyl ester resin (Type III) [Table 1-2.2-3 (Table 1-2.2-3M)]

6 REFERENCES

Plastic definitions and abbreviations used in this Standard are taken from ASTM D883, Standard Terminology Relating to Plastics, and ASTM D1600, Standard Terminology for Abbreviated Terms Relating to Plastics, respectively.

[2] ASME uses the current ASTM definition of *thermoset* — a plastic that, after having been cured by heat or other means, is substantially infusible and insoluble.

(20)

Table 1-1-1 Maximum Allowable Stress Values, S, for Thermoplastic Materials

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor
1	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	7.0	200	D01
2	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	7.0	200	D02
3	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	7.0	200	D03
4	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	7.0	200	D01
5	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	7.0	200	D02
6	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	7.0	200	D03
7	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	7.0	200	D01
8	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	7.0	200	D02
9	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	7.0	200	D03
10	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	7.0	200	D01
11	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	7.0	200	D02
12	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	7.0	200	D03
13	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	7.0	200	D01
14	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	7.0	200	D02
15	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	7.0	200	D03
16	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	7.0	200	D01
17	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	7.0	200	D02
18	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	200	D05 (0.4)
19	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	200	D06 (0.5)
20	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	200	D07 (0.63)
21	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	200	D08 (1.0)
22	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	180	D05 (0.4)
23	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	180	D06 (0.5)
24	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	180	D07 (0.63)
25	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	180	D08 (1.0)
26	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	200	D05 (0.4)
27	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	200	D06 (0.5)
28	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	200	D07 (0.63)
29	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	200	D08 (1.0)
30	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	180	D05 (0.4)
31	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	180	D06 (0.5)
32	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	180	D07 (0.63)
33	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	180	D08 (1.0)
34	Polyamide	Extruded pipe	SF-2945	PA 32312	...	7.0	180	D01
35	Polyamide	Extruded pipe	SF-2945	PA 32312	...	7.0	180	D02
36	Polyamide	Extruded pipe	SF-2945	PA 32312	...	7.0	180	D03

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials

Line No.	Notes	Maximum Allowable Stress, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
1	M01	1.60	1.51	1.38	1.25	1.13	1.02	0.907	0.798	0.694	0.593	0.495	0.400	0.308	0.219
2	M01	2.00	1.88	1.72	1.57	1.42	1.27	1.13	0.998	0.867	0.741	0.619	0.500	0.385	0.274
3	M01	4.00	3.77	3.45	3.14	2.84	2.55	2.27	2.00	1.74	1.48	1.24	1.00	0.770	0.547
4	M02	1.60	1.52	1.40	1.28	1.17	1.07	0.964	0.865	0.769	0.677	0.587	0.500	0.416	0.334
5	M02	2.00	1.89	1.75	1.60	1.47	1.33	1.21	1.08	0.962	0.846	0.734	0.625	0.520	0.417
6	M02	4.00	3.79	3.49	3.21	2.93	2.67	2.41	2.16	1.92	1.69	1.47	1.25	1.04	0.835
7	M01	1.60	1.51	1.38	1.25	1.13	1.02	0.907	0.798	0.694	0.593	0.495	0.400	0.308	0.219
8	M01	2.00	1.88	1.72	1.57	1.42	1.27	1.13	0.998	0.867	0.741	0.619	0.500	0.385	0.274
9	M01	4.00	3.77	3.45	3.14	2.84	2.55	2.27	2.00	1.74	1.48	1.24	1.00	0.770	0.547
10	M02	1.60	1.52	1.40	1.28	1.17	1.07	0.964	0.865	0.769	0.677	0.587	0.500	0.416	0.334
11	M02	2.00	1.89	1.75	1.60	1.47	1.33	1.21	1.08	0.962	0.846	0.734	0.625	0.520	0.417
12	M02	4.00	3.79	3.49	3.21	2.93	2.67	2.41	2.16	1.92	1.69	1.47	1.25	1.04	0.835
13	M01	1.60	1.51	1.38	1.25	1.13	1.02	0.907	0.798	0.694	0.593	0.495	0.400	0.308	0.219
14	M01	2.00	1.88	1.72	1.57	1.42	1.27	1.13	0.998	0.867	0.741	0.619	0.500	0.385	0.274
15	M01	4.00	3.77	3.45	3.14	2.84	2.55	2.27	2.00	1.74	1.48	1.24	1.00	0.770	0.547
16	M02	1.60	1.52	1.40	1.28	1.17	1.07	0.964	0.865	0.769	0.677	0.587	0.500	0.416	0.334
17	M02	2.00	1.89	1.75	1.60	1.47	1.33	1.21	1.08	0.962	0.846	0.734	0.625	0.520	0.417
18	M25, M26, M27	0.500	0.486	0.467	0.448	0.430	0.413	0.396	0.380	0.364	0.349	0.334	0.320	0.286	0.252
19	M25, M26, M27	0.625	0.608	0.584	0.560	0.538	0.516	0.495	0.475	0.455	0.436	0.418	0.400	0.358	0.315
20	M25, M26, M27	0.788	0.765	0.735	0.706	0.677	0.650	0.624	0.598	0.573	0.549	0.527	0.504	0.450	0.397
21	M25, M26, M27	1.25	1.22	1.17	1.12	1.08	1.03	0.990	0.949	0.910	0.872	0.836	0.800	0.715	0.630
22	M25, M26, M28	0.500	0.486	0.467	0.448	0.430	0.413	0.396	0.380	0.364	0.349	0.334	0.320	...	...
23	M25, M26, M28	0.625	0.608	0.584	0.560	0.538	0.516	0.495	0.475	0.455	0.436	0.418	0.400	...	...
24	M25, M26, M28	0.788	0.765	0.735	0.706	0.677	0.650	0.624	0.598	0.573	0.549	0.527	0.504	...	...
25	M25, M26, M28	1.25	1.22	1.17	1.12	1.08	1.03	0.990	0.949	0.910	0.872	0.836	0.800	...	...
26	M25, M26, M29	0.640	0.615	0.581	0.548	0.516	0.485	0.455	0.426	0.398	0.372	0.345	0.320	0.286	0.252
27	M25, M26, M29	0.800	0.769	0.726	0.685	0.645	0.606	0.569	0.533	0.498	0.465	0.432	0.400	0.358	0.315
28	M25, M26, M29	1.01	0.969	0.915	0.862	0.812	0.764	0.717	0.672	0.627	0.585	0.544	0.504	0.450	0.397
29	M25, M26, M29	1.60	1.54	1.45	1.37	1.29	1.21	1.14	1.07	0.996	0.929	0.863	0.800	0.715	0.630
30	M25, M26, M30	0.640	0.615	0.581	0.548	0.516	0.485	0.455	0.426	0.398	0.372	0.345	0.320	...	...
31	M25, M26, M30	0.800	0.769	0.726	0.685	0.645	0.606	0.569	0.533	0.498	0.465	0.432	0.400	...	...
32	M25, M26, M30	1.01	0.969	0.915	0.862	0.812	0.764	0.717	0.672	0.627	0.585	0.544	0.504	...	...
33	M25, M26, M30	1.60	1.54	1.45	1.37	1.29	1.21	1.14	1.07	0.996	0.929	0.863	0.800	...	...
34	M03	1.00	0.958	0.900	0.845	0.791	0.739	0.689	0.640	0.603	0.568	0.533	0.500	...	...
35	M03	1.25	1.20	1.13	1.06	0.988	0.923	0.861	0.800	0.754	0.710	0.667	0.625	...	...
36	M03	2.50	2.40	2.25	2.11	1.98	1.85	1.72	1.60	1.51	1.42	1.33	1.25	...	...

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor
37	Polyamide	Extruded pipe	SF-2945	PA 32316	...	7.0	180	D01
38	Polyamide	Extruded pipe	SF-2945	PA 32316	...	7.0	180	D02
39	Polyamide	Extruded pipe	SF-2945	PA 32316	...	7.0	180	D03
40	Polymide-12	Extruded pipe	SF-2785	PA 42316	...	5.8	180	D05 (0.4)
41	Polymide-12	Extruded pipe	SF-2785	PA 42316	...	5.8	180	D06 (0.5)
42	Polymide-12	Extruded pipe	SF-2785	PA 42316	...	5.8	180	D07 (0.63)
43	Polymide-12	Extruded pipe	SF-2785	PA 42316	...	5.8	180	D08 (1.0)
44	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	140	D04
45	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	140	D05
46	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	140	D07
47	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	140	D08
48	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	180	D04
49	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	180	D05
50	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	180	D07
51	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	180	D08
52	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	140	D04
53	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	140	D05
54	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	140	D07
55	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	140	D08
56	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	180	D04
57	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	180	D05
58	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	180	D07
59	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	180	D08
60	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	140	D04
61	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	140	D05
62	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	140	D07
63	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	140	D08
64	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	180	D04
65	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	180	D05
66	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	180	D07
67	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	180	D08
68	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	140	D04
69	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	140	D05
70	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	140	D07
71	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	140	D08
72	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	D04
73	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	D05
74	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	D07

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Notes	Maximum Allowable Stress, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
37	M04	1.26	1.21	1.15	1.08	1.02	0.959	0.902	0.846	0.792	0.740	0.689	0.640	...	...
38	M04	1.58	1.52	1.43	1.35	1.27	1.20	1.13	1.06	0.990	0.925	0.861	0.800	...	...
39	M04	3.15	3.03	2.86	2.70	2.55	2.40	2.25	2.12	1.98	1.85	1.72	1.60	...	...
40	M31	1.26	1.21	1.14	1.08	1.02	0.960	0.900	0.848	0.792	0.740	0.688	0.640	...	...
41	M31	1.58	1.52	1.43	1.35	1.28	1.20	1.13	1.06	0.990	0.925	0.860	0.800	...	...
42	M31	1.98	1.91	1.80	1.70	1.61	1.51	1.42	1.34	1.25	1.17	1.08	1.01	...	...
43	M31	3.15	3.03	2.86	2.70	2.55	2.40	2.25	2.12	1.98	1.85	1.72	1.60	...	...
44	M05, M06	0.400	0.391	0.378	0.365	0.353	0.342	0.331	0.320	...	...	...	...	...	...
45	M05, M06	0.500	0.488	0.472	0.457	0.442	0.427	0.413	0.400	...	...	...	...	...	...
46	M05, M06	0.788	0.769	0.744	0.719	0.696	0.673	0.651	0.630	...	...	...	...	...	...
47	M05, M06	1.25	1.22	1.18	1.14	1.11	1.07	1.03	1.00	...	...	...	...	...	...
48	M05, M07	0.400	0.385	0.363	0.343	0.323	0.304	0.285	0.267	0.250	0.233	0.217	0.202	...	...
49	M05, M07	0.500	0.481	0.454	0.428	0.404	0.380	0.357	0.334	0.313	0.292	0.272	0.252	...	...
50	M05, M07	0.788	0.757	0.715	0.675	0.636	0.598	0.562	0.527	0.493	0.460	0.428	0.397	...	...
51	M05, M07	1.25	1.20	1.14	1.07	1.01	0.949	0.892	0.836	0.782	0.730	0.679	0.630	...	...
52	M06, M08	0.400	0.391	0.378	0.365	0.353	0.342	0.331	0.320	...	...	...	...	...	...
53	M06, M08	0.500	0.488	0.472	0.457	0.442	0.427	0.413	0.400	...	...	...	...	...	...
54	M06, M08	0.788	0.769	0.744	0.719	0.696	0.673	0.651	0.630	...	...	...	...	...	...
55	M06, M08	1.25	1.22	1.18	1.14	1.11	1.07	1.03	1.00	...	...	...	...	...	...
56	M07, M08	0.400	0.385	0.363	0.343	0.323	0.304	0.285	0.267	0.250	0.233	0.217	0.202	...	...
57	M07, M08	0.500	0.481	0.454	0.428	0.404	0.380	0.357	0.334	0.313	0.292	0.272	0.252	...	...
58	M07, M08	0.788	0.757	0.715	0.675	0.636	0.598	0.562	0.527	0.493	0.460	0.428	0.397	...	...
59	M07, M08	1.25	1.20	1.14	1.07	1.01	0.949	0.892	0.836	0.782	0.730	0.679	0.630	...	...
60	M05, M06	0.400	0.391	0.378	0.365	0.353	0.342	0.331	0.320	...	...	...	...	...	...
61	M05, M06	0.500	0.488	0.472	0.457	0.442	0.427	0.413	0.400	...	...	...	...	...	...
62	M05, M06	0.788	0.769	0.744	0.719	0.696	0.673	0.651	0.630	...	...	...	...	...	...
63	M05, M06	1.25	1.22	1.18	1.14	1.11	1.07	1.03	1.00	...	...	...	...	...	...
64	M05, M07	0.400	0.385	0.363	0.343	0.323	0.304	0.285	0.267	0.250	0.233	0.217	0.202	...	...
65	M05, M07	0.500	0.481	0.454	0.428	0.404	0.380	0.357	0.334	0.313	0.292	0.272	0.252	...	...
66	M05, M07	0.788	0.757	0.715	0.675	0.636	0.598	0.562	0.527	0.493	0.460	0.428	0.397	...	...
67	M05, M07	1.25	1.20	1.14	1.07	1.01	0.949	0.892	0.836	0.782	0.730	0.679	0.630	...	...
68	M05, M06	0.400	0.391	0.378	0.365	0.353	0.342	0.331	0.320	...	...	...	...	...	...
69	M05, M06	0.500	0.488	0.472	0.457	0.442	0.427	0.413	0.400	...	...	...	...	...	...
70	M05, M06	0.788	0.769	0.744	0.719	0.696	0.673	0.651	0.630	...	...	...	...	...	...
71	M05, M06	1.25	1.22	1.18	1.14	1.11	1.07	1.03	1.00	...	...	...	...	...	...
72	M05, M07	0.400	0.385	0.363	0.343	0.323	0.304	0.285	0.267	0.250	0.233	0.217	0.202	...	...
73	M05, M07	0.500	0.481	0.454	0.428	0.404	0.380	0.357	0.334	0.313	0.292	0.272	0.252	...	...
74	M05, M07	0.788	0.757	0.715	0.675	0.636	0.598	0.562	0.527	0.493	0.460	0.428	0.397	...	...

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor
75	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	D08
76	Polyethylene	Extruded pipe	SF-714	PE2708	...	2.6	140	D04
77	Polyethylene	Extruded pipe	SF-714	PE2708	...	2.6	140	D05
78	Polyethylene	Extruded pipe	SF-714	PE2708	...	2.6	140	D07
79	Polyethylene	Extruded pipe	SF-714	PE2708	...	2.6	140	D08
80	Polyethylene	Extruded pipe	SF-714	PE2708	...	2.6	180	D04
81	Polyethylene	Extruded pipe	SF-714	PE2708	...	2.6	180	D05
82	Polyethylene	Extruded pipe	SF-714	PE2708	...	2.6	180	D07
83	Polyethylene	Extruded pipe	SF-714	PE2708	...	2.6	180	D08
84	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D04
85	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D05
86	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D06
87	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D08
88	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D04
89	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D05
90	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D06
91	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D08
92	Polyethylene	Extruded pipe	SD-2239	PE4608	...	3.0	140	D04
93	Polyethylene	Extruded pipe	SD-2239	PE4608	...	3.0	140	D05
94	Polyethylene	Extruded pipe	SD-2239	PE4608	...	3.0	140	D06
95	Polyethylene	Extruded pipe	SD-2239	PE4608	...	3.0	140	D08
96	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D04
97	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D05
98	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D07
99	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D08
100	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D04
101	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D05
102	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D07
103	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D08
104	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	180	D04
105	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	180	D05
106	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	180	D07
107	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	180	D08
108	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D04
109	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D05
110	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D07
111	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D08
112	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D04
113	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D05
114	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D07

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Notes	Maximum Allowable Stress, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
75	M05, M07	1.25	1.20	1.14	1.07	1.01	0.949	0.892	0.836	0.782	0.730	0.679	0.630	...	...
76	M06, M08	0.400	0.391	0.378	0.365	0.353	0.342	0.331	0.320	...	...	...	...	...	...
77	M06, M08	0.500	0.488	0.472	0.457	0.442	0.427	0.413	0.400	...	...	...	...	...	...
78	M06, M08	0.788	0.769	0.744	0.719	0.696	0.673	0.651	0.630	...	...	...	...	...	...
79	M06, M08	1.25	1.22	1.18	1.14	1.11	1.07	1.03	1.00	...	...	...	...	...	...
80	M07, M08	0.400	0.385	0.363	0.343	0.323	0.304	0.285	0.267	0.250	0.233	0.217	0.202	...	...
81	M07, M08	0.500	0.481	0.454	0.428	0.404	0.380	0.357	0.334	0.313	0.292	0.272	0.252	...	...
82	M07, M08	0.788	0.757	0.715	0.675	0.636	0.598	0.562	0.527	0.493	0.460	0.428	0.397	...	...
83	M07, M08	1.25	1.20	1.14	1.07	1.01	0.949	0.892	0.836	0.782	0.730	0.679	0.630	...	...
84	M05, M09	0.512	0.482	0.441	0.401	0.363	0.326	0.291	0.256	...	...	...	...	...	...
85	M05, M09	0.640	0.603	0.551	0.502	0.454	0.408	0.363	0.320	...	...	...	...	...	...
86	M05, M09	0.800	0.754	0.689	0.627	0.567	0.510	0.454	0.400	...	...	...	...	...	...
87	M05, M09	1.60	1.51	1.38	1.26	1.14	1.02	0.908	0.800	...	...	...	...	...	...
88	M05, M10	0.512	0.490	0.459	0.429	0.400	0.373	0.346	0.320	...	...	...	...	...	...
89	M05, M10	0.640	0.612	0.574	0.536	0.500	0.466	0.432	0.400	...	...	...	...	...	...
90	M05, M10	0.800	0.765	0.717	0.670	0.626	0.582	0.540	0.500	...	...	...	...	...	...
91	M05, M10	1.60	1.53	1.43	1.34	1.25	1.17	1.08	1.00	...	...	...	...	...	...
92	M05, M10	0.512	0.490	0.459	0.429	0.400	0.373	0.346	0.320	...	...	...	...	...	...
93	M05, M10	0.640	0.612	0.574	0.536	0.500	0.466	0.432	0.400	...	...	...	...	...	...
94	M05, M10	0.800	0.765	0.717	0.670	0.626	0.582	0.540	0.500	...	...	...	...	...	...
95	M05, M10	1.60	1.53	1.43	1.34	1.25	1.17	1.08	1.00	...	...	...	...	...	...
96	M05, M11	0.512	0.482	0.441	0.401	0.363	0.326	0.291	0.256	...	...	...	...	...	...
97	M05, M11	0.640	0.603	0.551	0.502	0.454	0.408	0.363	0.320	...	...	...	...	...	...
98	M05, M11	1.01	0.949	0.868	0.790	0.715	0.642	0.572	0.504	...	...	...	...	...	...
99	M05, M11	1.60	1.51	1.38	1.26	1.14	1.02	0.908	0.800	...	...	...	...	...	...
100	M05, M12	0.512	0.490	0.459	0.429	0.400	0.373	0.346	0.320	...	...	...	...	...	...
101	M05, M12	0.640	0.612	0.574	0.536	0.500	0.466	0.432	0.400	...	...	...	...	...	...
102	M05, M12	1.00	0.964	0.903	0.845	0.788	0.734	0.681	0.630	...	...	...	...	...	...
103	M05, M12	1.60	1.53	1.43	1.34	1.25	1.17	1.08	1.00	...	...	...	...	...	...
104	M05, M13	0.512	0.492	0.465	0.438	0.413	0.388	0.364	0.341	0.319	0.297	0.276	0.256	...	...
105	M05, M13	0.640	0.615	0.581	0.548	0.516	0.485	0.455	0.426	0.398	0.371	0.345	0.320	...	...
106	M05, M13	1.01	0.969	0.915	0.863	0.812	0.764	0.717	0.671	0.627	0.585	0.544	0.504	...	...
107	M05, M13	1.60	1.54	1.45	1.37	1.29	1.21	1.14	1.07	0.996	0.929	0.863	0.800	...	...
108	M08, M11	0.512	0.482	0.441	0.401	0.363	0.326	0.291	0.256	...	...	...	...	...	...
109	M08, M11	0.640	0.603	0.551	0.502	0.454	0.408	0.363	0.320	...	...	...	...	...	...
110	M08, M11	1.01	0.949	0.868	0.790	0.715	0.642	0.572	0.504	...	...	...	...	...	...
111	M08, M11	1.60	1.51	1.38	1.26	1.14	1.02	0.908	0.800	...	...	...	...	...	...
112	M08, M12	0.512	0.490	0.459	0.429	0.400	0.373	0.346	0.320	...	...	...	...	...	...
113	M08, M12	0.640	0.612	0.574	0.536	0.500	0.466	0.432	0.400	...	...	...	...	...	...
114	M08, M12	1.00	0.964	0.903	0.845	0.788	0.734	0.681	0.630	...	...	...	...	...	...

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor
115	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D08
116	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	180	D04
117	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	180	D05
118	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	180	D07
119	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	180	D08
120	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D04
121	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D05
122	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D06
123	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D08
124	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D04
125	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D05
126	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D06
127	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D08
128	Polyethylene	Extruded tube	SD-2737	PE4608	...	3.0	140	D04
129	Polyethylene	Extruded tube	SD-2737	PE4608	...	3.0	140	D05
130	Polyethylene	Extruded tube	SD-2737	PE4608	...	3.0	140	D06
131	Polyethylene	Extruded tube	SD-2737	PE4608	...	3.0	140	D08
132	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D04
133	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D05
134	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D07
135	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D08
136	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D04
137	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D05
138	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D07
139	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D08
140	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	180	D04
141	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	180	D05
142	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	180	D07
143	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	180	D08
144	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D04
145	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D05
146	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D06
147	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D08
148	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D04
149	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D05
150	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D06
151	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D08
152	Polyethylene	Extruded pipe	SD-3035	PE4608	...	3.0	140	D04
153	Polyethylene	Extruded pipe	SD-3035	PE4608	...	3.0	140	D05

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Notes	Maximum Allowable Stress, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
115	M08, M12	1.60	1.53	1.43	1.34	1.25	1.17	1.08	1.00	...	...	...	...	...	...
116	M08, M13	0.512	0.492	0.465	0.438	0.413	0.388	0.364	0.341	0.319	0.297	0.276	0.256	...	...
117	M08, M13	0.640	0.615	0.581	0.548	0.516	0.485	0.455	0.426	0.398	0.371	0.345	0.320	...	...
118	M08, M13	1.01	0.969	0.915	0.863	0.812	0.764	0.717	0.671	0.627	0.585	0.544	0.504	...	...
119	M08, M13	1.60	1.54	1.45	1.37	1.29	1.21	1.14	1.07	0.996	0.929	0.863	0.800	...	...
120	M05, M09	0.512	0.482	0.441	0.401	0.363	0.326	0.291	0.256	...	...	...	...	...	...
121	M05, M09	0.640	0.603	0.551	0.502	0.454	0.408	0.363	0.320	...	...	...	...	...	...
122	M05, M09	0.800	0.754	0.689	0.627	0.567	0.510	0.454	0.400	...	...	...	...	...	...
123	M05, M09	1.60	1.51	1.38	1.26	1.14	1.02	0.908	0.800	...	...	...	...	...	...
124	M05, M10	0.512	0.490	0.459	0.429	0.400	0.373	0.346	0.320	...	...	...	...	...	...
125	M05, M10	0.640	0.612	0.574	0.536	0.500	0.466	0.432	0.400	...	...	...	...	...	...
126	M05, M10	0.800	0.765	0.717	0.670	0.626	0.582	0.540	0.500	...	...	...	...	...	...
127	M05, M10	1.60	1.53	1.43	1.34	1.25	1.17	1.08	1.00	...	...	...	...	...	...
128	M05, M10	0.512	0.490	0.459	0.429	0.400	0.373	0.346	0.320	...	...	...	...	...	...
129	M05, M10	0.640	0.612	0.574	0.536	0.500	0.466	0.432	0.400	...	...	...	...	...	...
130	M05, M10	0.800	0.765	0.717	0.670	0.626	0.582	0.540	0.500	...	...	...	...	...	...
131	M05, M10	1.60	1.53	1.43	1.34	1.25	1.17	1.08	1.00	...	...	...	...	...	...
132	M05, M11	0.512	0.482	0.441	0.401	0.363	0.326	0.291	0.256	...	...	...	...	...	...
133	M05, M11	0.640	0.603	0.551	0.502	0.454	0.408	0.363	0.320	...	...	...	...	...	...
134	M05, M11	1.01	0.949	0.868	0.790	0.715	0.642	0.572	0.504	...	...	...	...	...	...
135	M05, M11	1.60	1.51	1.38	1.26	1.14	1.02	0.908	0.800	...	...	...	...	...	...
136	M05, M12	0.512	0.490	0.459	0.429	0.400	0.373	0.346	0.320	...	...	...	...	...	...
137	M05, M12	0.640	0.612	0.574	0.536	0.500	0.466	0.432	0.400	...	...	...	...	...	...
138	M05, M12	1.00	0.964	0.903	0.845	0.788	0.734	0.681	0.630	...	...	...	...	...	...
139	M05, M12	1.60	1.53	1.43	1.34	1.25	1.17	1.08	1.00	...	...	...	...	...	...
140	M05, M13	0.512	0.492	0.465	0.438	0.413	0.388	0.364	0.341	0.319	0.297	0.276	0.256	...	...
141	M05, M13	0.640	0.615	0.581	0.548	0.516	0.485	0.455	0.426	0.398	0.371	0.345	0.320	...	...
142	M05, M13	1.01	0.969	0.915	0.863	0.812	0.764	0.717	0.671	0.627	0.585	0.544	0.504	...	...
143	M05, M13	1.60	1.54	1.45	1.37	1.29	1.21	1.14	1.07	0.996	0.929	0.863	0.800	...	...
144	M05, M09	0.512	0.482	0.441	0.401	0.363	0.326	0.291	0.256	...	...	...	...	...	...
145	M05, M09	0.640	0.603	0.551	0.502	0.454	0.408	0.363	0.320	...	...	...	...	...	...
146	M05, M09	0.800	0.754	0.689	0.627	0.567	0.510	0.454	0.400	...	...	...	...	...	...
147	M05, M09	1.60	1.51	1.38	1.26	1.14	1.02	0.908	0.800	...	...	...	...	...	...
148	M05, M10	0.512	0.490	0.459	0.429	0.400	0.373	0.346	0.320	...	...	...	...	...	...
149	M05, M10	0.640	0.612	0.574	0.536	0.500	0.466	0.432	0.400	...	...	...	...	...	...
150	M05, M10	0.800	0.765	0.717	0.670	0.626	0.582	0.540	0.500	...	...	...	...	...	...
151	M05, M10	1.60	1.53	1.43	1.34	1.25	1.17	1.08	1.00	...	...	...	...	...	...
152	M05, M10	0.512	0.490	0.459	0.429	0.400	0.373	0.346	0.320	...	...	...	...	...	...
153	M05, M10	0.640	0.612	0.574	0.536	0.500	0.466	0.432	0.400	...	...	...	...	...	...

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor
154	Polyethylene	Extruded pipe	SD-3035	PE4608	...	3.0	140	D06
155	Polyethylene	Extruded pipe	SD-3035	PE4608	...	3.0	140	D08
156	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D04
157	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D05
158	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D07
159	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D08
160	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D04
161	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D05
162	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D07
163	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D08
164	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	180	D04
165	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	180	D05
166	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	180	D07
167	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	180	D08
168	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D04
169	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D05
170	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D06
171	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D08
172	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D04
173	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D05
174	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D06
175	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D08
176	Polyethylene	Extruded pipe	SF-714	PE4608	...	3.0	140	D04
177	Polyethylene	Extruded pipe	SF-714	PE4608	...	3.0	140	D05
178	Polyethylene	Extruded pipe	SF-714	PE4608	...	3.0	140	D06
179	Polyethylene	Extruded pipe	SF-714	PE4608	...	3.0	140	D08
180	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D04
181	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D05
182	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D07
183	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D08
184	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D04
185	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D05
186	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D07
187	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D08
188	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	180	D04
189	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	180	D05
190	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	180	D07
191	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	180	D08
192	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D04

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Notes	Maximum Allowable Stress, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
154	M05, M10	0.800	0.765	0.717	0.670	0.626	0.582	0.540	0.500	...	...	...	...	...	...
155	M05, M10	1.60	1.53	1.43	1.34	1.25	1.17	1.08	1.00	...	...	...	...	...	...
156	M05, M11	0.512	0.482	0.441	0.401	0.363	0.326	0.291	0.256	...	...	...	...	...	...
157	M05, M11	0.640	0.603	0.551	0.502	0.454	0.408	0.363	0.320	...	...	...	...	...	...
158	M05, M11	1.01	0.949	0.868	0.790	0.715	0.642	0.572	0.504	...	...	...	...	...	...
159	M05, M11	1.60	1.51	1.38	1.26	1.14	1.02	0.908	0.800	...	...	...	...	...	...
160	M05, M12	0.512	0.490	0.459	0.429	0.400	0.373	0.346	0.320	...	...	...	...	...	...
161	M05, M12	0.640	0.612	0.574	0.536	0.500	0.466	0.432	0.400	...	...	...	...	...	...
162	M05, M12	1.00	0.964	0.903	0.845	0.788	0.734	0.681	0.630	...	...	...	...	...	...
163	M05, M12	1.60	1.53	1.43	1.34	1.25	1.17	1.08	1.00	...	...	...	...	...	...
164	M05, M13	0.512	0.492	0.465	0.438	0.413	0.388	0.364	0.341	0.319	0.297	0.276	0.256	...	...
165	M05, M13	0.640	0.615	0.581	0.548	0.516	0.485	0.455	0.426	0.398	0.371	0.345	0.320	...	...
166	M05, M13	1.01	0.969	0.915	0.863	0.812	0.764	0.717	0.671	0.627	0.585	0.544	0.504	...	...
167	M05, M13	1.60	1.54	1.45	1.37	1.29	1.21	1.14	1.07	0.996	0.929	0.863	0.800	...	...
168	M08, M09	0.512	0.482	0.441	0.401	0.363	0.326	0.291	0.256	...	...	...	...	...	...
169	M08, M09	0.640	0.603	0.551	0.502	0.454	0.408	0.363	0.320	...	...	...	...	...	...
170	M08, M09	0.800	0.754	0.689	0.627	0.567	0.510	0.454	0.400	...	...	...	...	...	...
171	M08, M09	1.60	1.51	1.38	1.26	1.14	1.02	0.908	0.800	...	...	...	...	...	...
172	M08, M10	0.512	0.490	0.459	0.429	0.400	0.373	0.346	0.320	...	...	...	...	...	...
173	M08, M10	0.640	0.612	0.574	0.536	0.500	0.466	0.432	0.400	...	...	...	...	...	...
174	M08, M10	0.800	0.765	0.717	0.670	0.626	0.582	0.540	0.500	...	...	...	...	...	...
175	M08, M10	1.60	1.53	1.43	1.34	1.25	1.17	1.08	1.00	...	...	...	...	...	...
176	M08, M10	0.512	0.490	0.459	0.429	0.400	0.373	0.346	0.320	...	...	...	...	...	...
177	M08, M10	0.640	0.612	0.574	0.536	0.500	0.466	0.432	0.400	...	...	...	...	...	...
178	M08, M10	0.800	0.765	0.717	0.670	0.626	0.582	0.540	0.500	...	...	...	...	...	...
179	M08, M10	1.60	1.53	1.43	1.34	1.25	1.17	1.08	1.00	...	...	...	...	...	...
180	M08, M11	0.512	0.482	0.441	0.401	0.363	0.326	0.291	0.256	...	...	...	...	...	...
181	M08, M11	0.640	0.603	0.551	0.502	0.454	0.408	0.363	0.320	...	...	...	...	...	...
182	M08, M11	1.01	0.949	0.868	0.790	0.715	0.642	0.572	0.504	...	...	...	...	...	...
183	M08, M11	1.60	1.51	1.38	1.26	1.14	1.02	0.908	0.800	...	...	...	...	...	...
184	M08, M12	0.512	0.490	0.459	0.429	0.400	0.373	0.346	0.320	...	...	...	...	...	...
185	M08, M12	0.640	0.612	0.574	0.536	0.500	0.466	0.432	0.400	...	...	...	...	...	...
186	M08, M12	1.00	0.964	0.903	0.845	0.788	0.734	0.681	0.630	...	...	...	...	...	...
187	M08, M12	1.60	1.53	1.43	1.34	1.25	1.17	1.08	1.00	...	...	...	...	...	...
188	M08, M13	0.512	0.492	0.465	0.438	0.413	0.388	0.364	0.341	0.319	0.297	0.276	0.256	...	...
189	M08, M13	0.640	0.615	0.581	0.548	0.516	0.485	0.455	0.426	0.398	0.371	0.345	0.320	...	...
190	M08, M13	1.01	0.969	0.915	0.863	0.812	0.764	0.717	0.671	0.627	0.585	0.544	0.504	...	...
191	M08, M13	1.60	1.54	1.45	1.37	1.29	1.21	1.14	1.07	0.996	0.929	0.863	0.800	...	...
192	M09, M14	0.512	0.482	0.441	0.401	0.363	0.326	0.291	0.256	...	...	...	...	...	...

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor
193	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D05
194	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D06
195	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D08
196	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D04
197	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D05
198	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D06
199	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D08
200	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D04
201	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D05
202	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D07
203	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D08
204	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D04
205	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D05
206	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D07
207	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D08
208	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	180	D04
209	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	180	D05
210	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	180	D07
211	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	180	D08
212	PVC	Extruded pipe	SD-1785	PVC2110	C01	6.0	140	D01
213	PVC	Extruded pipe	SD-1785	PVC2110	C01	6.0	140	D02
214	PVC	Extruded pipe	SD-1785	PVC2110	C01	6.0	140	D03
215	PVC	Extruded pipe	SD-1785	PVC2112	C01	6.0	140	D01
216	PVC	Extruded pipe	SD-1785	PVC2112	C01	6.0	140	D02
217	PVC	Extruded pipe	SD-1785	PVC2112	C01	6.0	140	D03
218	PVC	Extruded pipe	SD-1785	PVC2116	C01	6.0	140	D01
219	PVC	Extruded pipe	SD-1785	PVC2116	C01	6.0	140	D02
220	PVC	Extruded pipe	SD-1785	PVC2116	C01	6.0	140	D03
221	PVC	Extruded pipe	SD-1785	PVC2120	C01	6.0	140	D01
222	PVC	Extruded pipe	SD-1785	PVC2120	C01	6.0	140	D02
223	PVC	Extruded pipe	SD-1785	PVC2120	C01	6.0	140	D03
224	PVC	Extruded tube	SD-2241	PVC2110	C01	6.0	140	D01
225	PVC	Extruded tube	SD-2241	PVC2110	C01	6.0	140	D02
226	PVC	Extruded tube	SD-2241	PVC2110	C01	6.0	140	D03
227	PVC	Extruded tube	SD-2241	PVC2112	C01	6.0	140	D01
228	PVC	Extruded tube	SD-2241	PVC2112	C01	6.0	140	D02
229	PVC	Extruded tube	SD-2241	PVC2112	C01	6.0	140	D03

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Notes	Maximum Allowable Stress, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
193	M09, M14	0.640	0.603	0.551	0.502	0.454	0.408	0.363	0.320	...	...	...	...	...	...
194	M09, M14	0.800	0.754	0.689	0.627	0.567	0.510	0.454	0.400	...	...	...	...	...	...
195	M09, M14	1.60	1.51	1.38	1.26	1.14	1.02	0.908	0.800	...	...	...	...	...	...
196	M10, M14	0.512	0.490	0.459	0.429	0.400	0.373	0.346	0.320	...	...	...	...	...	...
197	M10, M14	0.640	0.612	0.574	0.536	0.500	0.466	0.432	0.400	...	...	...	...	...	...
198	M10, M14	0.800	0.765	0.717	0.670	0.626	0.582	0.540	0.500	...	...	...	...	...	...
199	M10, M14	1.60	1.53	1.43	1.34	1.25	1.17	1.08	1.00	...	...	...	...	...	...
200	M11, M14	0.512	0.482	0.441	0.401	0.363	0.326	0.291	0.256	...	...	...	...	...	...
201	M11, M14	0.640	0.603	0.551	0.502	0.454	0.408	0.363	0.320	...	...	...	...	...	...
202	M11, M14	1.01	0.949	0.868	0.790	0.715	0.642	0.572	0.504	...	...	...	...	...	...
203	M11, M14	1.60	1.51	1.38	1.26	1.14	1.02	0.908	0.800	...	...	...	...	...	...
204	M12, M14	0.512	0.490	0.459	0.429	0.400	0.373	0.346	0.320	...	...	...	...	...	...
205	M12, M14	0.640	0.612	0.574	0.536	0.500	0.466	0.432	0.400	...	...	...	...	...	...
206	M12, M14	1.00	0.964	0.903	0.845	0.788	0.734	0.681	0.630	...	...	...	...	...	...
207	M12, M14	1.60	1.53	1.43	1.34	1.25	1.17	1.08	1.00	...	...	...	...	...	...
208	M13, M14	0.512	0.492	0.465	0.438	0.413	0.388	0.364	0.341	0.319	0.297	0.276	0.256	...	...
209	M13, M14	0.640	0.615	0.581	0.548	0.516	0.485	0.455	0.426	0.398	0.371	0.345	0.320	...	...
210	M13, M14	1.01	0.969	0.915	0.863	0.812	0.764	0.717	0.671	0.627	0.585	0.544	0.504	...	...
211	M13, M14	1.60	1.54	1.45	1.37	1.29	1.21	1.14	1.07	0.996	0.929	0.863	0.800	...	...
212	M15	0.800	0.704	0.600	0.496	0.400	0.320	0.240	0.176	...	...	...	...	...	...
213	M15	1.00	0.880	0.750	0.620	0.500	0.400	0.300	0.220	...	...	...	...	...	...
214	M15	2.00	1.76	1.50	1.24	1.00	0.800	0.600	0.440	...	...	...	...	...	...
215	M16	1.00	0.880	0.750	0.620	0.500	0.400	0.300	0.220	...	...	...	...	...	...
216	M16	1.25	1.10	0.938	0.775	0.625	0.500	0.375	0.275	...	...	...	...	...	...
217	M16	2.50	2.20	1.88	1.55	1.25	1.00	0.750	0.550	...	...	...	...	...	...
218	M17	1.28	1.13	0.960	0.794	0.640	0.512	0.384	0.282	...	...	...	...	...	...
219	M17	1.60	1.41	1.20	0.992	0.800	0.640	0.480	0.352	...	...	...	...	...	...
220	M17	3.20	2.82	2.40	1.98	1.60	1.28	0.960	0.704	...	...	...	...	...	...
221	M18	1.60	1.41	1.20	0.992	0.800	0.640	0.480	0.352	...	...	...	...	...	...
222	M18	2.00	1.76	1.50	1.24	1.00	0.800	0.600	0.440	...	...	...	...	...	...
223	M18	4.00	3.52	3.00	2.48	2.00	1.60	1.20	0.880	...	...	...	...	...	...
224	M15	0.800	0.704	0.600	0.496	0.400	0.320	0.240	0.176	...	...	...	...	...	...
225	M15	1.00	0.880	0.750	0.620	0.500	0.400	0.300	0.220	...	...	...	...	...	...
226	M15	2.00	1.76	1.50	1.24	1.00	0.800	0.600	0.440	...	...	...	...	...	...
227	M16	1.00	0.880	0.750	0.620	0.500	0.400	0.300	0.220	...	...	...	...	...	...
228	M16	1.25	1.10	0.938	0.775	0.625	0.500	0.375	0.275	...	...	...	...	...	...
229	M16	2.50	2.20	1.88	1.55	1.25	1.00	0.750	0.550	...	...	...	...	...	...

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor
230	PVC	Extruded tube	SD-2241	PVC2116	C01	6.0	140	D01
231	PVC	Extruded tube	SD-2241	PVC2116	C01	6.0	140	D02
232	PVC	Extruded tube	SD-2241	PVC2116	C01	6.0	140	D03
233	PVC	Extruded tube	SD-2241	PVC2120	C01	6.0	140	D01
234	PVC	Extruded tube	SD-2241	PVC2120	C01	6.0	140	D02
235	PVC	Extruded tube	SD-2241	PVC2120	C01	6.0	140	D03
236	PVC	Extruded pipe	SD-1785	PVC1120	C01	7.0	140	D01
237	PVC	Extruded pipe	SD-1785	PVC1120	C01	7.0	140	D02
238	PVC	Extruded pipe	SD-1785	PVC1120	C01	7.0	140	D03
239	PVC	Extruded pipe	SD-1785	PVC1220	C01	7.0	140	D01
240	PVC	Extruded pipe	SD-1785	PVC1220	C01	7.0	140	D02
241	PVC	Extruded pipe	SD-1785	PVC1220	C01	7.0	140	D03
242	PVC	Extruded pipe	SD-2241	PVC1120	C01	7.0	140	D01
243	PVC	Extruded pipe	SD-2241	PVC1120	C01	7.0	140	D02
244	PVC	Extruded pipe	SD-2241	PVC1120	C01	7.0	140	D03
245	PVC	Extruded pipe	SD-2241	PVC1220	C01	7.0	140	D01
246	PVC	Extruded pipe	SD-2241	PVC1220	C01	7.0	140	D02
247	PVC	Extruded pipe	SD-2241	PVC1220	C01	7.0	140	D03
248	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	7.0	130	D01
249	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	7.0	130	D02
250	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	7.0	130	D03
251	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	11.1	130	D01
252	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	11.1	130	D02
253	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	11.1	130	D03
254	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	6.5	200	D02
255	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	6.5	200	D03
256	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	7.7	200	D02
257	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	7.7	200	D03

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Notes	Maximum Allowable Stress, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
230	M17	1.28	1.13	0.960	0.794	0.640	0.512	0.384	0.282	...	...	...	...	...	...
231	M17	1.60	1.41	1.20	0.992	0.800	0.640	0.480	0.352	...	...	...	...	...	...
232	M17	3.20	2.82	2.40	1.98	1.60	1.28	0.960	0.704	...	...	...	...	...	...
233	M18	1.60	1.41	1.20	0.992	0.800	0.640	0.480	0.352	...	...	...	...	...	...
234	M18	2.00	1.76	1.50	1.24	1.00	0.800	0.600	0.440	...	...	...	...	...	...
235	M18	4.00	3.52	3.00	2.48	2.00	1.60	1.20	0.880	...	...	...	...	...	...
236	M19	1.60	1.41	1.20	0.992	0.800	0.640	0.480	0.352	...	...	...	...	...	...
237	M19	2.00	1.76	1.50	1.24	1.00	0.800	0.600	0.440	...	...	...	...	...	...
238	M19	4.00	3.52	3.00	2.48	2.00	1.60	1.20	0.880	...	...	...	...	...	...
239	M19	1.60	1.41	1.20	0.992	0.800	0.640	0.480	0.352	...	...	...	...	...	...
240	M19	2.00	1.76	1.50	1.24	1.00	0.800	0.600	0.440	...	...	...	...	...	...
241	M19	4.00	3.52	3.00	2.48	2.00	1.60	1.20	0.880	...	...	...	...	...	...
242	M19	1.60	1.41	1.20	0.992	0.800	0.640	0.480	0.352	...	...	...	...	...	...
243	M19	2.00	1.76	1.50	1.24	1.00	0.800	0.600	0.440	...	...	...	...	...	...
244	M19	4.00	3.52	3.00	2.48	2.00	1.60	1.20	0.880	...	...	...	...	...	...
245	M19	1.60	1.41	1.20	0.992	0.800	0.640	0.480	0.352	...	...	...	...	...	...
246	M19	2.00	1.76	1.50	1.24	1.00	0.800	0.600	0.440	...	...	...	...	...	...
247	M19	4.00	3.52	3.00	2.48	2.00	1.60	1.20	0.880	...	...	...	...	...	...
248	M20, M21	1.60	1.41	1.20	0.992	0.800	0.640	0.480	...	...	...	...	...	...	...
249	M20, M21	2.00	1.76	1.50	1.24	1.00	0.800	0.600	...	...	...	...	...	...	...
250	M20, M21	4.00	3.52	3.00	2.48	2.00	1.60	1.20	...	...	...	...	...	...	...
251	M20, M22	2.84	2.50	2.13	1.76	1.42	1.14	0.852	...	...	...	...	...	...	...
252	M20, M22	3.55	3.12	2.66	2.20	1.78	1.42	1.07	...	...	...	...	...	...	...
253	M20, M22	7.10	6.25	5.33	4.40	3.55	2.84	2.13	...	...	...	...	...	...	...
254	M23	2.00	1.91	1.78	1.66	1.54	1.42	1.31	1.20	1.10	0.997	0.900	0.805	0.714	0.625
255	M23	4.00	3.82	3.56	3.31	3.07	2.84	2.62	2.40	2.20	2.00	1.80	1.61	1.43	1.25
256	M24	2.50	2.40	2.27	2.13	2.01	1.89	1.77	1.65	1.54	1.44	1.33	1.23	1.14	1.04
257	M24	5.00	4.80	4.53	4.27	4.02	3.77	3.53	3.31	3.09	2.87	2.66	2.46	2.27	2.08

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

GENERAL NOTES:

(a) The stress values in this Table may be interpolated to determine values for intermediate temperatures. The values at intermediate temperatures shall be rounded to the same number of decimal places as the value at the higher temperature between which values are being interpolated. The rounding rule is: when the next digit beyond the last place to be retained is less than 5, retain unchanged the digit in the last place retained; when the next digit beyond the last place to be retained is 5 or greater, increase by 1 the digit in the last place retained.

(b) The following abbreviations are used: CPVC, chlorinated poly(vinyl chloride); PEX, cross-linked polyethylene; PVC, poly(vinyl chloride); and PVDF, poly(vinylidene fluoride).

NOTE: (1) Multiply ksi by 1,000 to obtain psi.

CONSTRUCTION CODE NOTES (ASME NM.1):

C01 Compounding ingredients may vary between material manufacturers for the same grade of CPVC or PVC. While these different ingredients do not impact the allowable stress values provided in this Table, they can influence the acceptability of the various joining methods allowed by ASME NM.1. In addition to the material and joining requirements set forth in ASME NM.1, the joining method to be used shall be approved by the piping component manufacturer.

C02 Cross-linking method may vary between material manufacturers for the same grade of PEX. While these different methods do not impact the allowable stress values provided in this Table, they can influence the acceptability of the various joining methods allowed by ASME NM.1. In addition to the material and joining requirements set forth in ASME NM.1, the joining method to be used shall be approved by the piping component manufacturer.

DESIGN FACTOR NOTES (ASME NM.1):

D01 The allowable stress values are based on the hydrostatic design basis (HDB) as determined in accordance with ASTM D2837 multiplied by a design factor (DF) of 0.40.

D02 The allowable stress values are based on the hydrostatic design basis (HDB) as determined in accordance with ASTM D2837 multiplied by a design factor (DF) of 0.50.

D03 The allowable stress values are based on the hydrostatic design basis (HDB) as determined in accordance with ASTM D2837 multiplied by a design factor (DF) of 1.0. These values are only to be used when the DF is incorporated in the construction code equations.

D04 The allowable stress values are based on the hydrostatic design basis (HDB) as identified in PPI TR-4 multiplied by a design factor (DF) of 0.32.

D05 The allowable stress values are based on the hydrostatic design basis (HDB) as identified in PPI TR-4 multiplied by a design factor (DF) of 0.40.

D06 The allowable stress values are based on the hydrostatic design basis (HDB) as identified in PPI TR-4 multiplied by a design factor (DF) of 0.50.

D07 The allowable stress values are based on the hydrostatic design basis (HDB) as identified in PPI TR-4 multiplied by a design factor (DF) of 0.63.

D08 The allowable stress values are based on the hydrostatic design basis (HDB) as identified in PPI TR-4 multiplied by a design factor (DF) of 1.0. These values are only to be used when the DF is incorporated in the construction code equations.

MATERIAL NOTES:

M01 Material shall have a

(a) minimum impact resistance of 1.5 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 360,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 212°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 73°F and 1,000 psi at 180°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 73°F and 500 psi at 180°F in accordance with ASTM D2837

M02 Material shall have a

(a) minimum impact resistance of 1.5 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 360,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 212°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 73°F and 1,250 psi at 180°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 73°F and 625 psi at 180°F in accordance with ASTM D2837

M03 Material shall have a

(a) classification of Group 3, Class 2, and Grade 3, in accordance with ASTM D4066.
(b) minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ±10% at 23°C ± 2°C and 50% ± 5% relative humidity.
(c) minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ±50% at 23°C ± 2°C and 50% ± 5% relative humidity.
(d) minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.
(e) minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.
(f) hydrostatic design basis (HDB) of 2,500 psi at 73°F, 1,600 psi at 140°F, and 1,250 psi at 180°F in accordance with ASTM D2837.
(g) hydrostatic design stress (HDS) of 1,250 psi at 73°F, 800 psi at 140°F, and 625 psi at 180°F in accordance with ASTM D2837.

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

M04 Material shall have a

(a) classification of Group 3, Class 2, and Grade 3 in accordance with ASTM D4066.

(b) minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ±10% at 23°C ± 2°C and 50% ± 5% relative humidity.

(c) minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ±50% at 23°C ± 2°C and 50% ± 5% relative humidity.

(d) minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.

(e) minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.

(f) hydrostatic design basis (HDB) of 3,150 psi at 73°F and 1,600 psi at 180°F in accordance with ASTM D2837.

(g) hydrostatic design stress (HDS) of 1,600 psi at 73°F and 800 psi at 180°F in accordance with ASTM D2837.

M05 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, natural with UV stabilizer, or colored with UV stabilizer.

M06 Material shall have a

(a) thermal stability of over 428°F in accordance with ASTM D3350

(b) maximum brittleness temperature of −76°F in accordance with ASTM D746

(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F

(d) slow crack growth resistance of over 500 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air

(e) hydrostatic design basis (HDB) of 1,250 psi at 73°F and 1,000 psi at 140°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

(f) hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M07 Material shall have a

(a) thermal stability of over 428°F in accordance with ASTM D3350

(b) maximum brittleness temperature of −76°F in accordance with ASTM D746

(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F

(d) slow crack growth resistance of over 500 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air

(e) hydrostatic design basis (HDB) of 1,250 psi at 73°F and 630 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

(f) hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M08 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, or colored with UV stabilizer.

M09 Material shall have a

(a) thermal stability of over 428°F in accordance with ASTM D3350

(b) maximum brittleness temperature of −76°F in accordance with ASTM D746

(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F

(d) slow crack growth resistance of over 100 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air

(e) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 800 psi at 140°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

(f) hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M10 Material shall have a

(a) thermal stability of over 428°F in accordance with ASTM D3350

(b) maximum brittleness temperature of −76°F in accordance with ASTM D746

(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F

(d) slow crack growth resistance of over 100 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air

(e) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 1,000 psi at 140°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

(f) hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M11 Material shall have a

(a) thermal stability of over 428°F in accordance with ASTM D3350

(b) maximum brittleness temperature of −76°F in accordance with ASTM D746

(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F

(d) slow crack growth resistance of over 500 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air

(e) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 800 psi at 140°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

(f) hydrostatic design stress (HDS) of 1,000 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M12 Material shall have a

(a) thermal stability of over 428°F in accordance with ASTM D3350

(b) maximum brittleness temperature of −76°F in accordance with ASTM D746

(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F

(d) slow crack growth resistance of over 500 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air

(e) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 1,000 psi at 140°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

(f) hydrostatic design stress (HDS) of 1,000 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M13 Material shall have a

(a) thermal stability of over 428°F in accordance with ASTM D3350

(b) maximum brittleness temperature of −76°F in accordance with ASTM D746

(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F

(d) slow crack growth resistance of over 500 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air

(e) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 800 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

(f) hydrostatic design stress (HDS) of 1,000 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M14 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603.

M15 Material shall have a

(a) minimum impact resistance of 5.0 ft-lb/in. of notch at 73°F in accordance with ASTM D256

(b) minimum modulus of elasticity in tension of 320,000 psi at 73°F in accordance with ASTM D638

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

(c) minimum deflection temperature under load of 140°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 2,000 psi at 73°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,000 psi at 73°F in accordance with ASTM D2837

M16 Material shall have a
(a) minimum impact resistance of 5.0 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 320,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 140°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 2,500 psi at 73°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,250 psi at 73°F in accordance with ASTM D2837

M17 Material shall have a
(a) minimum impact resistance of 5.0 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 320,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 140°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 3,200 psi at 73°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,600 psi at 73°F in accordance with ASTM D2837

M18 Material shall have a
(a) minimum impact resistance of 5.0 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 320,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 140°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 73°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 73°F in accordance with ASTM D2837

M19 Material shall have a
(a) minimum impact resistance of 0.65 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 400,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 158°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 73°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 73°F in accordance with ASTM D2837

M20 Material shall have a
(a) minimum impact resistance of 5.0 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 320,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 140°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 7,100 psi at 73°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 3,550 psi at 73°F in accordance with ASTM D2837

M21 Allowable stress values apply to the unoriented directions only.

M22 Allowable stress values apply to the oriented direction only.

M23 Material shall have a
(a) classification of Type I in accordance with ASME SD-3222
(b) minimum impact resistance of 1.5 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(c) minimum flexural modulus of 190,000 psi at 73°F in accordance with ASTM D790, using Method I
(d) minimum tensile elongation at break of 10% in accordance with ASTM D638, using a Type I tensile bar at 2 in./min at 73°F
(e) hydrostatic design basis (HDB) of 4,000 psi at 73°F and 1,250 psi at 200°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 73°F and 625 psi at 200°F in accordance with ASTM D2837

M24 Material shall have a
(a) classification of Type II in accordance with ASME SD-3222
(b) minimum flexural modulus of 190,000 psi at 73°F in accordance with ASTM D790, using Method I
(c) minimum tensile elongation at break of 10% in accordance with ASTM D638, using a Type I tensile bar at 2 in./min at 73°F
(d) hydrostatic design basis (HDB) of 5,000 psi at 73°F and 1,250 psi at 248°F in accordance with ASTM D2837
(e) hydrostatic design stress (HDS) of 2,500 psi at 73°F and 625 psi at 248°F in accordance with ASTM D2837

M25 The first two digits (XX) of the PEX Type/Grade designation may be any designation permitted by ASTM F2788. They relate to end-use properties such as oxidation and UV resistance and do not affect strength.

M26 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, natural with UV stabilizer, or colored with UV stabilizer. The degree of cross-linking for PEX pipe material shall be within the range from 65% to 89%, inclusive.
(a) PEX cross-linked using peroxides shall have a minimum degree of cross-linking of 70%.
(b) PEX cross-linked using silane compounds shall have a minimum degree of cross-linking of 65%.
(c) PEX cross-linked using electron beam compounds shall have a minimum degree of cross-linking of 65%.

M27 Material shall have a
(a) minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
(b) hydrostatic design basis (HDB) of 1,250 psi at 73°F and 630 psi at 200°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
(c) hydrostatic design stress (HDS) of 625 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M28 Material shall have a
(a) minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.

Table 1-1-1 Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

(b) hydrostatic design basis (HDB) of 1,250 psi at 73°F and 800 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(c) hydrostatic design stress (HDS) of 625 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M29 Material shall have a

(a) minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.

(b) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 630 psi at 200°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(c) hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M30 Material shall have a

(a) minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.

(b) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 800 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(c) hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M31 Material shall have a

(a) classification of Group 4, Class 2, and Grade 3 in accordance with ASTM D6779.

(b) minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ± 10% at 23°C and 50% ± 5% relative humidity.

(c) minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ± 50% at 23°C ± 2°C and 50% ± 5% relative humidity.

(d) minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.

(e) minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.

(f) hydrostatic design basis (HDB) of 3,150 psi at 73°F and 1,600 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(g) hydrostatic design stress (HDS) of 1,600 psi at 73°F and 800 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(20) **Table 1-1-2 Maximum Allowable Compression Stress Values, S_{comp}, for Thermoplastic Materials**

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Notes
1	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	7.0	200	M01
2	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	7.0	200	M02
3	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	7.0	200	M01
4	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	7.0	200	M02
5	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	7.0	200	M01
6	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	7.0	200	M02
7	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	3.0	200	M25, M26, M27
8	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	3.0	180	M25, M26, M28
9	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	3.0	200	M25, M26, M29
10	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	3.0	180	M25, M26, M30
11	Polyamide	Extruded pipe	SF-2945	PA 32312	...	7.0	180	M03
12	Polyamide	Extruded pipe	SF-2945	PA 32316	...	7.0	180	M04
13	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	5.8	180	M31
14	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	140	M05, M06
15	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	180	M05, M07
16	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	140	M06, M08
17	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	180	M07, M08
18	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	140	M05, M06
19	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	180	M05, M07
20	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	140	M05, M06
21	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	M05, M07
22	Polyethylene	Extruded pipe	SF-714	PE2708	...	2.6	140	M06, M08
23	Polyethylene	Extruded pipe	SF-714	PE2708	...	2.6	180	M07, M08
24	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	M05, M09
25	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	M05, M10
26	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	M08, M11
27	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	M08, M12
28	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	180	M08, M13
29	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	M05, M09
30	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	M05, M10
31	Polyethylene	Extruded tube	SD-2737	PE4608	...	3.0	140	M05, M10
32	Polyethylene	Extruded pipe	SD-2737	PE4710	...	3.0	140	M05, M11
33	Polyethylene	Extruded pipe	SD-2737	PE4710	...	3.0	140	M05, M12
34	Polyethylene	Extruded pipe	SD-2737	PE4710	...	3.0	180	M05, M13
35	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	M05, M09
36	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	M05, M10
37	Polyethylene	Extruded pipe	SD-3035	PE4608	...	3.0	140	M05, M10
38	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	M05, M11
39	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	M05, M12

Table 1-1-2 Maximum Allowable Compression Stress Values, S_{comp}, for Thermoplastic Materials

Line No.	Maximum Allowable Compression Stress, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
	73	80	90	100	110	120	130	140	150	160	170	180	190	200
1	2.50	2.36	2.15	1.96	1.77	1.59	1.42	1.25	1.08	0.926	0.774	0.625	0.481	0.343
2	2.50	2.37	2.18	2.00	1.83	1.67	1.51	1.35	1.20	1.06	0.918	0.781	0.650	0.521
3	2.50	2.36	2.15	1.96	1.77	1.59	1.42	1.25	1.08	0.926	0.774	0.625	0.481	0.343
4	2.50	2.37	2.18	2.00	1.83	1.67	1.51	1.35	1.20	1.06	0.918	0.781	0.650	0.521
5	2.50	2.36	2.15	1.96	1.77	1.59	1.42	1.25	1.08	0.926	0.774	0.625	0.481	0.343
6	2.50	2.37	2.18	2.00	1.83	1.67	1.51	1.35	1.20	1.06	0.918	0.781	0.650	0.521
7	0.800	0.769	0.727	0.686	0.646	0.608	0.571	0.535	0.500	0.467	0.435	0.403	0.374	0.346
8	0.800	0.769	0.727	0.686	0.646	0.608	0.571	0.535	0.500	0.467	0.435	0.403	...	...
9	1.15	1.11	1.04	0.984	0.927	0.871	0.818	0.766	0.716	0.667	0.620	0.575	0.533	0.492
10	1.15	1.11	1.04	0.984	0.927	0.871	0.818	0.766	0.716	0.667	0.620	0.575	...	...
11	1.56	1.50	1.41	1.32	1.24	1.15	1.08	1.00	0.943	0.888	0.834	0.781	...	...
12	1.97	1.89	1.79	1.69	1.59	1.50	1.41	1.32	1.24	1.16	1.08	1.00	...	...
13	1.97	1.89	1.79	1.69	1.59	1.50	1.41	1.33	1.24	1.16	1.08	1.00	...	...
14	0.800	0.781	0.756	0.731	0.707	0.684	0.662	0.640	...	...	...	...	...	...
15	0.800	0.769	0.727	0.686	0.646	0.608	0.571	0.535	0.500	0.467	0.435	0.403	...	...
16	0.800	0.781	0.756	0.731	0.707	0.684	0.662	0.640	...	...	...	...	...	...
17	0.800	0.769	0.727	0.686	0.646	0.608	0.571	0.535	0.500	0.467	0.435	0.403	...	...
18	0.800	0.781	0.756	0.731	0.707	0.684	0.662	0.640	...	...	...	...	...	...
19	0.800	0.769	0.727	0.686	0.646	0.608	0.571	0.535	0.500	0.467	0.435	0.403	...	...
20	0.800	0.781	0.756	0.731	0.707	0.684	0.662	0.640	...	...	...	...	...	...
21	0.800	0.769	0.727	0.686	0.646	0.608	0.571	0.535	0.500	0.467	0.435	0.403	...	...
22	0.800	0.781	0.756	0.731	0.707	0.684	0.662	0.640	...	...	...	...	...	...
23	0.800	0.769	0.727	0.686	0.646	0.608	0.571	0.535	0.500	0.467	0.435	0.403	...	...
24	1.00	0.942	0.862	0.784	0.709	0.637	0.567	0.500	...	...	...	...	...	...
25	1.00	0.956	0.896	0.838	0.782	0.728	0.676	0.625	...	...	...	...	...	...
26	1.15	1.08	0.991	0.902	0.816	0.733	0.653	0.575	...	...	...	...	...	...
27	1.15	1.10	1.03	0.964	0.899	0.837	0.777	0.719	...	...	...	...	...	...
28	1.15	1.11	1.04	0.984	0.927	0.871	0.818	0.766	0.716	0.667	0.620	0.575	...	...
29	1.00	0.942	0.862	0.784	0.709	0.637	0.567	0.500	...	...	...	...	...	...
30	1.00	0.956	0.896	0.838	0.782	0.728	0.676	0.625	...	...	...	...	...	...
31	1.00	0.956	0.896	0.838	0.782	0.728	0.676	0.625	...	...	...	...	...	...
32	1.15	1.08	0.991	0.902	0.816	0.733	0.653	0.575	...	...	...	...	...	...
33	1.15	1.10	1.03	0.964	0.899	0.837	0.777	0.719	...	...	...	...	...	...
34	1.15	1.11	1.04	0.984	0.927	0.871	0.818	0.766	0.716	0.667	0.620	0.575	...	...
35	1.00	0.942	0.862	0.784	0.709	0.637	0.567	0.500	...	...	...	...	...	...
36	1.00	0.956	0.896	0.838	0.782	0.728	0.676	0.625	...	...	...	...	...	...
37	1.00	0.956	0.896	0.838	0.782	0.728	0.676	0.625	...	...	...	...	...	...
38	1.15	1.08	0.991	0.902	0.816	0.733	0.653	0.575	...	...	...	...	...	...
39	1.15	1.10	1.03	0.964	0.899	0.837	0.777	0.719	...	...	...	...	...	...

Table 1-1-2 Maximum Allowable Compression Stress Values, S_{comp}, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Notes
40	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	180	M05, M13
41	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	M08, M09
42	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	M08, M10
43	Polyethylene	Extruded pipe	SF-714	PE4608	...	3.0	140	M08, M10
44	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	M08, M11
45	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	M08, M12
46	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	180	M08, M13
47	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	M09, M14
48	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	M10, M14
49	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	M11, M14
50	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	M12, M14
51	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	180	M13, M14
52	Polyethylene	Extruded pipe	SD-2239	PE4608	...	3.0	140	M05, M10
53	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	M05, M11
54	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	M05, M12
55	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	180	M05, M13
56	PVC	Extruded pipe	SD-1785	PVC2110	C01	6.0	140	M15
57	PVC	Extruded pipe	SD-1785	PVC2112	C01	6.0	140	M16
58	PVC	Extruded pipe	SD-1785	PVC2116	C01	6.0	140	M17
59	PVC	Extruded pipe	SD-1785	PVC2120	C01	6.0	140	M18
60	PVC	Extruded tube	SD-2241	PVC2110	C01	6.0	140	M15
61	PVC	Extruded tube	SD-2241	PVC2112	C01	6.0	140	M16
62	PVC	Extruded tube	SD-2241	PVC2116	C01	6.0	140	M17
63	PVC	Extruded tube	SD-2241	PVC2120	C01	6.0	140	M18
64	PVC	Extruded pipe	SD-1785	PVC1120	C01	7.0	140	M19
65	PVC	Extruded pipe	SD-1785	PVC1220	C01	7.0	140	M19
66	PVC	Extruded pipe	SD-2241	PVC1120	C01	7.0	140	M19
67	PVC	Extruded pipe	SD-2241	PVC1220	C01	7.0	140	M19
68	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	7.0	130	M20, M21
69	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	11.1	130	M20, M22
70	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	6.5	200	M23
71	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	7.7	200	M24

Table 1-1-2 Maximum Allowable Compression Stress Values, S_{comp}, for Thermoplastic Materials (Cont'd)

Line No.	Maximum Allowable Compression Stress, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
	73	80	90	100	110	120	130	140	150	160	170	180	190	200
40	1.15	1.11	1.04	0.984	0.927	0.871	0.818	0.766	0.716	0.667	0.620	0.575	...	...
41	1.00	0.942	0.862	0.784	0.709	0.637	0.567	0.500	...	...	...	...	...	...
42	1.00	0.956	0.896	0.838	0.782	0.728	0.676	0.625	...	...	...	...	...	...
43	1.00	0.956	0.896	0.838	0.782	0.728	0.676	0.625	...	...	...	...	...	...
44	1.15	1.08	0.991	0.902	0.816	0.733	0.653	0.575	...	...	...	...	...	...
45	1.15	1.10	1.03	0.964	0.899	0.837	0.777	0.719	...	...	...	...	...	...
46	1.15	1.11	1.04	0.984	0.927	0.871	0.818	0.766	0.716	0.667	0.620	0.575	...	...
47	1.00	0.942	0.862	0.784	0.709	0.637	0.567	0.500	...	...	...	...	...	...
48	1.00	0.956	0.896	0.838	0.782	0.728	0.676	0.625	...	...	...	...	...	...
49	1.15	1.08	0.991	0.902	0.816	0.733	0.653	0.575	...	...	...	...	...	...
50	1.15	1.10	1.03	0.964	0.899	0.837	0.777	0.719	...	...	...	...	...	...
51	1.15	1.11	1.04	0.984	0.927	0.871	0.818	0.766	0.716	0.667	0.620	0.575	...	...
52	1.00	0.956	0.896	0.838	0.782	0.728	0.676	0.625	...	...	...	...	...	...
53	1.15	1.08	0.991	0.902	0.816	0.733	0.653	0.575	...	...	...	...	...	...
54	1.15	1.10	1.03	0.964	0.899	0.837	0.777	0.719	...	...	...	...	...	...
55	1.15	1.11	1.04	0.984	0.927	0.871	0.818	0.766	0.716	0.667	0.620	0.575	...	...
56	1.25	1.10	0.938	0.775	0.625	0.500	0.375	0.275	...	...	...	...	...	...
57	1.56	1.38	1.17	0.969	0.781	0.625	0.469	0.344	...	...	...	...	...	...
58	2.00	1.76	1.50	1.24	1.00	0.800	0.600	0.440	...	...	...	...	...	...
59	2.50	2.20	1.88	1.55	1.25	1.00	0.750	0.550	...	...	...	...	...	...
60	1.25	1.10	0.938	0.775	0.625	0.500	0.375	0.275	...	...	...	...	...	...
61	1.56	1.38	1.17	0.969	0.781	0.625	0.469	0.344	...	...	...	...	...	...
62	2.00	1.76	1.50	1.24	1.00	0.800	0.600	0.440	...	...	...	...	...	...
63	2.50	2.20	1.88	1.55	1.25	1.00	0.750	0.550	...	...	...	...	...	...
64	2.50	2.20	1.88	1.55	1.25	1.00	0.750	0.550	...	...	...	...	...	...
65	2.50	2.20	1.88	1.55	1.25	1.00	0.750	0.550	...	...	...	...	...	...
66	2.50	2.20	1.88	1.55	1.25	1.00	0.750	0.550	...	...	...	...	...	...
67	2.50	2.20	1.88	1.55	1.25	1.00	0.750	0.550	...	...	...	...	...	...
68	2.50	2.20	1.88	1.55	1.25	1.00	0.750	...	...	...	...	...	...	...
69	4.44	3.91	3.33	2.75	2.22	1.78	1.33	...	...	...	...	...	...	...
70	2.50	2.38	2.22	2.07	1.92	1.78	1.64	1.50	1.37	1.25	1.13	1.01	0.893	0.781
71	3.13	3.00	2.83	2.67	2.51	2.36	2.21	2.07	1.93	1.79	1.67	1.54	1.42	1.30

Table 1-1-2 Maximum Allowable Compression Stress Values, S_{comp}, for Thermoplastic Materials (Cont'd)

GENERAL NOTES:

(a) The stress values in this Table may be interpolated to determine values for intermediate temperatures. The values at intermediate temperatures shall be rounded to the same number of decimal places as the value at the higher temperature between which values are being interpolated. The rounding rule is: when the next digit beyond the last place to be retained is less than 5, retain unchanged the digit in the last place retained; when the next digit beyond the last place to be retained is 5 or greater, increase by 1 the digit in the last place retained.

(b) The following abbreviations are used: CPVC, chlorinated poly(vinyl chloride); PEX, cross-linked polyethylene; PVC, poly(vinyl chloride); and PVDF, poly(vinylidene fluoride).

NOTE: (1) Multiply ksi by 1,000 to obtain psi.

CONSTRUCTION CODE NOTES (ASME NM.1):

C01 Compounding ingredients may vary between material manufacturers for the same grade of CPVC or PVC. While these different ingredients do not impact the allowable stress values provided in this Table, they can influence the acceptability of the various joining methods allowed by ASME NM.1. In addition to the material and joining requirements set forth in ASME NM.1, the joining method to be used shall be approved by the piping component manufacturer.

C02 Cross-linking method may vary between material manufacturers for the same grade of PEX. While these different methods do not impact the allowable stress values provided in this Table, they can influence the acceptability of the various joining methods allowed by ASME NM.1. In addition to the material and joining requirements set forth in ASME NM.1, the joining method to be used shall be approved by the piping component manufacturer.

MATERIAL NOTES:

M01 Material shall have a

(a) minimum impact resistance of 1.5 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 360,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 212°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 73°F and 1,000 psi at 180°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 73°F and 500 psi at 180°F in accordance with ASTM D2837

M02 Material shall have a

(a) minimum impact resistance of 1.5 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 360,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 212°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 73°F and 1,250 psi at 180°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 73°F and 625 psi at 180°F in accordance with ASTM D2837

M03 Material shall have a

(a) classification of Group 3, Class 2, and Grade 3 in accordance with ASTM D4066.
(b) minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ±10% at 23°C ± 2°C and 50% ± 5% relative humidity.
(c) minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ±50% at 23°C ± 2°C and 50% ± 5% relative humidity.
(d) minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.
(e) minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.
(f) hydrostatic design basis (HDB) of 2,500 psi at 73°F, 1,600 psi at 140°F, and 1,250 psi at 180°F in accordance with ASTM D2837.
(g) hydrostatic design stress (HDS) of 1,250 psi at 73°F, 800 psi at 140°F, and 625 psi at 180°F in accordance with ASTM D2837.

M04 Material shall have a

(a) classification of Group 3, Class 2, and Grade 3 in accordance with ASTM D4066.
(b) minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ±10% at 23°C ± 2°C and 50% ± 5% relative humidity.
(c) minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ±50% at 23°C ± 2°C and 50% ± 5% relative humidity.
(d) minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.
(e) minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.
(f) hydrostatic design basis (HDB) of 3,150 psi at 73°F and 1,600 psi at 180°F in accordance with ASTM D2837.
(g) hydrostatic design stress (HDS) of 1,600 psi at 73°F and 800 psi at 180°F in accordance with ASTM D2837.

M05 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, natural with UV stabilizer, or colored with UV stabilizer.

M06 Material shall have a

(a) thermal stability of over 428°F in accordance with ASTM D3350
(b) maximum brittleness temperature of −76°F in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F
(d) slow crack growth resistance of over 500 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air

Table 1-1-2 Maximum Allowable Compression Stress Values, S_{comp}, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

(e) hydrostatic design basis (HDB) of 1,250 psi at 73°F and 1,000 psi at 140°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M07 Material shall have a
(a) thermal stability of over 428°F in accordance with ASTM D3350
(b) maximum brittleness temperature of −76°F in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F
(d) slow crack growth resistance of over 500 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,250 psi at 73°F and 630 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M08 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, or colored with UV stabilizer.

M09 Material shall have a
(a) thermal stability of over 428°F in accordance with ASTM D3350
(b) maximum brittleness temperature of −76°F in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F
(d) slow crack growth resistance of over 100 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 800 psi at 140°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M10 Material shall have a
(a) thermal stability of over 428°F in accordance with ASTM D3350
(b) maximum brittleness temperature of −76°F in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F
(d) slow crack growth resistance of over 100 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 1,000 psi at 140°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M11 Material shall have a
(a) thermal stability of over 428°F in accordance with ASTM D3350
(b) maximum brittleness temperature of −76°F in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F
(d) slow crack growth resistance of over 500 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 800 psi at 140°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 1,000 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M12 Material shall have a
(a) thermal stability of over 428°F in accordance with ASTM D3350
(b) maximum brittleness temperature of −76°F in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F
(d) slow crack growth resistance of over 500 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 1,000 psi at 140°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 1,000 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M13 Material shall have a
(a) thermal stability of over 428°F in accordance with ASTM D3350
(b) maximum brittleness temperature of −76°F in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F
(d) slow crack growth resistance of over 500 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 800 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 1,000 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M14 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603.

M15 Material shall have a
(a) minimum impact resistance of 5.0 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 320,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 140°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 2,000 psi at 73°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,000 psi at 73°F in accordance with ASTM D2837

M16 Material shall have a
(a) minimum impact resistance of 5.0 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 320,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 140°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 2,500 psi at 73°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,250 psi at 73°F in accordance with ASTM D2837

M17 Material shall have a
(a) minimum impact resistance of 5.0 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 320,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 140°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 3,200 psi at 73°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,600 psi at 73°F in accordance with ASTM D2837

Table 1-1-2 Maximum Allowable Compression Stress Values, S_{comp}, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

M18 Material shall have a
- *(a)* minimum impact resistance of 5.0 ft-lb/in. of notch at 73°F in accordance with ASTM D256
- *(b)* minimum modulus of elasticity in tension of 320,000 psi at 73°F in accordance with ASTM D638
- *(c)* minimum deflection temperature under load of 140°F at a load of 264 psi in accordance with ASTM D648
- *(d)* average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
- *(e)* hydrostatic design basis (HDB) of 4,000 psi at 73°F in accordance with ASTM D2837
- *(f)* hydrostatic design stress (HDS) of 2,000 psi at 73°F in accordance with ASTM D2837

M19 Material shall have a
- *(a)* minimum impact resistance of 0.65 ft-lb/in. of notch at 73°F in accordance with ASTM D256
- *(b)* minimum modulus of elasticity in tension of 400,000 psi at 73°F in accordance with ASTM D638
- *(c)* minimum deflection temperature under load of 158°F at a load of 264 psi in accordance with ASTM D648
- *(d)* average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
- *(e)* hydrostatic design basis (HDB) of 4,000 psi at 73°F in accordance with ASTM D2837
- *(f)* hydrostatic design stress (HDS) of 2,000 psi at 73°F in accordance with ASTM D2837

M20 Material shall have a
- *(a)* minimum impact resistance of 5.0 ft-lb/in. of notch at 73°F in accordance with ASTM D256
- *(b)* minimum modulus of elasticity in tension of 320,000 psi at 73°F in accordance with ASTM D638
- *(c)* minimum deflection temperature under load of 140°F at a load of 264 psi in accordance with ASTM D648
- *(d)* average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
- *(e)* hydrostatic design basis (HDB) of 7,100 psi at 73°F in accordance with ASTM D2837
- *(f)* hydrostatic design stress (HDS) of 3,550 psi at 73°F in accordance with ASTM D2837

M21 Allowable stress values apply to the unoriented directions only.

M22 Allowable stress values apply to the oriented direction only.

M23 Material shall have a
- *(a)* classification of Type I in accordance with ASME SD-3222
- *(b)* minimum impact resistance of 1.5 ft-lb/in. of notch at 73°F in accordance with ASTM D256
- *(c)* minimum flexural modulus of 190,000 psi at 73°F in accordance with ASTM D790, using Method I
- *(d)* minimum tensile elongation at break of 10% in accordance with ASTM D638, using a Type I tensile bar at 2 in./min at 73°F
- *(e)* hydrostatic design basis (HDB) of 4,000 psi at 73°F and 1,250 psi at 200°F in accordance with ASTM D2837
- *(f)* hydrostatic design stress (HDS) of 2,000 psi at 73°F and 625 psi at 200°F in accordance with ASTM D2837

M24 Material shall have a
- *(a)* classification of Type II in accordance with ASME SD-3222
- *(b)* minimum flexural modulus of 190,000 psi at 73°F in accordance with ASTM D790, using Method I
- *(c)* minimum tensile elongation at break of 10% in accordance with ASTM D638, using a Type I tensile bar at 2 in./min at 73°F
- *(d)* hydrostatic design basis (HDB) of 5,000 psi at 73°F and 1,250 psi at 248°F in accordance with ASTM D2837
- *(e)* hydrostatic design stress (HDS) of 2,500 psi at 73°F and 625 psi at 248°F in accordance with ASTM D2837

M25 The first two digits (XX) of the PEX Type/Grade designation may be any designation permitted by ASTM F2788. They relate to end-use properties such as oxidation and UV resistance and do not affect strength.

M26 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, natural with UV stabilizer, or colored with UV stabilizer. The degree of cross-linking for PEX pipe material shall be within the range from 65% to 89%, inclusive.
- *(a)* PEX cross-linked using peroxides shall have a minimum degree of cross-linking of 70%.
- *(b)* PEX cross-linked using silane compounds shall have a minimum degree of cross-linking of 65%.
- *(c)* PEX cross-linked using electron beam compounds shall have a minimum degree of cross-linking of 65%.

M27 Material shall have a
- *(a)* minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
- *(b)* hydrostatic design basis (HDB) of 1,250 psi at 73°F and 630 psi at 200°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
- *(c)* hydrostatic design stress (HDS) of 625 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M28 Material shall have a
- *(a)* minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
- *(b)* hydrostatic design basis (HDB) of 1,250 psi at 73°F and 800 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
- *(c)* hydrostatic design stress (HDS) of 625 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M29 Material shall have a
- *(a)* minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
- *(b)* hydrostatic design basis (HDB) of 1,600 psi at 73°F and 630 psi at 200°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
- *(c)* hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M30 Material shall have a
- *(a)* minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
- *(b)* hydrostatic design basis (HDB) of 1,600 psi at 73°F and 800 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
- *(c)* hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M31 Material shall have a
- *(a)* classification of Group 4, Class 2, and Grade 3 in accordance with ASTM D6779.
- *(b)* minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ± 10% at 23°C and 50% ± 5% relative humidity.
- *(c)* minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ± 50% at 23°C ± 2°C and 50% ± 5% relative humidity.

Table 1-1-2 Maximum Allowable Compression Stress Values, S_{comp}, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

(d) minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.

(e) minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.

(f) hydrostatic design basis (HDB) of 3,150 psi at 73°F and 1,600 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(g) hydrostatic design stress (HDS) of 1,600 psi at 73°F and 800 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(20) **Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials**

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor	Notes
1	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	7.0	200	D01	M01
2	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	7.0	200	D01	M01
3	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	7.0	200	D01	M01
4	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	7.0	200	D01	M01
5	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	7.0	200	D01	M01
6	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	7.0	200	D01	M01
7	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	7.0	200	D01	M02
8	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	7.0	200	D01	M02
9	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	7.0	200	D01	M02
10	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	7.0	200	D01	M02
11	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	7.0	200	D01	M02
12	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	7.0	200	D01	M02
13	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	7.0	200	D01	M01
14	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	7.0	200	D01	M01
15	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	7.0	200	D01	M01
16	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	7.0	200	D01	M01
17	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	7.0	200	D01	M01
18	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	7.0	200	D01	M01
19	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	7.0	200	D01	M02
20	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	7.0	200	D01	M02
21	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	7.0	200	D01	M02
22	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	7.0	200	D01	M02
23	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	7.0	200	D01	M02
24	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	7.0	200	D01	M02
25	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	7.0	200	D01	M01
26	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	7.0	200	D01	M01
27	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	7.0	200	D01	M01
28	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	7.0	200	D01	M01
29	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	7.0	200	D01	M01
30	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	7.0	200	D01	M01
31	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	7.0	200	D01	M02
32	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	7.0	200	D01	M02
33	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	7.0	200	D01	M02
34	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	7.0	200	D01	M02
35	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	7.0	200	D01	M02
36	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	7.0	200	D01	M02
37	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	200	D01 (0.5)	M24, M25, M26
38	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	200	D01 (0.5)	M24, M25, M26
39	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	200	D01 (0.5)	M24, M25, M26
40	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	200	D01 (0.5)	M24, M25, M26

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
1	$N \le 1{,}000$	3.10	3.00	2.88	2.73	2.60	2.45	2.32	2.20	2.04	1.92	1.77	1.64	1.47	1.27
2	$1{,}000 < N \le 10{,}000$	1.85	1.79	1.72	1.63	1.55	1.46	1.39	1.31	1.22	1.15	1.05	0.981	0.879	0.757
3	$10{,}000 < N \le 25{,}000$	1.52	1.47	1.41	1.33	1.27	1.20	1.14	1.08	1.00	0.940	0.864	0.803	0.720	0.620
4	$25{,}000 < N \le 50{,}000$	1.30	1.26	1.21	1.15	1.09	1.03	0.976	0.924	0.859	0.807	0.742	0.690	0.619	0.533
5	$50{,}000 < N \le 75{,}000$	1.19	1.15	1.11	1.05	1.00	0.940	0.892	0.844	0.785	0.737	0.678	0.630	0.565	0.487
6	$75{,}000 < N \le 100{,}000$	1.11	1.08	1.04	0.981	0.936	0.881	0.836	0.791	0.736	0.691	0.635	0.591	0.530	0.456
7	$N \le 1{,}000$	3.10	3.00	2.88	2.73	2.60	2.45	2.32	2.20	2.04	1.92	1.77	1.64	1.47	1.27
8	$1{,}000 < N \le 10{,}000$	1.85	1.79	1.72	1.63	1.55	1.46	1.39	1.31	1.22	1.15	1.05	0.981	0.879	0.757
9	$10{,}000 < N \le 25{,}000$	1.52	1.47	1.41	1.33	1.27	1.20	1.14	1.08	1.00	0.940	0.864	0.803	0.720	0.620
10	$25{,}000 < N \le 50{,}000$	1.30	1.26	1.21	1.15	1.09	1.03	0.976	0.924	0.859	0.807	0.742	0.690	0.619	0.533
11	$50{,}000 < N \le 75{,}000$	1.19	1.15	1.11	1.05	1.00	0.940	0.892	0.844	0.785	0.737	0.678	0.630	0.565	0.487
12	$75{,}000 < N \le 100{,}000$	1.11	1.08	1.04	0.981	0.936	0.881	0.836	0.791	0.736	0.691	0.635	0.591	0.530	0.456
13	$N \le 1{,}000$	3.10	3.00	2.88	2.73	2.60	2.45	2.32	2.20	2.04	1.92	1.77	1.64	1.47	1.27
14	$1{,}000 < N \le 10{,}000$	1.85	1.79	1.72	1.63	1.55	1.46	1.39	1.31	1.22	1.15	1.05	0.981	0.879	0.757
15	$10{,}000 < N \le 25{,}000$	1.52	1.47	1.41	1.33	1.27	1.20	1.14	1.08	1.00	0.940	0.864	0.803	0.720	0.620
16	$25{,}000 < N \le 50{,}000$	1.30	1.26	1.21	1.15	1.09	1.03	0.976	0.924	0.859	0.807	0.742	0.690	0.619	0.533
17	$50{,}000 < N \le 75{,}000$	1.19	1.15	1.11	1.05	1.00	0.940	0.892	0.844	0.785	0.737	0.678	0.630	0.565	0.487
18	$75{,}000 < N \le 100{,}000$	1.11	1.08	1.04	0.981	0.936	0.881	0.836	0.791	0.736	0.691	0.635	0.591	0.530	0.456
19	$N \le 1{,}000$	3.10	3.00	2.88	2.73	2.60	2.45	2.32	2.20	2.04	1.92	1.77	1.64	1.47	1.27
20	$1{,}000 < N \le 10{,}000$	1.85	1.79	1.72	1.63	1.55	1.46	1.39	1.31	1.22	1.15	1.05	0.981	0.879	0.757
21	$10{,}000 < N \le 25{,}000$	1.52	1.47	1.41	1.33	1.27	1.20	1.14	1.08	1.00	0.940	0.864	0.803	0.720	0.620
22	$25{,}000 < N \le 50{,}000$	1.30	1.26	1.21	1.15	1.09	1.03	0.976	0.924	0.859	0.807	0.742	0.690	0.619	0.533
23	$50{,}000 < N \le 75{,}000$	1.19	1.15	1.11	1.05	1.00	0.940	0.892	0.844	0.785	0.737	0.678	0.630	0.565	0.487
24	$75{,}000 < N \le 100{,}000$	1.11	1.08	1.04	0.981	0.936	0.881	0.836	0.791	0.736	0.691	0.635	0.591	0.530	0.456
25	$N \le 1{,}000$	3.10	3.00	2.88	2.73	2.60	2.45	2.32	2.20	2.04	1.92	1.77	1.64	1.47	1.27
26	$1{,}000 < N \le 10{,}000$	1.85	1.79	1.72	1.63	1.55	1.46	1.39	1.31	1.22	1.15	1.05	0.981	0.879	0.757
27	$10{,}000 < N \le 25{,}000$	1.52	1.47	1.41	1.33	1.27	1.20	1.14	1.08	1.00	0.940	0.864	0.803	0.720	0.620
28	$25{,}000 < N \le 50{,}000$	1.30	1.26	1.21	1.15	1.09	1.03	0.976	0.924	0.859	0.807	0.742	0.690	0.619	0.533
29	$50{,}000 < N \le 75{,}000$	1.19	1.15	1.11	1.05	1.00	0.940	0.892	0.844	0.785	0.737	0.678	0.630	0.565	0.487
30	$75{,}000 < N \le 100{,}000$	1.11	1.08	1.04	0.981	0.936	0.881	0.836	0.791	0.736	0.691	0.635	0.591	0.530	0.456
31	$N \le 1{,}000$	3.10	3.00	2.88	2.73	2.60	2.45	2.32	2.20	2.04	1.92	1.77	1.64	1.47	1.27
32	$1{,}000 < N \le 10{,}000$	1.85	1.79	1.72	1.63	1.55	1.46	1.39	1.31	1.22	1.15	1.05	0.981	0.879	0.757
33	$10{,}000 < N \le 25{,}000$	1.52	1.47	1.41	1.33	1.27	1.20	1.14	1.08	1.00	0.940	0.864	0.803	0.720	0.620
34	$25{,}000 < N \le 50{,}000$	1.30	1.26	1.21	1.15	1.09	1.03	0.976	0.924	0.859	0.807	0.742	0.690	0.619	0.533
35	$50{,}000 < N \le 75{,}000$	1.19	1.15	1.11	1.05	1.00	0.940	0.892	0.844	0.785	0.737	0.678	0.630	0.565	0.487
36	$75{,}000 < N \le 100{,}000$	1.11	1.08	1.04	0.981	0.936	0.881	0.836	0.791	0.736	0.691	0.635	0.591	0.530	0.456
37	$N \le 1{,}000$	0.625	0.608	0.584	0.560	0.538	0.516	0.495	0.475	0.455	0.436	0.418	0.400	0.358	0.315
38	$1{,}000 < N \le 10{,}000$	0.625	0.608	0.584	0.560	0.538	0.516	0.495	0.475	0.455	0.436	0.418	0.400	0.358	0.315
39	$10{,}000 < N \le 25{,}000$	0.625	0.608	0.584	0.560	0.538	0.516	0.495	0.475	0.455	0.436	0.418	0.400	0.358	0.315
40	$25{,}000 < N \le 50{,}000$	0.625	0.608	0.584	0.560	0.538	0.516	0.495	0.475	0.455	0.436	0.418	0.400	0.358	0.315

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construc-tion Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor	Notes
41	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	200	D01 (0.5)	M24, M25, M26
42	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	200	D01 (0.5)	M24, M25, M26
43	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	180	D01 (0.5)	M24, M25, M27
44	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	180	D01 (0.5)	M24, M25, M27
45	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	180	D01 (0.5)	M24, M25, M27
46	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	180	D01 (0.5)	M24, M25, M27
47	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	180	D01 (0.5)	M24, M25, M27
48	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	3.0	180	D01 (0.5)	M24, M25, M27
49	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	200	D01 (0.5)	M24, M25, M28
50	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	200	D01 (0.5)	M24, M25, M28
51	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	200	D01 (0.5)	M24, M25, M28
52	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	200	D01 (0.5)	M24, M25, M28
53	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	200	D01 (0.5)	M24, M25, M28
54	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	200	D01 (0.5)	M24, M25, M28
55	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	180	D01 (0.5)	M24, M25, M29
56	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	180	D01 (0.5)	M24, M25, M29
57	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	180	D01 (0.5)	M24, M25, M29
58	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	180	D01 (0.5)	M24, M25, M29
59	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	180	D01 (0.5)	M24, M25, M29
60	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	3.0	180	D01 (0.5)	M24, M25, M29
61	Polyamide	Extruded pipe	SF-2945	PA 32312	...	7.0	180	D01	M03
62	Polyamide	Extruded pipe	SF-2945	PA 32312	...	7.0	180	D01	M03
63	Polyamide	Extruded pipe	SF-2945	PA 32312	...	7.0	180	D01	M03
64	Polyamide	Extruded pipe	SF-2945	PA 32312	...	7.0	180	D01	M03
65	Polyamide	Extruded pipe	SF-2945	PA 32312	...	7.0	180	D01	M03
66	Polyamide	Extruded pipe	SF-2945	PA 32312	...	7.0	180	D01	M03
67	Polyamide	Extruded pipe	SF-2945	PA 32316	...	7.0	180	D01	M04

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
41	50,000 < N ≤ 75,000	0.625	0.608	0.584	0.560	0.538	0.516	0.495	0.475	0.455	0.436	0.418	0.400	0.358	0.315
42	75,000 < N ≤ 100,000	0.625	0.608	0.584	0.560	0.538	0.516	0.495	0.475	0.455	0.436	0.418	0.400	0.358	0.315
43	N ≤ 1,000	0.625	0.608	0.584	0.560	0.538	0.516	0.495	0.475	0.455	0.436	0.418	0.400	...	...
44	1,000 < N ≤ 10,000	0.625	0.608	0.584	0.560	0.538	0.516	0.495	0.475	0.455	0.436	0.418	0.400	...	...
45	10,000 < N ≤ 25,000	0.625	0.608	0.584	0.560	0.538	0.516	0.495	0.475	0.455	0.436	0.418	0.400	...	...
46	25,000 < N ≤ 50,000	0.625	0.608	0.584	0.560	0.538	0.516	0.495	0.475	0.455	0.436	0.418	0.400	...	...
47	50,000 < N ≤ 75,000	0.625	0.608	0.584	0.560	0.538	0.516	0.495	0.475	0.455	0.436	0.418	0.400	...	...
48	75,000 < N ≤ 100,000	0.625	0.608	0.584	0.560	0.538	0.516	0.495	0.475	0.455	0.436	0.418	0.400	...	...
49	N ≤ 1,000	0.800	0.769	0.726	0.685	0.645	0.606	0.569	0.533	0.498	0.465	0.432	0.400	0.358	0.315
50	1,000 < N ≤ 10,000	0.800	0.769	0.726	0.685	0.645	0.606	0.569	0.533	0.498	0.465	0.432	0.400	0.358	0.315
51	10,000 < N ≤ 25,000	0.800	0.769	0.726	0.685	0.645	0.606	0.569	0.533	0.498	0.465	0.432	0.400	0.358	0.315
52	25,000 < N ≤ 50,000	0.800	0.769	0.726	0.685	0.645	0.606	0.569	0.533	0.498	0.465	0.432	0.400	0.358	0.315
53	50,000 < N ≤ 75,000	0.800	0.769	0.726	0.685	0.645	0.606	0.569	0.533	0.498	0.465	0.432	0.400	0.358	0.315
54	75,000 < N ≤ 100,000	0.800	0.769	0.726	0.685	0.645	0.606	0.569	0.533	0.498	0.465	0.432	0.400	0.358	0.315
55	N ≤ 1,000	0.800	0.769	0.726	0.685	0.645	0.606	0.569	0.533	0.498	0.465	0.432	0.400	...	...
56	1,000 < N ≤ 10,000	0.800	0.769	0.726	0.685	0.645	0.606	0.569	0.533	0.498	0.465	0.432	0.400	...	...
57	10,000 < N ≤ 25,000	0.800	0.769	0.726	0.685	0.645	0.606	0.569	0.533	0.498	0.465	0.432	0.400	...	...
58	25,00 < N ≤ 50,000	0.800	0.769	0.726	0.685	0.645	0.606	0.569	0.533	0.498	0.465	0.432	0.400	...	...
59	50,000 < N ≤ 75,000	0.800	0.769	0.726	0.685	0.645	0.606	0.569	0.533	0.498	0.465	0.432	0.400	...	...
60	75,000 < N ≤ 100,000	0.800	0.769	0.726	0.685	0.645	0.606	0.569	0.533	0.498	0.465	0.432	0.400	...	...
61	N ≤ 1,000	1.25	1.20	1.13	1.06	0.988	0.923	0.861	0.800	0.754	0.710	0.667	0.625	...	...
62	1,000 < N ≤ 10,000	1.25	1.20	1.13	1.06	0.988	0.923	0.861	0.800	0.754	0.710	0.667	0.625	...	...
63	10,000 < N ≤ 25,000	1.25	1.20	1.13	1.06	0.988	0.923	0.861	0.800	0.754	0.710	0.667	0.625	...	...
64	25,000 < N ≤ 50,000	1.25	1.20	1.13	1.06	0.988	0.923	0.861	0.800	0.754	0.710	0.667	0.625	...	...
65	50,000 < N ≤ 75,000	1.25	1.20	1.13	1.06	0.988	0.923	0.861	0.800	0.754	0.710	0.667	0.625	...	...
66	75,000 < N ≤ 100,000	1.25	1.20	1.13	1.06	0.988	0.923	0.861	0.800	0.754	0.710	0.667	0.625	...	...
67	N ≤ 1,000	1.25	1.20	1.13	1.06	0.988	0.923	0.861	0.800	0.754	0.710	0.667	0.625	...	...

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor	Notes
68	Polyamide	Extruded pipe	SF-2945	PA 32316	...	7.0	180	D01	M04
69	Polyamide	Extruded pipe	SF-2945	PA 32316	...	7.0	180	D01	M04
70	Polyamide	Extruded pipe	SF-2945	PA 32316	...	7.0	180	D01	M04
71	Polyamide	Extruded pipe	SF-2945	PA 32316	...	7.0	180	D01	M04
72	Polyamide	Extruded pipe	SF-2945	PA 32316	...	7.0	180	D01	M04
73	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	5.8	180	D01 (0.5)	M30
74	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	5.8	180	D01 (0.5)	M30
75	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	5.8	180	D01 (0.5)	M30
76	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	5.8	180	D01 (0.5)	M30
77	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	5.8	180	D01 (0.5)	M30
78	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	5.8	180	D01 (0.5)	M30
79	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	140	D01	M05, M06
80	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	140	D01	M05, M06
81	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	140	D01	M05, M06
82	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	140	D01	M05, M06
83	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	140	D01	M05, M06
84	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	140	D01	M05, M06
85	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	180	D01	M05, M07
86	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	180	D01	M05, M07
87	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	180	D01	M05, M07
88	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	180	D01	M05, M07
89	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	180	D01	M05, M07
90	Polyethylene	Extruded pipe	SD-2239	PE2708	...	2.6	180	D01	M05, M07
91	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	140	D01	M06, M08
92	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	140	D01	M06, M08
93	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	140	D01	M06, M08
94	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	140	D01	M06, M08
95	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	140	D01	M06, M08
96	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	140	D01	M06, M08
97	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	180	D01	M07, M08
98	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	180	D01	M07, M08
99	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	180	D01	M07, M08
100	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	180	D01	M07, M08
101	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	180	D01	M07, M08
102	Polyethylene	Extruded pipe	SD-2513	PE2708	...	2.6	180	D01	M07, M08
103	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	140	D01	M05, M06
104	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	140	D01	M05, M06
105	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	140	D01	M05, M06
106	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	140	D01	M05, M06
107	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	140	D01	M05, M06
108	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	140	D01	M05, M06
109	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	180	D01	M05, M07
110	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	180	D01	M05, M07

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
68	1,000 < N ≤ 10,000	1.25	1.20	1.13	1.06	0.988	0.923	0.861	0.800	0.754	0.710	0.667	0.625	...	...
69	10,000 < N ≤ 25,000	1.25	1.20	1.13	1.06	0.988	0.923	0.861	0.800	0.754	0.710	0.667	0.625	...	...
70	25,000 < N ≤ 50,000	1.25	1.20	1.13	1.06	0.988	0.923	0.861	0.800	0.754	0.710	0.667	0.625	...	...
71	50,000 < N ≤ 75,000	1.25	1.20	1.13	1.06	0.988	0.923	0.861	0.800	0.754	0.710	0.667	0.625	...	...
72	75,000 < N ≤ 100,000	1.25	1.20	1.13	1.06	0.988	0.923	0.861	0.800	0.754	0.710	0.667	0.625	...	...
73	N ≤ 1,000	1.58	1.52	1.43	1.35	1.275	1.2	1.125	1.06	0.99	0.925	0.86	0.8	...	...
74	1,000 < N ≤ 10,000	1.58	1.52	1.43	1.35	1.275	1.2	1.125	1.06	0.99	0.925	0.86	0.8	...	...
75	10,000 < N ≤ 25,000	1.58	1.52	1.43	1.35	1.275	1.2	1.125	1.06	0.99	0.925	0.86	0.8	...	...
76	25,000 < N ≤ 50,000	1.58	1.52	1.43	1.35	1.275	1.2	1.125	1.06	0.99	0.925	0.86	0.8	...	...
77	50,000 < N ≤ 75,000	1.58	1.52	1.43	1.35	1.275	1.2	1.125	1.06	0.99	0.925	0.86	0.8	...	...
78	75,000 < N ≤ 100,000	1.58	1.52	1.43	1.35	1.275	1.2	1.125	1.06	0.99	0.925	0.86	0.8	...	...
79	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
80	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
81	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
82	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
83	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
84	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
85	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
86	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
87	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
88	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
89	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
90	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
91	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
92	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
93	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
94	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
95	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
96	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
97	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
98	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
99	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
100	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
101	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
102	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
103	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
104	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
105	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
106	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
107	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
108	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
109	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
110	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construc-tion Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor	Notes
111	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	180	D01	M05, M07
112	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	180	D01	M05, M07
113	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	180	D01	M05, M07
114	Polyethylene	Extruded tube	SD-2737	PE2708	...	2.6	180	D01	M05, M07
115	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	140	D01	M05, M06
116	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	140	D01	M05, M06
117	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	140	D01	M05, M06
118	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	140	D01	M05, M06
119	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	140	D01	M05, M06
120	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	140	D01	M05, M06
121	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	D01	M05, M07
122	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	D01	M05, M07
123	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	D01	M05, M07
124	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	D01	M05, M07
125	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	D01	M05, M07
126	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	D01	M05, M07
127	Polyethylene	Extruded pipe	SF-714	PE2708	...	2.6	140	D01	M06, M08
128	Polyethylene	Extruded pipe	SF-714	PE2708	...	2.6	140	D01	M06, M08
129	Polyethylene	Extruded pipe	SF-714	PE2708	...	2.6	140	D01	M06, M08
130	Polyethylene	Extruded pipe	SF-714	PE2708	...	2.6	140	D01	M06, M08
131	Polyethylene	Extruded pipe	SF-714	PE2708	...	2.6	140	D01	M06, M08
132	Polyethylene	Extruded pipe	SF-714	PE2708	...	2.6	140	D01	M06, M08
133	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	D01	M07, M08
134	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	D01	M07, M08
135	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	D01	M07, M08
136	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	D01	M07, M08
137	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	D01	M07, M08
138	Polyethylene	Extruded pipe	SD-3035	PE2708	...	2.6	180	D01	M07, M08
139	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D01	M05, M09
140	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D01	M05, M09
141	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D01	M05, M09
142	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D01	M05, M09
143	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D01	M05, M09
144	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D01	M05, M09
145	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D01	M05, M10
146	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D01	M05, M10
147	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D01	M05, M10
148	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D01	M05, M10
149	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D01	M05, M10
150	Polyethylene	Extruded pipe	SD-2239	PE3608	...	3.0	140	D01	M05, M10
151	Polyethylene	Extruded pipe	SD-2239	PE4608	...	3.0	140	D01	M05, M10

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
111	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
112	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
113	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
114	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
115	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
116	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
117	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
118	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
119	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
120	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
121	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
122	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
123	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
124	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
125	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
126	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
127	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
128	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
129	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
130	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
131	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
132	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
133	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
134	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
135	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
136	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
137	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
138	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
139	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
140	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
141	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
142	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
143	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
144	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
145	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
146	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
147	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
148	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
149	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
150	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
151	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construc-tion Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor	Notes
152	Polyethylene	Extruded pipe	SD-2239	PE4608	...	3.0	140	D01	M05, M10
153	Polyethylene	Extruded pipe	SD-2239	PE4608	...	3.0	140	D01	M05, M10
154	Polyethylene	Extruded pipe	SD-2239	PE4608	...	3.0	140	D01	M05, M10
155	Polyethylene	Extruded pipe	SD-2239	PE4608	...	3.0	140	D01	M05, M10
156	Polyethylene	Extruded pipe	SD-2239	PE4608	...	3.0	140	D01	M05, M10
157	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D01	M05, M11
158	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D01	M05, M11
159	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D01	M05, M11
160	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D01	M05, M11
161	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D01	M05, M11
162	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D01	M05, M11
163	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D01	M05, M12
164	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D01	M05, M12
165	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D01	M05, M12
166	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D01	M05, M12
167	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D01	M05, M12
168	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	140	D01	M05, M12
169	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	180	D01	M05, M13
170	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	180	D01	M05, M13
171	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	180	D01	M05, M13
172	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	180	D01	M05, M13
173	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	180	D01	M05, M13
174	Polyethylene	Extruded pipe	SD-2239	PE4710	...	3.0	180	D01	M05, M13
175	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D01	M08, M11
176	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D01	M08, M11
177	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D01	M08, M11
178	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D01	M08, M11
179	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D01	M08, M11
180	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D01	M08, M11
181	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D01	M08, M12
182	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D01	M08, M12
183	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D01	M08, M12
184	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D01	M08, M12
185	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D01	M08, M12
186	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	140	D01	M08, M12
187	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	180	D01	M08, M13
188	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	180	D01	M08, M13
189	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	180	D01	M08, M13
190	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	180	D01	M08, M13
191	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	180	D01	M08, M13
192	Polyethylene	Extruded pipe	SD-2513	PE4710	...	3.0	180	D01	M08, M13

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
152	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
153	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
154	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
155	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
156	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
157	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
158	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
159	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
160	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
161	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
162	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
163	N ≤ 1,000	3.88	3.77	3.61	3.44	3.28	3.11	2.93	2.76	...	...	...	...	...	...
164	1,000 < N ≤ 10,000	2.57	2.50	2.40	2.30	2.19	2.08	1.97	1.86	...	...	...	...	...	...
165	10,000 < N ≤ 25,000	2.18	2.12	2.04	1.95	1.87	1.78	1.69	1.59	...	...	...	...	...	...
166	25,000 < N ≤ 50,000	1.92	1.87	1.80	1.73	1.65	1.58	1.50	1.42	...	...	...	...	...	...
167	50,000 < N ≤ 75,000	1.78	1.74	1.68	1.61	1.54	1.47	1.40	1.32	...	...	...	...	...	...
168	N > 75,000	1.70	1.66	1.59	1.53	1.47	1.40	1.33	1.26	...	...	...	...	...	...
169	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
170	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
171	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
172	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
173	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
174	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
175	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
176	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
177	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
178	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
179	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
180	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
181	N ≤ 1,000	3.88	3.77	3.61	3.44	3.28	3.11	2.93	2.76	...	...	...	...	...	...
182	1,000 < N ≤ 10,000	2.57	2.50	2.40	2.30	2.19	2.08	1.97	1.86	...	...	...	...	...	...
183	10,000 < N ≤ 25,000	2.18	2.12	2.04	1.95	1.87	1.78	1.69	1.59	...	...	...	...	...	...
184	25,000 < N ≤ 50,000	1.92	1.87	1.80	1.73	1.65	1.58	1.50	1.42	...	...	...	...	...	...
185	50,000 < N ≤ 75,000	1.78	1.74	1.68	1.61	1.54	1.47	1.40	1.32	...	...	...	...	...	...
186	N > 75,000	1.70	1.66	1.59	1.53	1.47	1.40	1.33	1.26	...	...	...	...	...	...
187	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
188	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
189	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
190	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
191	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
192	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construc-tion Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor	Notes
193	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D01	M05, M09
194	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D01	M05, M09
195	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D01	M05, M09
196	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D01	M05, M09
197	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D01	M05, M09
198	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D01	M05, M09
199	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D01	M05, M10
200	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D01	M05, M10
201	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D01	M05, M10
202	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D01	M05, M10
203	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D01	M05, M10
204	Polyethylene	Extruded tube	SD-2737	PE3608	...	3.0	140	D01	M05, M10
205	Polyethylene	Extruded tube	SD-2737	PE4608	...	3.0	140	D01	M05, M10
206	Polyethylene	Extruded tube	SD-2737	PE4608	...	3.0	140	D01	M05, M10
207	Polyethylene	Extruded tube	SD-2737	PE4608	...	3.0	140	D01	M05, M10
208	Polyethylene	Extruded tube	SD-2737	PE4608	...	3.0	140	D01	M05, M10
209	Polyethylene	Extruded tube	SD-2737	PE4608	...	3.0	140	D01	M05, M10
210	Polyethylene	Extruded tube	SD-2737	PE4608	...	3.0	140	D01	M05, M10
211	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D01	M05, M11
212	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D01	M05, M11
213	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D01	M05, M11
214	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D01	M05, M11
215	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D01	M05, M11
216	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D01	M05, M11
217	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D01	M05, M12
218	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D01	M05, M12
219	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D01	M05, M12
220	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D01	M05, M12
221	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D01	M05, M12
222	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	140	D01	M05, M12
223	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	180	D01	M05, M13
224	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	180	D01	M05, M13
225	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	180	D01	M05, M13
226	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	180	D01	M05, M13
227	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	180	D01	M05, M13
228	Polyethylene	Extruded tube	SD-2737	PE4710	...	3.0	180	D01	M05, M13
229	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D01	M05, M09
230	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D01	M05, M09
231	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D01	M05, M09
232	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D01	M05, M09
233	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D01	M05, M09
234	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D01	M05, M09

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
193	$N \le 1{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
194	$1{,}000 < N \le 10{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
195	$10{,}000 < N \le 25{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
196	$25{,}000 < N \le 50{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
197	$50{,}000 < N \le 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
198	$N > 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
199	$N \le 1{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
200	$1{,}000 < N \le 10{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
201	$10{,}000 < N \le 25{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
202	$25{,}000 < N \le 50{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
203	$50{,}000 < N \le 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
204	$N > 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
205	$N \le 1{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
206	$1{,}000 < N \le 10{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
207	$10{,}000 < N \le 25{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
208	$25{,}000 < N \le 50{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
209	$50{,}000 < N \le 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
210	$N > 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
211	$N \le 1{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
212	$1{,}000 < N \le 10{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
213	$10{,}000 < N \le 25{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
214	$25{,}000 < N \le 50{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
215	$50{,}000 < N \le 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
216	$N > 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
217	$N \le 1{,}000$	3.88	3.77	3.61	3.44	3.28	3.11	2.93	2.76	...	...	...	...	...	...
218	$1{,}000 < N \le 10{,}000$	2.57	2.50	2.40	2.30	2.19	2.08	1.97	1.86	...	...	...	...	...	...
219	$10{,}000 < N \le 25{,}000$	2.18	2.12	2.04	1.95	1.87	1.78	1.69	1.59	...	...	...	...	...	...
220	$25{,}000 < N \le 50{,}000$	1.92	1.87	1.80	1.73	1.65	1.58	1.50	1.42	...	...	...	...	...	...
221	$50{,}000 < N \le 75{,}000$	1.78	1.74	1.68	1.61	1.54	1.47	1.40	1.32	...	...	...	...	...	...
222	$N > 75{,}000$	1.70	1.66	1.59	1.53	1.47	1.40	1.33	1.26	...	...	...	...	...	...
223	$N \le 1{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
224	$1{,}000 < N \le 10{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
225	$10{,}000 < N \le 25{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
226	$25{,}000 < N \le 50{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
227	$50{,}000 < N \le 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
228	$N > 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
229	$N \le 1{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
230	$1{,}000 < N \le 10{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
231	$10{,}000 < N \le 25{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
232	$25{,}000 < N \le 50{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
233	$50{,}000 < N \le 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
234	$N > 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construc-tion Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor	Notes
235	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D01	M05, M10
236	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D01	M05, M10
237	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D01	M05, M10
238	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D01	M05, M10
239	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D01	M05, M10
240	Polyethylene	Extruded pipe	SD-3035	PE3608	...	3.0	140	D01	M05, M10
241	Polyethylene	Extruded pipe	SD-3035	PE4608	...	3.0	140	D01	M05, M10
242	Polyethylene	Extruded pipe	SD-3035	PE4608	...	3.0	140	D01	M05, M10
243	Polyethylene	Extruded pipe	SD-3035	PE4608	...	3.0	140	D01	M05, M10
244	Polyethylene	Extruded pipe	SD-3035	PE4608	...	3.0	140	D01	M05, M10
245	Polyethylene	Extruded pipe	SD-3035	PE4608	...	3.0	140	D01	M05, M10
246	Polyethylene	Extruded pipe	SD-3035	PE4608	...	3.0	140	D01	M05, M10
247	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D01	M05, M11
248	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D01	M05, M11
249	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D01	M05, M11
250	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D01	M05, M11
251	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D01	M05, M11
252	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D01	M05, M11
253	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D01	M05, M12
254	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D01	M05, M12
255	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D01	M05, M12
256	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D01	M05, M12
257	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D01	M05, M12
258	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	140	D01	M05, M12
259	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	180	D01	M05, M13
260	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	180	D01	M05, M13
261	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	180	D01	M05, M13
262	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	180	D01	M05, M13
263	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	180	D01	M05, M13
264	Polyethylene	Extruded pipe	SD-3035	PE4710	...	3.0	180	D01	M05, M13
265	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D01	M08, M09
266	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D01	M08, M09
267	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D01	M08, M09
268	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D01	M08, M09
269	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D01	M08, M09
270	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D01	M08, M09
271	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D01	M08, M10
272	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D01	M08, M10
273	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D01	M08, M10
274	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D01	M08, M10
275	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D01	M08, M10

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
235	$N \le 1{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
236	$1{,}000 < N \le 10{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
237	$10{,}000 < N \le 25{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
238	$25{,}000 < N \le 50{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
239	$50{,}000 < N \le 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
240	$N > 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
241	$N \le 1{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
242	$1{,}000 < N \le 10{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
243	$10{,}000 < N \le 25{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
244	$25{,}000 < N \le 50{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
245	$50{,}000 < N \le 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
246	$N > 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
247	$N \le 1{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
248	$1{,}000 < N \le 10{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
249	$10{,}000 < N \le 25{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
250	$25{,}000 < N \le 50{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
251	$50{,}000 < N \le 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
252	$N > 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
253	$N \le 1{,}000$	3.88	3.77	3.61	3.44	3.28	3.11	2.93	2.76	...	...	...	...	...	...
254	$1{,}000 < N \le 10{,}000$	2.57	2.50	2.40	2.30	2.19	2.08	1.97	1.86	...	...	...	...	...	...
255	$10{,}000 < N \le 25{,}000$	2.18	2.12	2.04	1.95	1.87	1.78	1.69	1.59	...	...	...	...	...	...
256	$25{,}000 < N \le 50{,}000$	1.92	1.87	1.80	1.73	1.65	1.58	1.50	1.42	...	...	...	...	...	...
257	$50{,}000 < N \le 75{,}000$	1.78	1.74	1.68	1.61	1.54	1.47	1.40	1.32	...	...	...	...	...	...
258	$N > 75{,}000$	1.70	1.66	1.59	1.53	1.47	1.40	1.33	1.26	...	...	...	...	...	...
259	$N \le 1{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
260	$1{,}000 < N \le 10{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
261	$10{,}000 < N \le 25{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
262	$25{,}000 < N \le 50{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
263	$50{,}000 < N \le 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
264	$N > 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
265	$N \le 1{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
266	$1{,}000 < N \le 10{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
267	$10{,}000 < N \le 25{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
268	$25{,}000 < N \le 50{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
269	$50{,}000 < N \le 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
270	$N > 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
271	$N \le 1{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
272	$1{,}000 < N \le 10{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
273	$10{,}000 < N \le 25{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
274	$25{,}000 < N \le 50{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...
275	$50{,}000 < N \le 75{,}000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construc-tion Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor	Notes
276	Polyethylene	Extruded pipe	SF-714	PE3608	...	3.0	140	D01	M08, M10
277	Polyethylene	Extruded pipe	SF-714	PE4608	...	3.0	140	D01	M08, M10
278	Polyethylene	Extruded pipe	SF-714	PE4608	...	3.0	140	D01	M08, M10
279	Polyethylene	Extruded pipe	SF-714	PE4608	...	3.0	140	D01	M08, M10
280	Polyethylene	Extruded pipe	SF-714	PE4608	...	3.0	140	D01	M08, M10
281	Polyethylene	Extruded pipe	SF-714	PE4608	...	3.0	140	D01	M08, M10
282	Polyethylene	Extruded pipe	SF-714	PE4608	...	3.0	140	D01	M08, M10
283	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D01	M08, M11
284	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D01	M08, M11
285	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D01	M08, M11
286	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D01	M08, M11
287	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D01	M08, M11
288	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D01	M08, M11
289	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D01	M08, M12
290	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D01	M08, M12
291	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D01	M08, M12
292	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D01	M08, M12
293	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D01	M08, M12
294	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	140	D01	M08, M12
295	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	180	D01	M08, M13
296	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	180	D01	M08, M13
297	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	180	D01	M08, M13
298	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	180	D01	M08, M13
299	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	180	D01	M08, M13
300	Polyethylene	Extruded pipe	SF-714	PE4710	...	3.0	180	D01	M08, M13
301	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D01	M09, M14
302	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D01	M09, M14
303	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D01	M09, M14
304	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D01	M09, M14
305	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D01	M09, M14
306	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D01	M09, M14
307	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D01	M10, M14
308	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D01	M10, M14
309	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D01	M10, M14
310	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D01	M10, M14
311	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D01	M10, M14
312	Polyethylene	Extruded pipe	SF-2619	PE3608	...	3.0	140	D01	M10, M14
313	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D01	M11, M14
314	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D01	M11, M14
315	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D01	M11, M14
316	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D01	M11, M14

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
276	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
277	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
278	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
279	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
280	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
281	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
282	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
283	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
284	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
285	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
286	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
287	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
288	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
289	N ≤ 1,000	3.88	3.77	3.61	3.44	3.28	3.11	2.93	2.76	...	...	...	...	...	...
290	1,000 < N ≤ 10,000	2.57	2.50	2.40	2.30	2.19	2.08	1.97	1.86	...	...	...	...	...	...
291	10,000 < N ≤ 25,000	2.18	2.12	2.04	1.95	1.87	1.78	1.69	1.59	...	...	...	...	...	...
292	25,000 < N ≤ 50,000	1.92	1.87	1.80	1.73	1.65	1.58	1.50	1.42	...	...	...	...	...	...
293	50,000 < N ≤ 75,000	1.78	1.74	1.68	1.61	1.54	1.47	1.40	1.32	...	...	...	...	...	...
294	N > 75,000	1.70	1.66	1.59	1.53	1.47	1.40	1.33	1.26	...	...	...	...	...	...
295	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
296	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
297	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
298	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
299	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
300	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
301	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
302	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
303	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
304	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
305	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
306	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
307	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
308	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
309	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
310	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
311	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
312	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
313	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
314	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
315	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
316	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construc-tion Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor	Notes
317	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D01	M11, M14
318	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D01	M11, M14
319	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D01	M12, M14
320	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D01	M12, M14
321	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D01	M12, M14
322	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D01	M12, M14
323	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D01	M12, M14
324	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	140	D01	M12, M14
325	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	180	D01	M13, M14
326	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	180	D01	M13, M14
327	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	180	D01	M13, M14
328	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	180	D01	M13, M14
329	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	180	D01	M13, M14
330	Polyethylene	Extruded pipe	SF-2619	PE4710	...	3.0	180	D01	M13, M14
331	PVC	Extruded pipe	SD-1785	PVC2110	C01	6.0	140	D01	M15
332	PVC	Extruded pipe	SD-1785	PVC2110	C01	6.0	140	D01	M15
333	PVC	Extruded pipe	SD-1785	PVC2110	C01	6.0	140	D01	M15
334	PVC	Extruded pipe	SD-1785	PVC2110	C01	6.0	140	D01	M15
335	PVC	Extruded pipe	SD-1785	PVC2110	C01	6.0	140	D01	M15
336	PVC	Extruded pipe	SD-1785	PVC2110	C01	6.0	140	D01	M15
337	PVC	Extruded pipe	SD-1785	PVC2112	C01	6.0	140	D01	M16
338	PVC	Extruded pipe	SD-1785	PVC2112	C01	6.0	140	D01	M16
339	PVC	Extruded pipe	SD-1785	PVC2112	C01	6.0	140	D01	M16
340	PVC	Extruded pipe	SD-1785	PVC2112	C01	6.0	140	D01	M16
341	PVC	Extruded pipe	SD-1785	PVC2112	C01	6.0	140	D01	M16
342	PVC	Extruded pipe	SD-1785	PVC2112	C01	6.0	140	D01	M16
343	PVC	Extruded pipe	SD-1785	PVC2116	C01	6.0	140	D01	M17
344	PVC	Extruded pipe	SD-1785	PVC2116	C01	6.0	140	D01	M17
345	PVC	Extruded pipe	SD-1785	PVC2116	C01	6.0	140	D01	M17
346	PVC	Extruded pipe	SD-1785	PVC2116	C01	6.0	140	D01	M17
347	PVC	Extruded pipe	SD-1785	PVC2116	C01	6.0	140	D01	M17
348	PVC	Extruded pipe	SD-1785	PVC2116	C01	6.0	140	D01	M17
349	PVC	Extruded pipe	SD-1785	PVC2120	C01	6.0	140	D01	M18
350	PVC	Extruded pipe	SD-1785	PVC2120	C01	6.0	140	D01	M18
351	PVC	Extruded pipe	SD-1785	PVC2120	C01	6.0	140	D01	M18
352	PVC	Extruded pipe	SD-1785	PVC2120	C01	6.0	140	D01	M18
353	PVC	Extruded pipe	SD-1785	PVC2120	C01	6.0	140	D01	M18
354	PVC	Extruded pipe	SD-1785	PVC2120	C01	6.0	140	D01	M18
355	PVC	Extruded tube	SD-2241	PVC2110	C01	6.0	140	D01	M15
356	PVC	Extruded tube	SD-2241	PVC2110	C01	6.0	140	D01	M15
357	PVC	Extruded tube	SD-2241	PVC2110	C01	6.0	140	D01	M15

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
317	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
318	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
319	N ≤ 1,000	3.88	3.77	3.61	3.44	3.28	3.11	2.93	2.76	...	...	...	...	...	...
320	1,000 < N ≤ 10,000	2.57	2.50	2.40	2.30	2.19	2.08	1.97	1.86	...	...	...	...	...	...
321	10,000 < N ≤ 25,000	2.18	2.12	2.04	1.95	1.87	1.78	1.69	1.59	...	...	...	...	...	...
322	25,000 < N ≤ 50,000	1.92	1.87	1.80	1.73	1.65	1.58	1.50	1.42	...	...	...	...	...	...
323	50,000 < N ≤ 75,000	1.78	1.74	1.68	1.61	1.54	1.47	1.40	1.32	...	...	...	...	...	...
324	N > 75,000	1.70	1.66	1.59	1.53	1.47	1.40	1.33	1.26	...	...	...	...	...	...
325	N ≤ 1,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
326	1,000 < N ≤ 10,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
327	10,000 < N ≤ 25,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
328	25,000 < N ≤ 50,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
329	50,000 < N ≤ 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
330	N > 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...
331	N ≤ 1,000	3.10	2.94	2.69	2.45	2.20	1.95	1.70	1.46	...	...	...	...	...	...
332	1,000 < N ≤ 10,000	1.85	1.76	1.61	1.46	1.31	1.17	1.02	0.870	...	...	...	...	...	...
333	10,000 < N ≤ 25,000	1.52	1.44	1.32	1.20	1.08	0.955	0.834	0.712	...	...	...	...	...	...
334	25,000 < N ≤ 50,000	1.30	1.24	1.13	1.03	0.924	0.820	0.716	0.612	...	...	...	...	...	...
335	50,000 < N ≤ 75,000	1.19	1.13	1.03	0.940	0.844	0.749	0.654	0.559	...	...	...	...	...	...
336	75,000 < N ≤ 100,000	1.11	1.06	0.970	0.881	0.791	0.702	0.613	0.524	...	...	...	...	...	...
337	N ≤ 1,000	3.10	2.94	2.69	2.45	2.20	1.95	1.70	1.46	...	...	...	...	...	...
338	1,000 < N ≤ 10,000	1.85	1.76	1.61	1.46	1.31	1.17	1.02	0.870	...	...	...	...	...	...
339	10,000 < N ≤ 25,000	1.52	1.44	1.32	1.20	1.08	0.955	0.834	0.712	...	...	...	...	...	...
340	25,000 < N ≤ 50,000	1.30	1.24	1.13	1.03	0.924	0.820	0.716	0.612	...	...	...	...	...	...
341	50,000 < N ≤ 75,000	1.19	1.13	1.03	0.940	0.844	0.749	0.654	0.559	...	...	...	...	...	...
342	75,000 < N ≤ 100,000	1.11	1.06	0.970	0.881	0.791	0.702	0.613	0.524	...	...	...	...	...	...
343	N ≤ 1,000	3.10	2.94	2.69	2.45	2.20	1.95	1.70	1.46	...	...	...	...	...	...
344	1,000 < N ≤ 10,000	1.85	1.76	1.61	1.46	1.31	1.17	1.02	0.870	...	...	...	...	...	...
345	10,000 < N ≤ 25,000	1.52	1.44	1.32	1.20	1.08	0.955	0.834	0.712	...	...	...	...	...	...
346	25,000 < N ≤ 50,000	1.30	1.24	1.13	1.03	0.924	0.820	0.716	0.612	...	...	...	...	...	...
347	50,000 < N ≤ 75,000	1.19	1.13	1.03	0.940	0.844	0.749	0.654	0.559	...	...	...	...	...	...
348	75,000 < N ≤ 100,000	1.11	1.06	0.970	0.881	0.791	0.702	0.613	0.524	...	...	...	...	...	...
349	N ≤ 1,000	3.10	2.94	2.69	2.45	2.20	1.95	1.70	1.46	...	...	...	...	...	...
350	1,000 < N ≤ 10,000	1.85	1.76	1.61	1.46	1.31	1.17	1.02	0.870	...	...	...	...	...	...
351	10,000 < N ≤ 25,000	1.52	1.44	1.32	1.20	1.08	0.955	0.834	0.712	...	...	...	...	...	...
352	25,000 < N ≤ 50,000	1.30	1.24	1.13	1.03	0.924	0.820	0.716	0.612	...	...	...	...	...	...
353	50,000 < N ≤ 75,000	1.19	1.13	1.03	0.940	0.844	0.749	0.654	0.559	...	...	...	...	...	...
354	75,000 < N ≤ 100,000	1.11	1.06	0.970	0.881	0.791	0.702	0.613	0.524	...	...	...	...	...	...
355	N ≤ 1,000	3.10	2.94	2.69	2.45	2.20	1.95	1.70	1.46	...	...	...	...	...	...
356	1,000 < N ≤ 10,000	1.85	1.76	1.61	1.46	1.31	1.17	1.02	0.870	...	...	...	...	...	...
357	10,000 < N ≤ 25,000	1.52	1.44	1.32	1.20	1.08	0.955	0.834	0.712	...	...	...	...	...	...

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construc-tion Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor	Notes
358	PVC	Extruded tube	SD-2241	PVC2110	C01	6.0	140	D01	M15
359	PVC	Extruded tube	SD-2241	PVC2110	C01	6.0	140	D01	M15
360	PVC	Extruded tube	SD-2241	PVC2110	C01	6.0	140	D01	M15
361	PVC	Extruded tube	SD-2241	PVC2112	C01	6.0	140	D01	M16
362	PVC	Extruded tube	SD-2241	PVC2112	C01	6.0	140	D01	M16
363	PVC	Extruded tube	SD-2241	PVC2112	C01	6.0	140	D01	M16
364	PVC	Extruded tube	SD-2241	PVC2112	C01	6.0	140	D01	M16
365	PVC	Extruded tube	SD-2241	PVC2112	C01	6.0	140	D01	M16
366	PVC	Extruded tube	SD-2241	PVC2112	C01	6.0	140	D01	M16
367	PVC	Extruded tube	SD-2241	PVC2116	C01	6.0	140	D01	M17
368	PVC	Extruded tube	SD-2241	PVC2116	C01	6.0	140	D01	M17
369	PVC	Extruded tube	SD-2241	PVC2116	C01	6.0	140	D01	M17
370	PVC	Extruded tube	SD-2241	PVC2116	C01	6.0	140	D01	M17
371	PVC	Extruded tube	SD-2241	PVC2116	C01	6.0	140	D01	M17
372	PVC	Extruded tube	SD-2241	PVC2116	C01	6.0	140	D01	M17
373	PVC	Extruded tube	SD-2241	PVC2120	C01	6.0	140	D01	M18
374	PVC	Extruded tube	SD-2241	PVC2120	C01	6.0	140	D01	M18
375	PVC	Extruded tube	SD-2241	PVC2120	C01	6.0	140	D01	M18
376	PVC	Extruded tube	SD-2241	PVC2120	C01	6.0	140	D01	M18
377	PVC	Extruded tube	SD-2241	PVC2120	C01	6.0	140	D01	M18
378	PVC	Extruded tube	SD-2241	PVC2120	C01	6.0	140	D01	M18
379	PVC	Extruded pipe	SD-1785	PVC1120	C01	7.0	140	D01	M19
380	PVC	Extruded pipe	SD-1785	PVC1120	C01	7.0	140	D01	M19
381	PVC	Extruded pipe	SD-1785	PVC1120	C01	7.0	140	D01	M19
382	PVC	Extruded pipe	SD-1785	PVC1120	C01	7.0	140	D01	M19
383	PVC	Extruded pipe	SD-1785	PVC1120	C01	7.0	140	D01	M19
384	PVC	Extruded pipe	SD-1785	PVC1120	C01	7.0	140	D01	M19
385	PVC	Extruded pipe	SD-1785	PVC1220	C01	7.0	140	D01	M19
386	PVC	Extruded pipe	SD-1785	PVC1220	C01	7.0	140	D01	M19
387	PVC	Extruded pipe	SD-1785	PVC1220	C01	7.0	140	D01	M19
388	PVC	Extruded pipe	SD-1785	PVC1220	C01	7.0	140	D01	M19
389	PVC	Extruded pipe	SD-1785	PVC1220	C01	7.0	140	D01	M19
390	PVC	Extruded pipe	SD-1785	PVC1220	C01	7.0	140	D01	M19
391	PVC	Extruded pipe	SD-2241	PVC1120	C01	7.0	140	D01	M19
392	PVC	Extruded pipe	SD-2241	PVC1120	C01	7.0	140	D01	M19
393	PVC	Extruded pipe	SD-2241	PVC1120	C01	7.0	140	D01	M19
394	PVC	Extruded pipe	SD-2241	PVC1120	C01	7.0	140	D01	M19
395	PVC	Extruded pipe	SD-2241	PVC1120	C01	7.0	140	D01	M19
396	PVC	Extruded pipe	SD-2241	PVC1120	C01	7.0	140	D01	M19
397	PVC	Extruded pipe	SD-2241	PVC1220	C01	7.0	140	D01	M19
398	PVC	Extruded pipe	SD-2241	PVC1220	C01	7.0	140	D01	M19
399	PVC	Extruded pipe	SD-2241	PVC1220	C01	7.0	140	D01	M19

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
358	25,000 < N ≤ 50,000	1.30	1.24	1.13	1.03	0.924	0.820	0.716	0.612	...	...	...	...	...	...
359	50,000 < N ≤ 75,000	1.19	1.13	1.03	0.940	0.844	0.749	0.654	0.559	...	...	...	...	...	...
360	75,000 < N ≤ 100,000	1.11	1.06	0.970	0.881	0.791	0.702	0.613	0.524	...	...	...	...	...	...
361	N ≤ 1,000	3.10	2.94	2.69	2.45	2.20	1.95	1.70	1.46	...	...	...	...	...	...
362	1,000 < N ≤ 10,000	1.85	1.76	1.61	1.46	1.31	1.17	1.02	0.870	...	...	...	...	...	...
363	10,000 < N ≤ 25,000	1.52	1.44	1.32	1.20	1.08	0.955	0.834	0.712	...	...	...	...	...	...
364	25,000 < N ≤ 50,000	1.30	1.24	1.13	1.03	0.924	0.820	0.716	0.612	...	...	...	...	...	...
365	50,000 < N ≤ 75,000	1.19	1.13	1.03	0.940	0.844	0.749	0.654	0.559	...	...	...	...	...	...
366	75,000 < N ≤ 100,000	1.11	1.06	0.970	0.881	0.791	0.702	0.613	0.524	...	...	...	...	...	...
367	N ≤ 1,000	3.10	2.94	2.69	2.45	2.20	1.95	1.70	1.46	...	...	...	...	...	...
368	1,000 < N ≤ 10,000	1.85	1.76	1.61	1.46	1.31	1.17	1.02	0.870	...	...	...	...	...	...
369	10,000 < N ≤ 25,000	1.52	1.44	1.32	1.20	1.08	0.955	0.834	0.712	...	...	...	...	...	...
370	25,000 < N ≤ 50,000	1.30	1.24	1.13	1.03	0.924	0.820	0.716	0.612	...	...	...	...	...	...
371	50,000 < N ≤ 75,000	1.19	1.13	1.03	0.940	0.844	0.749	0.654	0.559	...	...	...	...	...	...
372	75,000 < N ≤ 100,000	1.11	1.06	0.970	0.881	0.791	0.702	0.613	0.524	...	...	...	...	...	...
373	N ≤ 1,000	3.10	2.94	2.69	2.45	2.20	1.95	1.70	1.46	...	...	...	...	...	...
374	1,000 < N ≤ 10,000	1.85	1.76	1.61	1.46	1.31	1.17	1.02	0.870	...	...	...	...	...	...
375	10,000 < N ≤ 25,000	1.52	1.44	1.32	1.20	1.08	0.955	0.834	0.712	...	...	...	...	...	...
376	25,000 < N ≤ 50,000	1.30	1.24	1.13	1.03	0.924	0.820	0.716	0.612	...	...	...	...	...	...
377	50,000 < N ≤ 75,000	1.19	1.13	1.03	0.940	0.844	0.749	0.654	0.559	...	...	...	...	...	...
378	75,000 < N ≤ 100,000	1.11	1.06	0.970	0.881	0.791	0.702	0.613	0.524	...	...	...	...	...	...
379	N ≤ 1,000	3.10	2.94	2.69	2.45	2.20	1.95	1.70	1.46	...	...	...	...	...	...
380	1,000 < N ≤ 10,000	1.85	1.76	1.61	1.46	1.31	1.17	1.02	0.870	...	...	...	...	...	...
381	10,000 < N ≤ 25,000	1.52	1.44	1.32	1.20	1.08	0.955	0.834	0.712	...	...	...	...	...	...
382	25,000 < N ≤ 50,000	1.30	1.24	1.13	1.03	0.924	0.820	0.716	0.612	...	...	...	...	...	...
383	50,000 < N ≤ 75,000	1.19	1.13	1.03	0.940	0.844	0.749	0.654	0.559	...	...	...	...	...	...
384	75,000 < N ≤ 100,000	1.11	1.06	0.970	0.881	0.791	0.702	0.613	0.524	...	...	...	...	...	...
385	N ≤ 1,000	3.10	2.94	2.69	2.45	2.20	1.95	1.70	1.46	...	...	...	...	...	...
386	1,000 < N ≤ 10,000	1.85	1.76	1.61	1.46	1.31	1.17	1.02	0.870	...	...	...	...	...	...
387	10,000 < N ≤ 25,000	1.52	1.44	1.32	1.20	1.08	0.955	0.834	0.712	...	...	...	...	...	...
388	25,000 < N ≤ 50,000	1.30	1.24	1.13	1.03	0.924	0.820	0.716	0.612	...	...	...	...	...	...
389	50,000 < N ≤ 75,000	1.19	1.13	1.03	0.940	0.844	0.749	0.654	0.559	...	...	...	...	...	...
390	75,000 < N ≤ 100,000	1.11	1.06	0.970	0.881	0.791	0.702	0.613	0.524	...	...	...	...	...	...
391	N ≤ 1,000	3.10	2.94	2.69	2.45	2.20	1.95	1.70	1.46	...	...	...	...	...	...
392	1,000 < N ≤ 10,000	1.85	1.76	1.61	1.46	1.31	1.17	1.02	0.870	...	...	...	...	...	...
393	10,000 < N ≤ 25,000	1.52	1.44	1.32	1.20	1.08	0.955	0.834	0.712	...	...	...	...	...	...
394	25,000 < N ≤ 50,000	1.30	1.24	1.13	1.03	0.924	0.820	0.716	0.612	...	...	...	...	...	...
395	50,000 < N ≤ 75,000	1.19	1.13	1.03	0.940	0.844	0.749	0.654	0.559	...	...	...	...	...	...
396	75,000 < N ≤ 100,000	1.11	1.06	0.970	0.881	0.791	0.702	0.613	0.524	...	...	...	...	...	...
397	N ≤ 1,000	3.10	2.94	2.69	2.45	2.20	1.95	1.70	1.46	...	...	...	...	...	...
398	1,000 < N ≤ 10,000	1.85	1.76	1.61	1.46	1.31	1.17	1.02	0.870	...	...	...	...	...	...
399	10,000 < N ≤ 25,000	1.52	1.44	1.32	1.20	1.08	0.955	0.834	0.712	...	...	...	...	...	...

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construc-tion Code Notes	Minimum Yield Strength, ksi	Maximum Temperature Limit, °F	Design Factor	Notes
400	PVC	Extruded pipe	SD-2241	PVC1220	C01	7.0	140	D01	M19
401	PVC	Extruded pipe	SD-2241	PVC1220	C01	7.0	140	D01	M19
402	PVC	Extruded pipe	SD-2241	PVC1220	C01	7.0	140	D01	M19
403	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	7.0	130	D01	M20, M21
404	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	7.0	130	D01	M20, M21
405	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	7.0	130	D01	M20, M21
406	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	7.0	130	D01	M20, M21
407	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	7.0	130	D01	M20, M21
408	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	7.0	130	D01	M20, M21
409	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	6.5	200	D01	M22
410	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	6.5	200	D01	M22
411	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	6.5	200	D01	M22
412	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	6.5	200	D01	M22
413	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	6.5	200	D01	M22
414	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	6.5	200	D01	M22
415	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	7.7	200	D01	M23
416	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	7.7	200	D01	M23
417	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	7.7	200	D01	M23
418	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	7.7	200	D01	M23
419	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	7.7	200	D01	M23
420	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	7.7	200	D01	M23

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
		73	80	90	100	110	120	130	140	150	160	170	180	190	200
400	25,000 < N ≤ 50,000	1.30	1.24	1.13	1.03	0.924	0.820	0.716	0.612	...	...	...	...	...	...
401	50,000 < N ≤ 75,000	1.19	1.13	1.03	0.940	0.844	0.749	0.654	0.559	...	...	...	...	...	...
402	75,000 < N ≤ 100,000	1.11	1.06	0.970	0.881	0.791	0.702	0.613	0.524	...	...	...	...	...	...
403	N ≤ 1,000	3.10	2.94	2.69	2.45	2.20	1.95	1.70	...	...	...	...	...	...	...
404	1,000 < N ≤ 10,000	1.85	1.76	1.61	1.46	1.31	1.17	1.02	...	...	...	...	...	...	...
405	10,000 < N ≤ 25,000	1.52	1.44	1.32	1.20	1.08	0.955	0.834	...	...	...	...	...	...	...
406	25,000 < N ≤ 50,000	1.30	1.24	1.13	1.03	0.924	0.820	0.716	...	...	...	...	...	...	...
407	50,000 < N ≤ 75,000	1.19	1.13	1.03	0.940	0.844	0.749	0.654	...	...	...	...	...	...	...
408	75,000 < N ≤ 100,000	1.11	1.06	0.970	0.881	0.791	0.702	0.613	...	...	...	...	...	...	...
409	N ≤ 1,000	6.63	6.43	6.14	5.86	5.58	5.29	5.01	4.72	4.45	4.18	3.91	3.65	3.38	3.11
410	1,000 < N ≤ 10,000	6.32	6.14	5.88	5.62	5.36	5.10	4.84	4.58	4.32	4.05	3.79	3.53	3.26	3.00
411	10,000 < N ≤ 25,000	6.20	6.03	5.78	5.53	5.28	5.03	4.78	4.52	4.26	4.00	3.74	3.48	3.22	2.95
412	25,000 < N ≤ 50,000	6.11	5.94	5.70	5.45	5.21	4.97	4.73	4.48	4.22	3.96	3.70	3.44	3.18	2.92
413	50,000 < N ≤ 75,000	6.05	5.89	5.65	5.41	5.17	4.93	4.70	4.46	4.20	3.94	3.68	3.42	3.16	2.90
414	75,000 < N ≤ 100,000	6.02	5.85	5.62	5.38	5.15	4.91	4.68	4.44	4.18	3.92	3.66	3.40	3.15	2.89
415	N ≤ 1,000	7.84	7.60	7.27	6.93	6.59	6.25	5.92	5.58	5.26	4.95	4.63	4.31	3.99	3.68
416	1,000 < N ≤ 10,000	7.48	7.26	6.95	6.65	6.34	6.03	5.72	5.42	5.10	4.79	4.48	4.17	3.86	3.54
417	10,000 < N ≤ 25,000	7.33	7.12	6.83	6.53	6.24	5.94	5.65	5.35	5.04	4.73	4.42	4.11	3.80	3.49
418	25,000 < N ≤ 50,000	7.22	7.02	6.73	6.45	6.16	5.87	5.59	5.30	4.99	4.68	4.38	4.07	3.76	3.45
419	50,000 < N ≤ 75,000	7.16	6.96	6.68	6.40	6.12	5.83	5.55	5.27	4.96	4.66	4.35	4.04	3.74	3.43
420	75,000 < N ≤ 100,000	7.11	6.92	6.64	6.36	6.08	5.81	5.53	5.25	4.94	4.64	4.33	4.03	3.72	3.41

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

GENERAL NOTES:

(a) The stress values in this Table may be interpolated to determine values for intermediate temperatures. The values at intermediate temperatures shall be rounded to the same number of decimal places as the value at the higher temperature between which values are being interpolated. The rounding rule is: when the next digit beyond the last place to be retained is less than 5, retain unchanged the digit in the last place retained; when the next digit beyond the last place to be retained is 5 or greater, increase by 1 the digit in the last place retained.

(b) The following abbreviations are used: CPVC, chlorinated poly(vinyl chloride); PEX, cross-linked polyethylene; PVC, poly(vinyl chloride); and PVDF, poly(vinylidene fluoride).

NOTE: (1) Multiply ksi by 1,000 to obtain psi.

CONSTRUCTION CODE NOTES (ASME NM.1):

C01 Compounding ingredients may vary between material manufacturers for the same grade of CPVC or PVC. While these different ingredients do not impact the allowable stress values provided in this Table, they can influence the acceptability of the various joining methods allowed by ASME NM.1. In addition to the material and joining requirements set forth in ASME NM.1, the joining method to be used shall be approved by the piping component manufacturer.

C02 Cross-linking method may vary between material manufacturers for the same grade of PEX. While these different methods do not impact the allowable stress values provided in this Table, they can influence the acceptability of the various joining methods allowed by ASME NM.1. In addition to the material and joining requirements set forth in ASME NM.1, the joining method to be used shall be approved by the piping component manufacturer.

DESIGN FACTOR NOTE (ASME NM.1):

D01 Allowable stress range values are based on a design factor (DF) of 0.50.

MATERIAL NOTES:

M01 Material shall have a

(a) minimum impact resistance of 1.5 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 360,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 212°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 73°F and 1,000 psi at 180°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 73°F and 500 psi at 180°F in accordance with ASTM D2837

M02 Material shall have a

(a) minimum impact resistance of 1.5 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 360,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 212°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 73°F and 1,250 psi at 180°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 73°F and 625 psi at 180°F in accordance with ASTM D2837

M03 Material shall have a

(a) classification of Group 3, Class 2, and Grade 3 in accordance with ASTM D4066.
(b) minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ±10% at 23°C ± 2°C and 50% ± 5% relative humidity.
(c) minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ± 50% at 23°C ± 2°C and 50% ± 5% relative humidity.
(d) minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.
(e) minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.
(f) hydrostatic design basis (HDB) of 2,500 psi at 73°F, 1,600 psi at 140°F, and 1,250 psi at 180°F in accordance with ASTM D2837.
(g) hydrostatic design stress (HDS) of 1,250 psi at 73°F, 800 psi at 140°F, and 625 psi at 180°F in accordance with ASTM D2837.

M04 Material shall have a

(a) classification of Group 3, Class 2, and Grade 3 in accordance with ASTM D4066.
(b) minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ±10% at 23°C ± 2°C and 50% ± 5% relative humidity.
(c) minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ± 50% at 23°C ± 2°C and 50% ± 5% relative humidity.
(d) minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.
(e) minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.
(f) hydrostatic design basis (HDB) of 3,150 psi at 73°F and 1,600 psi at 180°F in accordance with ASTM D2837.
(g) hydrostatic design stress (HDS) of 1,600 psi at 73°F and 800 psi at 180°F in accordance with ASTM D2837.

M05 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, natural with UV stabilizer, or colored with UV stabilizer.

M06 Material shall have a

(a) thermal stability of over 428°F in accordance with ASTM D3350

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

(b) maximum brittleness temperature of –76°F in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F
(d) slow crack growth resistance of over 500 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,250 psi at 73°F and 1,000 psi at 140°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M07 Material shall have a
(a) thermal stability of over 428°F in accordance with ASTM D3350
(b) maximum brittleness temperature of –76°F in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F
(d) slow crack growth resistance of over 500 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,250 psi at 73°F and 630 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M08 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, or colored with UV stabilizer.

M09 Material shall have a
(a) thermal stability of over 428°F in accordance with ASTM D3350
(b) maximum brittleness temperature of –76°F in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F
(d) slow crack growth resistance of over 100 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 800 psi at 140°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M10 Material shall have a
(a) thermal stability of over 428°F in accordance with ASTM D3350
(b) maximum brittleness temperature of –76°F in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F
(d) slow crack growth resistance of over 100 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 1,000 psi at 140°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M11 Material shall have a
(a) thermal stability of over 428°F in accordance with ASTM D3350
(b) maximum brittleness temperature of –76°F in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F
(d) slow crack growth resistance of over 500 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 800 psi at 140°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 1,000 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M12 Material shall have a
(a) thermal stability of over 428°F in accordance with ASTM D3350
(b) maximum brittleness temperature of –76°F in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F
(d) slow crack growth resistance of over 500 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 1,000 psi at 140°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 1,000 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M13 Material shall have a
(a) thermal stability of over 428°F in accordance with ASTM D3350
(b) maximum brittleness temperature of –76°F in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 2 in./min at 73°F
(d) slow crack growth resistance of over 500 hr in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 800 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 1,000 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M14 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603.

M15 Material shall have a
(a) minimum impact resistance of 5.0 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 320,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 140°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 2,000 psi at 73°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,000 psi at 73°F in accordance with ASTM D2837

M16 Material shall have a
(a) minimum impact resistance of 5.0 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 320,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 140°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 2,500 psi at 73°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,250 psi at 73°F in accordance with ASTM D2837

M17 Material shall have a
(a) minimum impact resistance of 5.0 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 320,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 140°F at a load of 264 psi in accordance with ASTM D648

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 3,200 psi at 73°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,600 psi at 73°F in accordance with ASTM D2837

M18 Material shall have a
(a) minimum impact resistance of 5.0 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 320,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 140°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 73°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 73°F in accordance with ASTM D2837

M19 Material shall have a
(a) minimum impact resistance of 0.65 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 400,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 158°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 73°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 73°F in accordance with ASTM D2837

M20 Material shall have a
(a) minimum impact resistance of 5.0 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 320,000 psi at 73°F in accordance with ASTM D638
(c) minimum deflection temperature under load of 140°F at a load of 264 psi in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 sec in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 7,100 psi at 73°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 3,550 psi at 73°F in accordance with ASTM D2837

M21 Allowable stress values apply to both the oriented and unoriented directions.

M22 Material shall have a
(a) classification of Type I in accordance with ASME SD-3222
(b) minimum impact resistance of 1.5 ft-lb/in. of notch at 73°F in accordance with ASTM D256
(c) minimum flexural modulus of 190,000 psi at 73°F in accordance with ASTM D790, using Method I
(d) minimum tensile elongation at break of 10% in accordance with ASTM D638, using a Type I tensile bar at 2 in./min at 73°F
(e) hydrostatic design basis (HDB) of 4,000 psi at 73°F and 1,250 psi at 200°F in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 73°F and 625 psi at 200°F in accordance with ASTM D2837

M23 Material shall have a
(a) classification of Type II in accordance with ASME SD-3222
(b) minimum flexural modulus of 190,000 psi at 73°F in accordance with ASTM D790, using Method I
(c) minimum tensile elongation at break of 10% in accordance with ASTM D638, using a Type I tensile bar at 2 in./min at 73°F
(d) hydrostatic design basis (HDB) of 5,000 psi at 73°F and 1,250 psi at 248°F in accordance with ASTM D2837
(e) hydrostatic design stress (HDS) of 2,500 psi at 73°F and 625 psi at 248°F in accordance with ASTM D2837

M24 The first two digits (XX) of the PEX Type/Grade designation may be any designation permitted by ASTM F2788. They relate to end-use properties such as oxidation and UV resistance and do not affect strength.

M25 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, natural with UV stabilizer, or colored with UV stabilizer. The degree of cross-linking for PEX pipe material shall be within the range from 65% to 89%, inclusive.
(a) PEX cross-linked using peroxides shall have a minimum degree of cross-linking of 70%.
(b) PEX cross-linked using silane compounds shall have a minimum degree of cross-linking of 65%.
(c) PEX cross-linked using electron beam compounds shall have a minimum degree of cross-linking of 65%.

M26 Material shall have a
(a) minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
(b) hydrostatic design basis (HDB) of 1,250 psi at 73°F and 630 psi at 200°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
(c) hydrostatic design stress (HDS) of 625 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M27 Material shall have a
(a) minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
(b) hydrostatic design basis (HDB) of 1,250 psi at 73°F and 800 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
(c) hydrostatic design stress (HDS) of 625 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M28 Material shall have a
(a) minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
(b) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 630 psi at 200°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
(c) hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M29 Material shall have a
(a) minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
(b) hydrostatic design basis (HDB) of 1,600 psi at 73°F and 800 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
(c) hydrostatic design stress (HDS) of 800 psi at 73°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M30 Material shall have a
(a) classification of Group 4, Class 2, and Grade 3 in accordance with ASTM D6779.
(b) minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ± 10% at 23°C and 50% ± 5% relative humidity.
(c) minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ± 50% at 23°C ± 2°C and 50% ± 5% relative humidity.

Table 1-1-3 Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

(d) minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.

(e) minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.

(f) hydrostatic design basis (HDB) of 3,150 psi at 73°F and 1,600 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(g) hydrostatic design stress (HDS) of 1,600 psi at 73°F and 800 psi at 180°F in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(20)

Table 1-1-Y Yield Strength Values, S_y, for Thermoplastic Materials

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Minimum Yield Strength, ksi	Notes
1	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	7.0	M01
2	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	7.0	M01
3	CPVC	Extruded pipe	SF-441	CPVC 4120-05	7.0	M01
4	CPVC	Extruded pipe	SF-441	CPVC 4120-06	7.0	M01
5	CPVC	Extruded pipe	SF-442	CPVC 4120-05	7.0	M01
6	CPVC	Extruded pipe	SF-442	CPVC 4120-06	7.0	M01
7	PEX	Extruded pipe	F2788/F2788M	PEX XX06	3.0	M07, M08
8	PEX	Extruded pipe	F2788/F2788M	PEX XX08	3.0	M07, M08
9	Polyamide	Extruded pipe	SF-2945	PA 32312	7.0	M02
10	Polyamide	Extruded pipe	SF-2945	PA 32316	7.0	M02
11	Polyamide-12	Extruded pipe	SF-2785	PA 42316	5.8	M09
12	Polyethylene	Extruded pipe	SD-2239	PE2708	2.6	M03
13	Polyethylene	Extruded pipe	SD-2513	PE2708	2.6	M03
14	Polyethylene	Extruded tube	SD-2737	PE2708	2.6	M03
15	Polyethylene	Extruded pipe	SD-3035	PE2708	2.6	M03
16	Polyethylene	Extruded pipe	SF-714	PE2708	2.6	M03
17	Polyethylene	Extruded pipe	SD-2239	PE3608	3.0	M03
18	Polyethylene	Extruded pipe	SD-2239	PE4608	3.0	M03
19	Polyethylene	Extruded pipe	SD-2239	PE4710	3.0	M03
20	Polyethylene	Extruded pipe	SD-2513	PE4710	3.0	M03
21	Polyethylene	Extruded tube	SD-2737	PE3608	3.0	M03
22	Polyethylene	Extruded tube	SD-2737	PE4608	3.0	M03
23	Polyethylene	Extruded tube	SD-2737	PE4710	3.0	M03
24	Polyethylene	Extruded pipe	SD-3035	PE3608	3.0	M03
25	Polyethylene	Extruded pipe	SD-3035	PE4608	3.0	M03
26	Polyethylene	Extruded pipe	SD-3035	PE4710	3.0	M03
27	Polyethylene	Extruded pipe	SF-714	PE3608	3.0	M03
28	Polyethylene	Extruded pipe	SF-714	PE4608	3.0	M03
29	Polyethylene	Extruded pipe	SF-714	PE4710	3.0	M03
30	Polyethylene	Extruded pipe	SF-2619	PE3608	3.0	M03
31	Polyethylene	Extruded pipe	SF-2619	PE4710	3.0	M03
32	PVC	Extruded pipe	SD-1785	PVC2110	6.0	M01
33	PVC	Extruded pipe	SD-1785	PVC2112	6.0	M01
34	PVC	Extruded pipe	SD-1785	PVC2116	6.0	M01
35	PVC	Extruded pipe	SD-1785	PVC2120	6.0	M01

Table 1-1-Y Yield Strength Values, S_y, for Thermoplastic Materials

Line No.	Yield Strength, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
	73	80	90	100	110	120	130	140	150	160	170	180	190	200
1	7.00	6.79	6.51	6.16	5.88	5.53	5.25	4.97	4.62	4.34	3.99	3.71	3.43	3.08
2	7.00	6.79	6.51	6.16	5.88	5.53	5.25	4.97	4.62	4.34	3.99	3.71	3.43	3.08
3	7.00	6.79	6.51	6.16	5.88	5.53	5.25	4.97	4.62	4.34	3.99	3.71	3.43	3.08
4	7.00	6.79	6.51	6.16	5.88	5.53	5.25	4.97	4.62	4.34	3.99	3.71	3.43	3.08
5	7.00	6.79	6.51	6.16	5.88	5.53	5.25	4.97	4.62	4.34	3.99	3.71	3.43	3.08
6	7.00	6.79	6.51	6.16	5.88	5.53	5.25	4.97	4.62	4.34	3.99	3.71	3.43	3.08
7	3.00	2.94	2.85	2.75	2.64	2.52	2.39	2.26	2.11	1.96	1.80	1.63	1.45	1.26
8	3.00	2.94	2.85	2.75	2.64	2.52	2.39	2.26	2.11	1.96	1.80	1.63	1.45	1.26
9	6.96	6.53	5.95	5.43	4.97	4.55	4.19	3.88	3.63	3.43	3.28	3.19	...	...
10	6.96	6.53	5.95	5.43	4.97	4.55	4.19	3.88	3.63	3.43	3.28	3.19	...	...
11	5.97	5.47	4.89	4.42	4.04	3.72	3.45	3.21	3.01	2.83	2.67	2.53	2.40	2.29
12	2.60	...	...	...	...	...	...	...	...	...	...	...	...	...
13	2.60	...	...	...	...	...	...	...	...	...	...	...	...	...
14	2.60	...	...	...	...	...	...	...	...	...	...	...	...	...
15	2.60	...	...	...	...	...	...	...	...	...	...	...	...	...
16	2.60	...	...	...	...	...	...	...	...	...	...	...	...	...
17	3.00	2.84	2.62	2.39	2.17	1.94	1.72	1.49	1.27	1.04	...	...	...	...
18	3.00	2.84	2.61	2.39	2.16	1.94	1.71	1.48	1.26	1.03	0.80	0.58	...	...
19	3.00	2.84	2.61	2.39	2.16	1.94	1.71	1.48	1.26	1.03	0.80	0.58	...	...
20	3.00	2.84	2.61	2.39	2.16	1.94	1.71	1.48	1.26	1.03	0.80	0.58	...	...
21	3.00	2.84	2.62	2.39	2.17	1.94	1.72	1.49	1.27	1.04	...	...	...	...
22	3.00	2.84	2.61	2.39	2.16	1.94	1.71	1.48	1.26	1.03	0.80	0.58	...	...
23	3.00	2.84	2.61	2.39	2.16	1.94	1.71	1.48	1.26	1.03	0.80	0.58	...	...
24	3.00	2.84	2.62	2.39	2.17	1.94	1.72	1.49	1.27	1.04	...	...	...	...
25	3.00	2.84	2.61	2.39	2.16	1.94	1.71	1.48	1.26	1.03	0.80	0.58	...	...
26	3.00	2.84	2.61	2.39	2.16	1.94	1.71	1.48	1.26	1.03	0.80	0.58	...	...
27	3.00	2.84	2.62	2.39	2.17	1.94	1.72	1.49	1.27	1.04	...	...	...	...
28	3.00	2.84	2.61	2.39	2.16	1.94	1.71	1.48	1.26	1.03	0.80	0.58	...	...
29	3.00	2.84	2.61	2.39	2.16	1.94	1.71	1.48	1.26	1.03	0.80	0.58	...	...
30	3.00	2.84	2.62	2.39	2.17	1.94	1.72	1.49	1.27	1.04	...	...	...	...
31	3.00	2.84	2.61	2.39	2.16	1.94	1.71	1.48	1.26	1.03	0.80	0.58	...	...
32	6.00	5.70	5.22	4.74	4.26	3.78	3.30	2.82	...	...	...	...	...	...
33	6.00	5.70	5.22	4.74	4.26	3.78	3.30	2.82	...	...	...	...	...	...
34	6.00	5.70	5.22	4.74	4.26	3.78	3.30	2.82	...	...	...	...	...	...
35	6.00	5.70	5.22	4.74	4.26	3.78	3.30	2.82	...	...	...	...	...	...

Table 1-1-Y Yield Strength Values, S_y, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Minimum Yield Strength, ksi	Notes
36	PVC	Extruded tube	SD-2241	PVC2110	6.0	M01
37	PVC	Extruded tube	SD-2241	PVC2112	6.0	M01
38	PVC	Extruded tube	SD-2241	PVC2116	6.0	M01
39	PVC	Extruded tube	SD-2241	PVC2120	6.0	M01
40	PVC	Extruded pipe	SD-1785	PVC1120	7.0	M01
41	PVC	Extruded pipe	SD-1785	PVC1220	7.0	M01
42	PVC	Extruded pipe	SD-2241	PVC1120	7.0	M01
43	PVC	Extruded pipe	SD-2241	PVC1220	7.0	M01
44	PVC	Extruded pipe	SF-1483	PVCO 1135	7.0	M01, M04
45	PVC	Extruded pipe	SF-1483	PVCO 1135	11.1	M01, M05
46	PVDF	Extruded pipe	SF-1673	PVDF 2020	6.5	M06
47	PVDF	Extruded pipe	SF-1673	PVDF 2025	7.7	M06

Table 1-1-Y Yield Strength Values, S_y, for Thermoplastic Materials (Cont'd)

Line No.	Yield Strength, ksi [Note (1)], for Material Temperature, °F, Not Exceeding													
	73	80	90	100	110	120	130	140	150	160	170	180	190	200
36	6.00	5.70	5.22	4.74	4.26	3.78	3.30	2.82	...	...	...	...	...	...
37	6.00	5.70	5.22	4.74	4.26	3.78	3.30	2.82	...	...	...	...	...	...
38	6.00	5.70	5.22	4.74	4.26	3.78	3.30	2.82	...	...	...	...	...	...
39	6.00	5.70	5.22	4.74	4.26	3.78	3.30	2.82	...	...	...	...	...	...
40	7.00	6.65	6.09	5.53	4.97	4.41	3.85	3.29	...	...	...	...	...	...
41	7.00	6.65	6.09	5.53	4.97	4.41	3.85	3.29	...	...	...	...	...	...
42	7.00	6.65	6.09	5.53	4.97	4.41	3.85	3.29	...	...	...	...	...	...
43	7.00	6.65	6.09	5.53	4.97	4.41	3.85	3.29	...	...	...	...	...	...
44	7.00	6.65	6.09	5.53	4.97	4.41	3.85	...	...	...	...	...	...	...
45	11.10	10.55	9.66	8.77	7.88	6.99	6.11	...	...	...	...	...	...	...
46	6.50	6.31	6.05	5.78	5.52	5.25	4.98	4.72	4.45	4.19	3.92	3.65	3.39	3.12
47	7.69	7.39	6.99	6.63	6.30	5.99	5.69	5.41	5.14	4.87	4.60	4.34	4.07	3.81

Table 1-1-Y Yield Strength Values, S_y, for Thermoplastic Materials (Cont'd)

GENERAL NOTES:

(a) The tabulated values of yield strength are those that the Committee believes are suitable for use in design calculations. At temperatures above room temperature, the yield strength values correspond to the yield strength trend curve adjusted to the minimum specified room-temperature yield strength. The yield strength values do not correspond exactly to "minimum" or "average" as these terms are applied to a statistical treatment of a homogeneous set of data. Neither the ASME material specifications nor the rules of ASME NM.1 require elevated temperature testing for yield strengths of production material for use in Code components. It is not intended that results of such tests, if performed, be compared with these tabulated yield strength values for ASME Code acceptance/rejection purposes for materials. If some elevated temperature test results on production material appear lower than the tabulated values by a large amount (more than the typical variability of material and suggesting the possibility of some error), further investigation by retest or other means should be considered.

(b) Notes limiting applications of these materials appear in Tables 1-1-1, 1-1-2, and 1-1-3.

(c) The stress values in this Table may be interpolated to determine values for intermediate temperatures. The values at intermediate temperatures shall be rounded to the same number of decimal places as the value at the higher temperature between which values are being interpolated. The rounding rule is: when the next digit beyond the last place to be retained is less than 5, retain unchanged the digit in the last place retained; when the next digit beyond the last place to be retained is 5 or greater, increase by 1 the digit in the last place retained.

(d) The following abbreviations are used: CPVC, chlorinated poly(vinyl chloride); PEX, cross-linked polyethylene; PVC, poly(vinyl chloride); and PVDF, poly(vinylidene fluoride).

(e) Chlorinated poly(vinyl chloride), polyamide, polyethylene, poly(vinyl chloride), and poly(vinylidene fluoride) are viscoelastic materials. The stress values in this Table are based on short-duration loads and are not appropriate for use as design stresses for long-term sustained loads.

NOTE: (1) Multiply ksi by 1,000 to obtain psi.

MATERIAL NOTES:

M01 The stress values for chlorinated poly(vinyl chloride) and poly(vinyl chloride) in this Table are based on tensile testing in accordance with ASTM D638 using a Type I tensile bar at 0.20 in./min at 73°F. At other strain rates, other values may apply.

M02 The stress values for polyamide in this Table are based on tensile testing in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ±10% at 23°C ± 2°C and 50% ± 5% relative humidity. At other strain rates, other values may apply.

M03 The stress values for polyethylene in this Table are based on tensile testing in accordance with ASTM D638 using a Type IV tensile bar at 2 in./min at 73°F. At other strain rates, other values may apply.

M04 These stress values for oriented poly(vinyl chloride) apply to the unoriented directions only.

M05 These stress values for oriented poly(vinyl chloride) apply to the oriented direction only.

M06 The stress values for poly(vinylidene fluoride) in this Table are based on tensile testing in accordance with ASTM D638 using a Type I tensile bar at 2 in./min at 73°F. At other strain rates, other values may apply.

M07 The first two digits (XX) of the PEX Type/Grade designation may be any designation permitted by ASTM F2788. They relate to end-use properties such as oxidation and UV resistance and do not affect strength.

M08 The stress values for PEX in this Table are based in tensile testing in accordance with ASTM D638 using Type IV tensile bar at 2 in./min at 73°F. At other strain rates, other values may apply.

M09 The stress values for Polyamide-12 in this Table are based in tensile testing at 23°C ± 2°C and 50% ± 5% relative humidity in accordance with ISO 527 on Type 1A specimens with a strain rate of 50 mm/min. At other strain rates, other values may apply.

Table 1-2.1-1 Data Sheet for Fiberglass Unsaturated Polyester Resin Type I (SC-582)

Description and Service Limits	
Reinforcement material:	Fiberglass (Type E or ECR glass)
Resin material:	Unsaturated polyester resin
Reinforcement pattern:	Random glass
Structural wall thickness range, in.:	0.1 to 0.7
Liner thickness, in.:	0.1

Modulus Data [Notes (1), (2), and (3)]

			Modulus of Elasticity for Total Wall Thickness, in. (Including 0.1–in. Liner), and Temperature, °F											
			Up to and Including 77°F				150°F				200°F			
Property	Symbol	ASTM Test Method	0.2	0.4	0.6	0.8 and Over	0.2	0.4	0.6	0.8 and Over	0.2	0.4	0.6	0.8 and Over
Axial tensile, psi	E_{AT}	D638, D1599, or D2105	1.12E+06	1.13E+06	1.13E+06	1.13E+06	9.92E+05	1.00E+06	1.01E+06	1.01E+06	8.69E+05	8.78E+05	8.82E+05	8.84E+05
Axial compressive, psi	E_{AC}	D695	1.12E+06	1.13E+06	1.13E+06	1.13E+06	9.92E+05	1.00E+06	1.01E+06	1.01E+06	8.69E+05	8.78E+05	8.82E+05	8.84E+05
Axial flexural, psi	E_{AF}	D790 or D2925	1.08E+06	1.10E+06	1.12E+06	1.12E+06	9.56E+05	9.80E+05	9.91E+05	9.97E+05	8.34E+05	8.58E+05	8.69E+05	8.74E+05
Hoop tensile, psi	E_{HT}	D638, D1599, or D2290	1.12E+06	1.13E+06	1.13E+06	1.13E+06	9.92E+05	1.00E+06	1.01E+06	1.01E+06	8.69E+05	8.78E+05	8.82E+05	8.84E+05
Hoop flexural, psi	E_{HF}	D790 or D2412	1.08E+06	1.10E+06	1.12E+06	1.12E+06	9.56E+05	9.80E+06	9.91E+05	9.97E+06	8.34E+05	8.58E+05	8.69E+05	8.74E+05
In–plane shear, psi	G	D4255	4.18E+05	4.21E+05	4.23E+05	4.23E+05	3.71E+05	3.74E+05	3.76E+05	3.77E+05	3.25E+05	3.29E+05	3.30E+05	3.31E+05

Other Property Data [Notes (1), (2), and (3)]

Property	Symbol	ASTM Test Method	Value for 0.2-in. Thickness
Poisson's ratio: hoop–axial tensile	ν_{HAT}	...	0.34
Poisson's ratio: axial–hoop tensile	ν_{AHT}	...	0.34
Coefficient of thermal expansion, in./in./°F: axial	α_A	D696	2.11E–05
Coefficient of thermal expansion, in./in./°F: hoop	α_H	...	2.11E–05
Density, lbm/in.^{3}	ρ	D792	0.051
Thermal conductivity, Btu-in./(hr-ft^2-°F)	k	C1045	1.2654

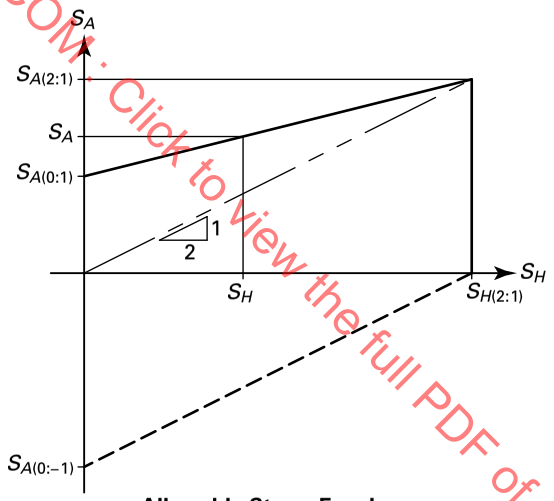
Allowable Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	77°F	150°F	200°F
Axial tensile, psi	$S_{A(0:1)}$	D638 or D2105	1.13E+03	1.00E+03	8.78E+02
Axial flexural, psi	$S_{Af(0:1)}$	D790 or D2925	1.66E+03	1.47E+03	1.29E+03
Axial compressive, psi	$S_{A(0:-1)}$	D695	1.13E+03	1.00E+03	8.78E+02
Axial 2 × 1 biaxial tensile, psi	$S_{A(2:1)}$	D1599	1.13E+03	1.00E+03	8.78E+02
Hoop 2 × 1 biaxial tensile, psi	$S_{H(2:1)}$	D1599	1.13E+03	1.00E+03	8.78E+02
Hoop tensile, psi	$S_{H(1:0)}$	D638, D1599, or D2290	1.13E+03	1.00E+03	8.78E+02
In–plane shear, psi	τ	D4255	4.21E+02	3.74E+02	3.29E+02

Table 1-2.1-1 Data Sheet for Fiberglass Unsaturated Polyester Resin Type I (SC-582) (Cont'd)

Ultimate Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	77°F	150°F	200°F
Axial tensile, psi	$S_{A(0:1)}$	D638 or D2105	1.13E+04	1.00E+04	8.78E+03
Axial flexural, psi	$S_{Af(0:1)}$	D790 or D2925	1.66E+04	1.47E+04	1.29E+04
Axial compressive, psi	$S_{A(0:-1)}$	D695	1.13E+04	1.00E+04	8.78E+03
Axial 2 × 1 biaxial tensile, psi	$S_{A(2:1)}$	D1599	1.13E+04	1.00E+04	8.78E+03
Hoop 2 × 1 biaxial tensile, psi	$S_{H(2:1)}$	D1599	1.13E+04	1.00E+04	8.78E+03
Hoop tensile, psi	$S_{H(1:0)}$	D638, D1599, or D2290	1.13E+04	1.00E+04	8.78E+03
In–plane shear, psi	τ	D4255	4.21E+03	3.74E+03	3.29E+03



Allowable Stress Envelope

GENERAL NOTES:
(a) The values in this table may be interpolated to determine values for intermediate temperatures and thicknesses.
(b) Refer to ASME NM.2, Table 3-3.1-1 for limitations on service based on temperature.
(c) The maximum allowable design stress value shall be 1,800 psi for flanges constructed of Type I laminates.

NOTES:
(1) Elastic properties apply to total wall, not just to structural wall. This is to ensure that the loads on the piping, the supports, and the connected equipment, as calculated in the pipe stress analysis, are not understated.
(2) For modulus values of the structural wall only, or for pipe for which the liner thickness is 0.0 in., it is permissible to use the modulus values applicable to a total wall thickness of 0.80 in. and over.
(3) Elastic properties may also be determined in accordance with ASME NM.2, Mandatory Appendix II.
(4) Allowable and ultimate stress values apply to the structural wall only, not the total wall thickness.

Table 1-2.1-2 Data Sheet for Fiberglass Unsaturated Polyester Resin Type II (SC-582) (20)

Description and Service Limits

Reinforcement material:	Fiberglass (Type E or ECR glass)
Resin material:	Unsaturated polyester resin
Reinforcement pattern:	Random glass/WR (0/90)
Structural wall thickness range, in.:	0.1 to 0.7
Liner thickness, in.:	0.1

Modulus Data [Notes (1), (2), and (3)]

			Modulus of Elasticity for Total Wall Thickness, in. (Including 0.1-in. Liner), and Temperature, °F											
			Up to and Including 77°F				150°F				200°F			
Property	Symbol	ASTM Test Method	0.2	0.4	0.6	0.8 and Over	0.2	0.4	0.6	0.8 and Over	0.2	0.4	0.6	0.8 and Over
Axial tensile, psi	E_{AT}	D638, D1599, or D2105	1.32E+06	1.51E+06	1.65E+06	1.67E+06	1.19E+06	1.38E+06	1.51E+06	1.53E+06	1.06E+06	1.25E+06	1.38E+06	1.40E+06
Axial compressive, psi	E_{AC}	D695	1.32E+06	1.51E+06	1.65E+06	1.67E+06	1.19E+06	1.38E+06	1.51E+06	1.53E+06	1.06E+06	1.25E+06	1.38E+06	1.40E+06
Axial flexural, psi	E_{AF}	D790 or D2925	1.18E+06	1.23E+06	1.44E+06	1.44E+06	1.05E+06	1.10E+06	1.31E+06	1.31E+06	9.21E+05	9.77E+05	1.18E+06	1.19E+06
Hoop tensile, psi	E_{HT}	D638, D1599, or D2290	1.33E+06	1.51E+06	1.65E+06	1.67E+06	1.19E+06	1.38E+06	1.51E+06	1.53E+06	1.06E+06	1.25E+06	1.38E+06	1.40E+06
Hoop flexural, psi	E_{HF}	D790 or D2412	1.18E+06	1.23E+06	1.44E+06	1.44E+06	1.10E+06	1.10E+06	1.31E+06	1.31E+06	9.14E+05	9.74E+06	1.18E+06	1.19E+06
In-plane shear, psi	G	D4255	4.10E+05	4.10E+05	4.07E+05	4.07E+05	3.59E+05	3.56E+05	3.50E+05	3.51E+05	3.09E+05	3.03E+05	2.94E+05	2.94E+05

Other Property Data [Notes (1), (2), and (3)]

Property	Symbol	ASTM Test Method	Value for 0.2–in. Thickness
Poisson's ratio: hoop–axial tensile	ν_{HAT}	...	0.29
Poisson's ratio: axial–hoop tensile	ν_{AHT}	...	0.29
Coefficient of thermal expansion, in./in./°F: axial	α_A	D696	1.93E–05
Coefficient of thermal expansion, in./in./°F: hoop	α_H	...	1.93E–05
Density, lbm/in.^{3}	ρ	D792	0.053
Thermal conductivity, Btu-in./(hr-ft^2-°F)	k	C1045	1.76

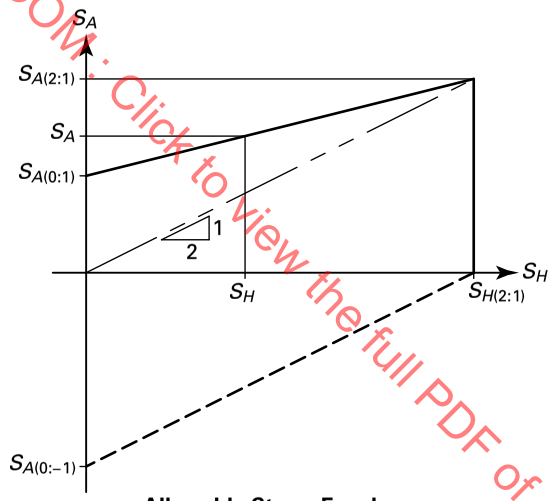
Allowable Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	77°F	150°F	200°F
Axial tensile, psi	$S_{A(0:1)}$	D638 or D2105	1.96E+03	1.79E+03	1.62E+03
Axial flexural, psi	$S_{Af(0:1)}$	D790 or D2925	2.46E+03	2.20E+03	1.95E+03
Axial compressive, psi	$S_{A(0:-1)}$	D695	1.96E+03	1.79E+03	1.62E+03
Axial 2 × 1 biaxial tensile, psi	$S_{A(2:1)}$	D1599	1.97E+03	1.79E+03	1.62E+03
Hoop 2 × 1 biaxial tensile, psi	$S_{H(2:1)}$	D1599	1.97E+03	1.79E+03	1.62E+03
Hoop tensile, psi	$S_{H(1:0)}$	D638, D1599, or D2290	1.97E+03	1.79E+03	1.62E+03
In-plane shear, psi	τ	D4255	4.10E+02	3.56E+02	3.03E+02

Table 1-2.1-2 Data Sheet for Fiberglass Unsaturated Polyester Resin Type II (SC-582) (Cont'd)

Ultimate Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	77°F	150°F	200°F
Axial tensile, psi	$S_{A(0:1)}$	D638 or D2105	1.96E+04	1.79E+04	1.62E+04
Axial flexural, psi	$S_{Af(0:1)}$	D790 or D2925	2.46E+04	2.20E+04	1.95E+04
Axial compressive, psi	$S_{A(0:-1)}$	D695	1.96E+04	1.79E+04	1.62E+04
Axial 2 × 1 biaxial tensile, psi	$S_{A(2:1)}$	D1599	1.97E+04	1.79E+04	1.62E+04
Hoop 2 × 1 biaxial tensile, psi	$S_{H(2:1)}$	D1599	1.97E+04	1.79E+04	1.62E+04
Hoop tensile, psi	$S_{H(1:0)}$	D638, D1599, or D2290	1.97E+04	1.79E+04	1.62E+04
In–plane shear, psi	τ	D4255	4.10E+03	3.56E+03	3.03E+03



Allowable Stress Envelope

GENERAL NOTES:
(a) The values in this table may be interpolated to determine values for intermediate temperatures and thicknesses.
(b) Refer to ASME NM.2, Table 3-3.1-1 for limitations on service based on temperature.
(c) The maximum allowable design stress value shall be 3,000 psi for flanges constructed of Type II laminates.

NOTES:
(1) Elastic properties apply to total wall, not just to structural wall. This is to ensure that the loads on the piping, the supports, and the connected equipment, as calculated in the pipe stress analysis, are not understated.
(2) For modulus values of the structural wall only, or for pipe for which the liner thickness is 0.0 in., it is permissible to use the modulus values applicable to a total wall thickness of 0.80 in. and over.
(3) Elastic properties may also be determined in accordance with ASME NM.2, Mandatory Appendix II.
(4) Allowable and ultimate stress values apply to the structural wall only, not the total wall thickness.

Table 1-2.1-3 Data Sheet for Fiberglass Unsaturated Polyester Resin Type III (55-deg Filament Wound; ASME NM.2, Mandatory Appendix IV)

Description and Service Limits

Reinforcement material:	Fiberglass (Type E or ECR glass)
Resin material:	Unsaturated polyester resin
Reinforcement pattern:	FW (±55)
Structural wall thickness range, in.:	0.1 to 0.7
Liner thickness, in.:	0.1

Modulus Data [Notes (1), (2), and (3)]

			Modulus of Elasticity for Total Wall Thickness, in. (Including 0.1-in. Liner), and Temperature, °F											
			Up to and Including 77°F				150°F				200°F			
Property	Symbol	ASTM Test Method	0.2	0.4	0.6	0.8 and Over	0.2	0.4	0.6	0.8 and Over	0.2	0.4	0.6	0.8 and Over
Axial tensile, psi	E_{AT}	D638, D1599, or D2105	1.19E+06	1.26E+06	1.28E+06	1.29E+06	1.01E+06	1.04E+06	1.04E+06	1.05E+06	8.20E+05	8.08E+05	8.03E+05	8.01E+06
Axial compressive, psi	E_{AC}	D695	1.19E+06	1.26E+06	1.28E+06	1.29E+06	1.01E+06	1.04E+06	1.04E+06	1.05E+06	8.20E+05	8.08E+05	8.03E+05	8.01E+06
Axial flexural, psi	E_{AF}	D790 or D2925	1.11E+06	1.19E+06	1.22E+06	1.24E+06	9.40E+06	9.94E+05	1.02E+06	1.03E+06	7.62E+05	7.98E+05	8.04E+05	8.05E+06
Hoop tensile, psi	E_{HT}	D638, D1599, or D2290	1.51E+06	1.87E+06	1.99E+06	2.04E+06	1.33E+06	1.65E+06	1.76E+06	1.80E+06	1.16E+06	1.42E+06	1.50E+06	1.54E+06
Hoop flexural, psi	E_{HF}	D790 or D2412	1.27E+06	1.59E+06	1.76E+06	1.86E+06	1.10E+06	1.41E+05	1.56E+06	1.65E+06	9.32E+05	1.22E+06	1.35E+06	1.42E+06
In-plane shear, psi	G	D4255	6.86E+05	1.02E+06	1.15E+06	1.21E+06	6.26E+05	9.62E+05	1.09E+06	1.15E+06	5.65E+05	9.03E+05	1.03E+06	1.09E+06

Other Property Data [Notes (1), (2), and (3)]

Property	Symbol	ASTM Test Method	Value for 0.2–in. Thickness
Poisson's ratio: hoop–axial tensile	ν_{HAT}	...	0.52
Poisson's ratio: axial–hoop tensile	ν_{AHT}	...	0.39
Coefficient of thermal expansion, in./in./°F: axial	α_A	D696	1.98E–05
Coefficient of thermal expansion, in./in./°F: hoop	α_H	...	1.04E–05
Density, lbm/in.^{3}	ρ	D792	0.059
Thermal conductivity, Btu-in./(hr-ft^2-°F)	k	C1045	1.76

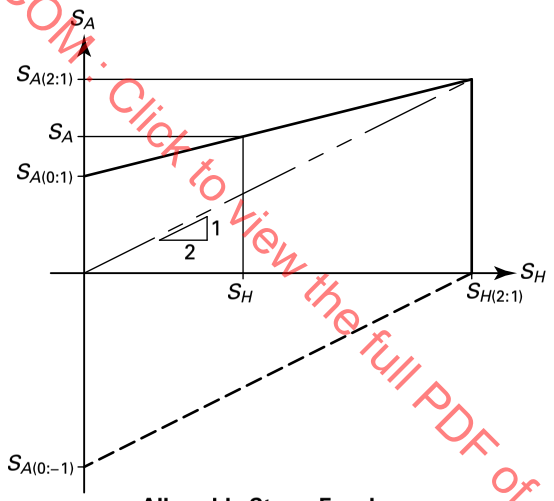
Allowable Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	77°F	150°F	200°F
Axial tensile, psi	$S_{A(0:1)}$	D638 or D2105	8.17E+02	8.08E+02	6.46E+02
Axial flexural, psi	$S_{Af(0:1)}$	D790 or D2925	1.78E+03	1.49E+03	1.20E+03
Axial compressive, psi	$S_{A(0:-1)}$	D695	1.63E+03	1.35E+03	1.05E+03
Axial 2 × 1 biaxial tensile, psi	$S_{A(2:1)}$	D1599	1.87E+03	1.82E+03	1.05E+03
Hoop 2 × 1 biaxial tensile, psi	$S_{H(2:1)}$	D1599	2.42E+03	2.15E+03	1.50E+03
Hoop tensile, psi	$S_{H(1:0)}$	D638, D1599, or D2290	2.42E+03	2.15E+03	1.50E+03
In-plane shear, psi	τ	D4255	1.02E+03	9.62E+02	9.03E+02

Table 1-2.1-3 Data Sheet for Fiberglass Unsaturated Polyester Resin Type III (55-deg Filament Wound; ASME NM.2, Mandatory Appendix IV) (Cont'd)

Ultimate Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	77°F	150°F	200°F
Axial tensile, psi	$S_{A(0:1)}$	D638 or D2105	8.17E+03	8.08E+03	6.46E+03
Axial flexural, psi	$S_{Af(0:1)}$	D790 or D2925	1.78E+04	1.49E+04	1.20E+04
Axial compressive, psi	$S_{A(0:-1)}$	D695	1.63E+04	1.35E+04	1.05E+04
Axial 2 × 1 biaxial tensile, psi	$S_{A(2:1)}$	D1599	1.87E+04	1.82E+04	1.05E+04
Hoop 2 × 1 biaxial tensile, psi	$S_{H(2:1)}$	D1599	2.42E+04	2.15E+04	1.50E+04
Hoop tensile, psi	$S_{H(1:0)}$	D638, D1599, or D2290	2.42E+04	2.15E+04	1.50E+04
In-plane shear, psi	τ	D4255	1.02E+04	9.62E+03	9.03E+03



Allowable Stress Envelope

GENERAL NOTES:

(a) The values in this table may be interpolated to determine values for intermediate temperatures and thicknesses.

(b) Refer to ASME NM.2, Table 3-3.1-1 for limitations on service based on temperature.

(c) The Type III laminate values are based on 60% to 65% glass content; slight variations on thermal expansion can be expected if the glass content of the laminate is greater than 65%.

NOTES:

(1) Elastic properties apply to total wall, not just to structural wall. This is to ensure that the loads on the piping, the supports, and the connected equipment, as calculated in the pipe stress analysis, are not understated.

(2) For modulus values of the structural wall only, or for pipe for which the liner thickness is 0.0 in., it is permissible to use the modulus values applicable to a total wall thickness of 0.80 in. and over.

(3) Elastic properties may also be determined in accordance with ASME NM.2, Mandatory Appendix II.

(4) Allowable and ultimate stress values apply to the structural wall only, not the total wall thickness.

Table 1-2.2-1 Data Sheet for Vinyl Ester Resin Type I (SC-582)

Description and Service Limits

Reinforcement material:	Fiberglass (Type E or ECR glass)
Resin material:	Vinyl ester resin
Reinforcement pattern:	Random glass
Structural wall thickness range, in.:	0.1 to 0.7
Liner thickness, in.:	0.1

Modulus Data [Notes (1), (2), and (3)]

			Modulus of Elasticity for Total Wall Thickness, in. (Including 0.1-in. Liner), and Temperature, °F											
			Up to and Including 77°F				150°F				200°F			
Property	Symbol	ASTM Test Method	0.2	0.4	0.6	0.8 and Over	0.2	0.4	0.6	0.8 and Over	0.2	0.4	0.6	0.8 and Over
Axial tensile, psi	E_{AT}	D638, D1599, or D2105	1.10E+06	1.11E+06	1.12E+06	1.12E+06	1.08E+06	1.09E+06	1.09E+06	1.12E+06	9.09E+05	9.19E+05	9.23E+05	9.25E+05
Axial compressive, psi	E_{AC}	D695	1.10E+06	1.11E+06	1.12E+06	1.12E+06	1.08E+06	1.09E+06	1.09E+06	1.12E+06	9.09E+05	9.19E+05	9.23E+05	9.25E+05
Axial flexural, psi	E_{AF}	D790 or D2925	1.06E+06	1.09E+06	1.10E+06	1.11E+06	1.04E+06	1.06E+06	1.08E+06	1.11E+06	8.75E+05	8.98E+05	9.09E+05	9.14E+05
Hoop tensile, psi	E_{HT}	D638, D1599, or D2290	1.10E+06	1.11E+06	1.12E+06	1.12E+06	1.08E+06	1.09E+06	1.09E+06	1.12E+06	9.09E+05	9.19E+05	9.23E+05	9.25E+05
Hoop flexural, psi	E_{HF}	D790 or D2412	1.06E+06	1.09E+06	1.10E+06	1.11E+06	1.04E+06	1.06E+06	1.08E+06	1.11E+06	8.75E+05	8.98E+05	9.09E+05	9.14E+05
In–plane shear, psi	G	D4255	4.11E+05	4.17E+05	4.18E+05	4.19E+05	4.02E+05	4.06E+05	4.08E+05	4.19E+05	3.40E+05	3.44E+05	3.45E+05	3.46E+05

Other Property Data [Notes (1), (2), and (3)]

Property	Symbol	ASTM Test Method	Value for 0.2-in. Thickness
Poisson's ratio: hoop–axial tensile	ν_{HAT}	...	0.34
Poisson's ratio: axial–hoop tensile	ν_{AHT}	...	0.34
Coefficient of thermal expansion, in./in./°F: axial	α_A	D696	1.855E–05
Coefficient of thermal expansion, in./in./°F: hoop	α_H	...	1.855E–05
Density, lbm/in.^{3}	ρ	D792	0.049
Thermal conductivity, Btu-in./(hr-ft^2-°F)	k	C1045	1.547

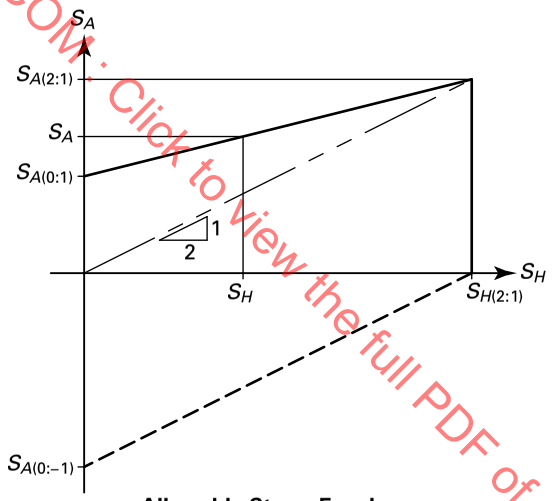
Allowable Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	77°F	150°F	200°F
Axial tensile, psi	$S_{A(0:1)}$	D638 or D2105	1.11E+03	1.09E+03	9.19E+02
Axial flexural, psi	$S_{Af(0:1)}$	D790 or D2925	1.64E+03	1.60E+03	1.35E+03
Axial compressive, psi	$S_{A(0:-1)}$	D695	1.11E+03	1.09E+03	9.19E+02
Axial 2 × 1 biaxial tensile, psi	$S_{A(2:1)}$	D1599	1.11E+03	1.09E+03	9.19E+02
Hoop 2 × 1 biaxial tensile, psi	$S_{H(2:1)}$	D1599	1.11E+03	1.09E+03	9.19E+02
Hoop tensile, psi	$S_{H(1:0)}$	D638, D1599, or D2290	1.11E+03	1.09E+03	9.19E+02
In–plane shear, psi	τ	D4255	4.17E+02	4.06E+02	3.44E+02

Table 1-2.2-1 Data Sheet for Vinyl Ester Resin Type I (SC-582) (Cont'd)

Ultimate Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	77°F	150°F	200°F
Axial tensile, psi	$S_{A(0:1)}$	D638 or D2105	1.11E+04	1.09E+04	9.19E+03
Axial flexural, psi	$S_{Af(0:1)}$	D790 or D2925	1.64E+04	1.60E+04	1.35E+04
Axial compressive, psi	$S_{A(0:-1)}$	D695	1.11E+04	1.09E+04	9.19E+03
Axial 2 × 1 biaxial tensile, psi	$S_{A(2:1)}$	D1599	1.11E+04	1.09E+04	9.19E+03
Hoop 2 × 1 biaxial tensile, psi	$S_{H(2:1)}$	D1599	1.11E+04	1.09E+04	9.19E+03
Hoop tensile, psi	$S_{H(1:0)}$	D638, D1599, or D2290	1.11E+04	1.09E+04	9.19E+03
In–plane shear, psi	τ	D4255	4.17E+03	4.06E+03	3.44E+03



Allowable Stress Envelope

GENERAL NOTES:

(a) The values in this table may be interpolated to determine values for intermediate temperatures and thicknesses.

(b) Refer to ASME NM.2, Table 3-3.1-1 for limitations on service based on temperature.

(c) The maximum allowable design stress value shall be 1,800 psi for flanges constructed of Type I laminates.

NOTES:

(1) Elastic properties apply to total wall, not just to structural wall. This is to ensure that the loads on the piping, the supports, and the connected equipment, as calculated in the pipe stress analysis, are not understated.

(2) For modulus values of the structural wall only, or for pipe for which the liner thickness is 0.0 in., it is permissible to use the modulus values applicable to a total wall thickness of 0.80 in. and over.

(3) Elastic properties may also be determined in accordance with ASME NM.2, Mandatory Appendix II.

(4) Allowable and ultimate stress values apply to the structural wall only, not the total wall thickness.

Table 1-2.2-2 Data Sheet for Vinyl Ester Resin Type II (SC-582)

Description and Service Limits

Reinforcement material:	Fiberglass (Type E or ECR glass)
Resin material:	Vinyl ester resin
Reinforcement pattern:	Random glass/WR (0/90)
Structural wall thickness range, in.:	0.1 to 0.7
Liner thickness, in.:	0.1

Modulus Data [Notes (1), (2), and (3)]

			Modulus of Elasticity for Total Wall Thickness, in. (Including 0.1-in. Liner), and Temperature, °F											
			Up to and Including 77°F				150°F				200°F			
Property	Symbol	ASTM Test Method	0.2	0.4	0.6	0.8 and Over	0.2	0.4	0.6	0.8 and Over	0.2	0.4	0.6	0.8 and Over
Axial tensile, psi	E_{AT}	D638, D1599, or D2105	1.31E+06	1.44E+06	1.59E+06	1.66E+06	1.28E+06	1.47E+06	1.61E+06	1.62E+06	1.11E+06	1.29E+06	1.38E+06	1.40E+06
Axial compressive, psi	E_{AC}	D695	1.31E+06	1.44E+06	1.59E+06	1.66E+06	1.28E+06	1.47E+06	1.61E+06	1.62E+06	1.11E+06	1.29E+06	1.38E+06	1.40E+06
Axial flexural, psi	E_{AF}	D790 or D2925	1.17E+06	1.19E+06	1.39E+06	1.48E+06	1.14E+06	1.19E+06	1.40E+06	1.40E+06	9.64E+05	1.02E+06	1.18E+06	1.19E+06
Hoop tensile, psi	E_{HT}	D638, D1599, or D2290	1.31E+06	1.50E+06	1.64E+06	1.70E+06	1.28E+06	1.47E+06	1.61E+06	1.63E+06	1.06E+06	1.29E+06	1.38E+06	1.40E+06
Hoop flexural, psi	E_{HF}	D790 or D2412	1.16E+06	1.21E+06	1.44E+06	1.53E+06	1.14E+06	1.18E+06	1.40E+06	1.40E+06	9.14E+05	1.01E+06	1.18E+06	1.19E+06
In–plane shear, psi	G	D4255	4.05E+05	4.05E+05	4.02E+05	4.01E+05	3.94E+05	3.92E+05	3.88E+05	3.89E+05	3.09E+05	3.20E+05	2.94E+05	2.94E+05

Other Property Data [Notes (1), (2), and (3)]

Property	Symbol	ASTM Test Method	Value for 0.2-in. Thickness
Poisson's ratio: hoop–axial tensile	ν_{HAT}	...	0.29
Poisson's ratio: axial–hoop tensile	ν_{AHT}	...	0.29
Coefficient of thermal expansion, in./in./°F: axial	α_A	D696	1.66E–05
Coefficient of thermal expansion, in./in./°F: hoop	α_H	...	1.66E–05
Density, lbm/in.^{3}	ρ	D792	0.050
Thermal conductivity, Btu-in./(hr-ft^2-°F)	k	C1045	1.3694

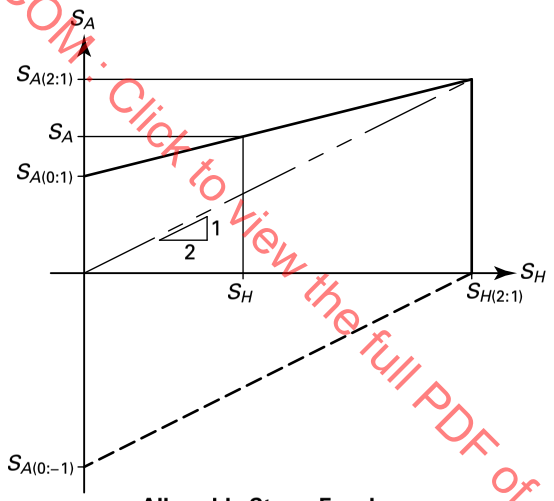
Allowable Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	77°F	150°F	200°F
Axial tensile, psi	$S_{A(0:1)}$	D638 or D2105	1.87E+03	1.91E+03	1.68E+03
Axial flexural, psi	$S_{Af(0:1)}$	D790 or D2925	2.38E+03	2.37E+03	2.04E+03
Axial compressive, psi	$S_{A(0:-1)}$	D695	1.95E+03	1.91E+03	1.68E+03
Axial 2 × 1 biaxial tensile, psi	$S_{A(2:1)}$	D1599	1.95E+03	1.91E+03	1.68E+03
Hoop 2 × 1 biaxial tensile, psi	$S_{H(2:1)}$	D1599	1.95E+03	1.91E+03	1.68E+03
Hoop tensile, psi	$S_{H(1:0)}$	D638, D1599, or D2290	1.95E+03	1.91E+03	1.68E+03
In-plane shear, psi	τ	D4255	4.05E+02	3.92E+02	3.20E+02

Table 1-2.2-2 Data Sheet for Vinyl Ester Resin Type II (SC-582) (Cont'd)

Ultimate Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	77°F	150°F	200°F
Axial tensile, psi	$S_{A(0:1)}$	D638 or D2105	1.87E+04	1.91E+04	1.68E+04
Axial flexural, psi	$S_{Af(0:1)}$	D790 or D2925	2.38E+04	2.37E+04	2.04E+04
Axial compressive, psi	$S_{A(0:-1)}$	D695	1.95E+04	1.91E+04	1.68E+04
Axial 2 × 1 biaxial tensile, psi	$S_{A(2:1)}$	D1599	1.95E+04	1.91E+04	1.68E+04
Hoop 2 × 1 biaxial tensile, psi	$S_{H(2:1)}$	D1599	1.95E+04	1.91E+04	1.68E+04
Hoop tensile, psi	$S_{H(1:0)}$	D638, D1599, or D2290	1.95E+04	1.91E+04	1.68E+04
In-plane shear, psi	τ	D4255	4.05E+03	3.92E+03	3.20E+03



Allowable Stress Envelope

GENERAL NOTES:

(a) The values in this table may be interpolated to determine values for intermediate temperatures and thicknesses.

(b) Refer to ASME NM.2, Table 3-3.1-1 for limitations on service based on temperature.

(c) The maximum allowable design stress value shall be 3,000 psi for flanges constructed of Type II laminates.

NOTES:

(1) Elastic properties apply to total wall, not just to structural wall. This is to ensure that the loads on the piping, the supports, and the connected equipment, as calculated in the pipe stress analysis, are not understated.

(2) For modulus values of the structural wall only, or for pipe for which the liner thickness is 0.0 in., it is permissible to use the modulus values applicable to a total wall thickness of 0.80 in. and over.

(3) Elastic properties may also be determined in accordance with ASME NM.2, Mandatory Appendix II.

(4) Allowable and ultimate stress values apply to the structural wall only, not the total wall thickness.

Table 1-2.2-3 Data Sheet for Vinyl Ester Resin Type III (55-deg Filament Wound; ASME NM.2, Mandatory Appendix IV) (20)

Description and Service Limits	
Reinforcement material:	Fiberglass (Type E or ECR glass)
Resin material:	Vinyl ester resin
Reinforcement pattern:	FW (±55)
Structural wall thickness range, in.:	0.1 to 0.7
Liner thickness, in.:	0.1

Modulus Data [Notes (1), (2), and (3)]

			Modulus of Elasticity for Total Wall Thickness, in. (Including 0.1-in. Liner), and Temperature, °F											
			Up to and Including 77°F				150°F				200°F			
Property	Symbol	ASTM Test Method	0.2	0.4	0.6	0.8 and Over	0.2	0.4	0.6	0.8 and Over	0.2	0.4	0.6	0.8 and Over
Axial tensile, psi	E_{AT}	D638, D1599, or D2105	1.18E+06	1.24E+06	1.26E+06	1.27E+06	1.15E+06	1.19E+06	1.21E+06	1.21E+06	8.84E+05	8.84E+05	8.84E+05	8.84E+05
Axial compressive, psi	E_{AC}	D695	1.18E+06	1.24E+06	1.26E+06	1.27E+06	1.15E+06	1.19E+06	1.21E+06	1.21E+06	8.84E+05	8.84E+05	8.84E+05	8.84E+05
Axial flexural, psi	E_{AF}	D790 or D2925	1.10E+06	1.17E+06	1.14E+06	1.22E+06	1.08E+06	1.14E+06	1.16E+06	1.18E+06	8.22E+05	8.64E+05	8.75E+05	8.79E+05
Hoop tensile, psi	E_{HT}	D638, D1599, or D2290	1.49E+06	1.85E+06	1.97E+06	2.02E+06	1.47E+06	1.81E+06	1.92E+06	1.97E+06	1.22E+06	1.50E+06	1.59E+06	1.63E+06
Hoop flexural, psi	E_{HF}	D790 or D2412	1.25E+06	1.57E+06	1.76E+06	1.84E+06	1.24E+06	1.54E+06	1.71E+06	1.80E+06	9.90E+05	1.28E+06	1.43E+06	1.50E+06
In-plane shear, psi	G	D4255	6.80E+05	1.01E+06	1.14E+06	1.20E+06	6.74E+05	1.00E+06	1.13E+06	1.19E+06	5.86E+05	9.23E+05	1.05E+06	1.11E+06

Other Property Data [Notes (1), (2), and (3)]

Property	Symbol	ASTM Test Method	Value for 0.2-in. Thickness
Poisson's ratio: hoop–axial tensile	ν_{HAT}	...	0.49
Poisson's ratio: axial–hoop tensile	ν_{AHT}	...	0.39
Coefficient of thermal expansion, in./in./°F: axial	α_A	D696	1.831E–05
Coefficient of thermal expansion, in./in./°F: hoop	α_H	...	1.067E–05
Density, lbm/in.^{3}	ρ	D792	0.057
Thermal conductivity, Btu-in./(hr-ft^2-°F)	k	C1045	1.74

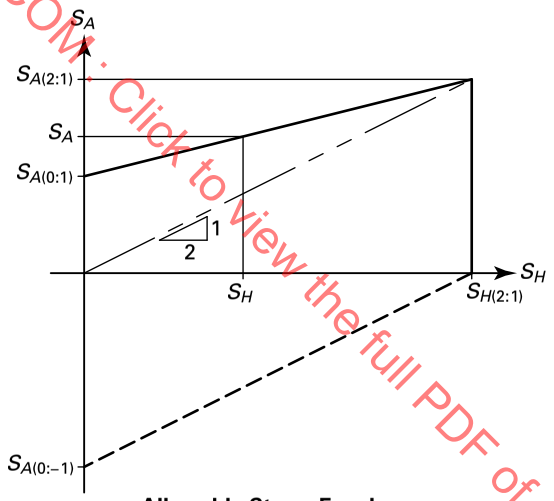
Allowable Stress Data [Notes (4) and (5)]

Property	Symbol	ASTM Test Method	77°F	150°F	200°F
Axial tensile, psi	$S_{A(0:1)}$	D638 or D2105	1.20E+03	1.15E+03	8.54E+02
Axial flexural, psi	$S_{Af(0:1)}$	D790 or D2925	1.74E+03	1.70E+03	1.50E+03
Axial compressive, psi	$S_{A(0:-1)}$	D695	1.61E+03	1.55E+03	1.15E+03
Axial 2 × 1 biaxial tensile, psi	$S_{A(2:1)}$	D1599	2.25E+03	2.20E+03	1.82E+03
Hoop 2 × 1 biaxial tensile, psi	$S_{H(2:1)}$	D1599	4.50E+03	4.40E+03	3.65E+03
Hoop tensile, psi	$S_{H(1:0)}$	D638, D1599, or D2290	4.50E+03	4.40E+03	3.65E+03
In-plane shear, psi	τ	D4255	1.01E+03	1.00E+03	9.23E+02

Table 1-2.2-3 Data Sheet for Vinyl Ester Resin Type III (55-deg Filament Wound; ASME NM.2, Mandatory Appendix IV) (Cont'd)

Ultimate Stress Data [Notes (4) and (5)]

Property	Symbol	ASTM Test Method	77°F	150°F	200°F
Axial tensile, psi	$S_{A(0:1)}$	D638 or D2105	9.60E+03	9.21E+03	6.84E+03
Axial flexural, psi	$S_{Af(0:1)}$	D790 or D2925	1.74E+04	1.70E+04	1.50E+04
Axial compressive, psi	$S_{A(0:-1)}$	D695	1.61E+04	1.55E+04	1.15E+04
Axial 2 × 1 biaxial tensile, psi	$S_{A(2:1)}$	D1599	1.80E+04	1.76E+04	1.46E+04
Hoop 2 × 1 biaxial tensile, psi	$S_{H(2:1)}$	D1599	3.60E+04	3.52E+04	2.92E+04
Hoop tensile, psi	$S_{H(1:0)}$	D638, D1599, or D2290	3.60E+04	3.52E+04	2.92E+04
In-plane shear, psi	τ	D4255	1.01E+04	1.00E+04	9.23E+03



Allowable Stress Envelope

GENERAL NOTES:

(a) The values in this table may be interpolated to determine values for intermediate temperatures and thicknesses.

(b) Refer to ASME NM.2, Table 3-3.1-1 for limitations on service based on temperature.

(c) The Type III laminate values are based on 60% to 65% glass content; slight variations on thermal expansion can be expected if the glass content of the laminate is greater than 65%.

NOTES:

(1) Elastic properties apply to total wall, not just to structural wall. This is to ensure that the loads on the piping, the supports, and the connected equipment, as calculated in the pipe stress analysis, are not understated.

(2) For modulus values of the structural wall only, or for pipe for which the liner thickness is 0.0 in., it is permissible to use the modulus values applicable to a total wall thickness of 0.80 in. and over.

(3) Elastic properties may also be determined in accordance with ASME NM.2, Mandatory Appendix II.

(4) Allowable and ultimate stress values apply to the structural wall only, not the total wall thickness.

Table 1-2.2-3 Data Sheet for Vinyl Ester Resin Type III (55-deg Filament Wound; ASME NM.2, Mandatory Appendix IV) (Cont'd)

NOTES: (Cont'd)

(5) The ultimate axial tensile strength of 9,600 psi, if tested per ASTM D638, may not be achieved. The value defined is based on experience with testing pipe per ASTM D2105; however, ASTM D2105 testing is not practical for all pipe sizes due to the load required to break the pipe exceeding the capacity of many tensile testing machines. If the purchaser requires testing per NM.2, Mandatory Appendix IV and ASTM D638 testing is performed, the mean strength shall exceed 8,000 psi for the pipe to be qualified to meet ASME NM.3.3 requirements.

(20)

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
1	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	48.3	93.3	D01	M01
2	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	48.3	93.3	D02	M01
3	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	48.3	93.3	D03	M01
4	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	48.3	93.3	D01	M02
5	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	48.3	93.3	D02	M02
6	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	48.3	93.3	D03	M02
7	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	48.3	93.3	D01	M01
8	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	48.3	93.3	D02	M01
9	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	48.3	93.3	D03	M01
10	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	48.3	93.3	D01	M02
11	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	48.3	93.3	D02	M02
12	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	48.3	93.3	D03	M02
13	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	48.3	93.3	D01	M01
14	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	48.3	93.3	D02	M01
15	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	48.3	93.3	D03	M01
16	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	48.3	93.3	D01	M02
17	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	48.3	93.3	D02	M02
18	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	48.3	93.3	D03	M02
19	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	93.3	D05 (0.4)	M25, M26, M27
20	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	93.3	D06 (0.5)	M25, M26, M27
21	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	93.3	D07 (0.63)	M25, M26, M27
22	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	93.3	D08 (1.0)	M25, M26, M27
23	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	82.2	D05 (0.4)	M25, M26, M28
24	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	82.2	D06 (0.5)	M25, M26, M28
25	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	82.2	D07 (0.63)	M25, M26, M28
26	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	82.2	D08 (1.0)	M25, M26, M28
27	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	93.3	D05 (0.4)	M25, M26, M29
28	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	93.3	D06 (0.5)	M25, M26, M29
29	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	93.3	D07 (0.63)	M25, M26, M29
30	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	93.3	D08 (1.0)	M25, M26, M29

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials

Line No.	Maximum Allowable Stress, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
	23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
1	11.0	10.7	9.89	9.10	8.34	7.60	6.88	6.19	5.52	4.87	4.23	3.62	3.02	2.44	1.87	1.32
2	13.8	13.4	12.4	11.4	10.4	9.50	8.60	7.74	6.90	6.08	5.29	4.52	3.77	3.05	2.34	1.65
3	27.6	26.8	24.7	22.8	20.8	19.0	17.2	15.5	13.8	12.2	10.6	9.04	7.55	6.09	4.68	3.30
4	11.0	10.7	9.98	9.26	8.56	7.88	7.23	6.59	5.98	5.38	4.80	4.23	3.69	3.15	2.64	2.13
5	13.8	13.4	12.5	11.6	10.7	9.86	9.04	8.24	7.47	6.72	6.00	5.29	4.61	3.94	3.29	2.66
6	27.6	26.8	25.0	23.2	21.4	19.7	18.1	16.5	14.9	13.5	12.0	10.6	9.22	7.88	6.59	5.33
7	11.0	10.7	9.89	9.10	8.34	7.60	6.88	6.19	5.52	4.87	4.23	3.62	3.02	2.44	1.87	1.32
8	13.8	13.4	12.4	11.4	10.4	9.50	8.60	7.74	6.90	6.08	5.29	4.52	3.77	3.05	2.34	1.65
9	27.6	26.8	24.7	22.8	20.8	19.0	17.2	15.5	13.8	12.2	10.6	9.04	7.55	6.09	4.68	3.30
10	11.0	10.7	9.98	9.26	8.56	7.88	7.23	6.59	5.98	5.38	4.80	4.23	3.69	3.15	2.64	2.13
11	13.8	13.4	12.5	11.6	10.7	9.86	9.04	8.24	7.47	6.72	6.00	5.29	4.61	3.94	3.29	2.66
12	27.6	26.8	25.0	23.2	21.4	19.7	18.1	16.5	14.9	13.5	12.0	10.6	9.22	7.88	6.59	5.33
13	11.0	10.7	9.89	9.10	8.34	7.60	6.88	6.19	5.52	4.87	4.23	3.62	3.02	2.44	1.87	1.32
14	13.8	13.4	12.4	11.4	10.4	9.50	8.60	7.74	6.90	6.08	5.29	4.52	3.77	3.05	2.34	1.65
15	27.6	26.8	24.7	22.8	20.8	19.0	17.2	15.5	13.8	12.2	10.6	9.04	7.55	6.09	4.68	3.30
16	11.0	10.7	9.98	9.26	8.56	7.88	7.23	6.59	5.98	5.38	4.80	4.23	3.69	3.15	2.64	2.13
17	13.8	13.4	12.5	11.6	10.7	9.86	9.04	8.24	7.47	6.72	6.00	5.29	4.61	3.94	3.29	2.66
18	27.6	26.8	25.0	23.2	21.4	19.7	18.1	16.5	14.9	13.5	12.0	10.6	9.22	7.88	6.59	5.33
19	3.4	3.4	3.3	3.2	3.1	3.0	2.8	2.7	2.6	2.5	2.4	2.3	2.3	2.1	1.9	1.7
20	4.3	4.2	4.1	3.9	3.8	3.7	3.6	3.4	3.3	3.2	3.0	2.9	2.9	2.6	2.3	2.1
21	5.4	5.3	5.1	5.0	4.8	4.6	4.5	4.3	4.2	4.0	3.8	3.7	3.6	3.3	3.0	2.6
22	8.5	8.4	8.2	7.9	7.6	7.4	7.1	6.9	6.6	6.3	6.1	5.8	5.8	5.2	4.7	4.2
23	3.4	3.4	3.3	3.2	3.1	3.0	2.8	2.7	2.6	2.5	2.4	2.3	2.3	2.1	...	...
24	4.3	4.2	4.1	3.9	3.8	3.7	3.6	3.4	3.3	3.2	3.0	2.9	2.9	2.6	...	...
25	5.4	5.3	5.1	5.0	4.8	4.6	4.5	4.3	4.2	4.0	3.8	3.7	3.6	3.3	...	...
26	8.5	8.4	8.2	7.9	7.6	7.4	7.1	6.9	6.6	6.3	6.1	5.8	5.8	5.2	...	...
27	4.3	4.3	4.1	3.9	3.7	3.5	3.3	3.2	3.0	2.8	2.6	2.4	2.2	2.1	1.9	1.7
28	5.4	5.3	5.1	4.9	4.6	4.4	4.2	3.9	3.7	3.5	3.3	3.0	2.8	2.6	2.3	2.1
29	6.8	6.7	6.4	6.1	5.9	5.6	5.3	5.0	4.7	4.4	4.1	3.8	3.5	3.3	3.0	2.6
30	10.9	10.7	10.2	9.8	9.3	8.8	8.4	7.9	7.4	7.0	6.5	6.0	5.6	5.2	4.7	4.2

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
31	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	82.2	D05 (0.4)	M01, M02, M30
32	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	82.2	D06 (0.5)	M01, M02, M30
33	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	82.2	D07 (0.63)	M01, M02, M30
34	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	82.2	D08 (1.0)	M01, M02, M30
35	Polyamide	Extruded pipe	SF-2945	PA 32312	...	48.0	82.2	D01	M03
36	Polyamide	Extruded pipe	SF-2945	PA 32312	...	48.0	82.2	D02	M03
37	Polyamide	Extruded pipe	SF-2945	PA 32312	...	48.0	82.2	D03	M03
38	Polyamide	Extruded pipe	SF-2945	PA 32316	...	48.0	82.2	D01	M04
39	Polyamide	Extruded pipe	SF-2945	PA 32316	...	48.0	82.2	D02	M04
40	Polyamide	Extruded pipe	SF-2945	PA 32316	...	48.0	82.2	D03	M04
41	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	40.0	82.2	D05 (0.4)	M31
42	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	40.0	82.2	D06 (0.5)	M31
43	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	40.0	82.2	D07 (0.63)	M31
44	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	40.0	82.2	D08 (1.0)	M31
45	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	60.0	D04	M05, M06
46	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	60.0	D05	M05, M06
47	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	60.0	D07	M05, M06
48	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	60.0	D08	M05, M06
49	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	82.2	D04	M05, M07
50	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	82.2	D05	M05, M07
51	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	82.2	D07	M05, M07
52	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	82.2	D08	M05, M07
53	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	60.0	D04	M06, M08
54	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	60.0	D05	M06, M08
55	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	60.0	D07	M06, M08
56	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	60.0	D08	M06, M08
57	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	82.2	D04	M07, M08
58	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	82.2	D05	M07, M08
59	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	82.2	D07	M07, M08
60	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	82.2	D08	M07, M08
61	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	60.0	D04	M05, M06
62	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	60.0	D05	M05, M06
63	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	60.0	D07	M05, M06
64	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	60.0	D08	M05, M06

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Maximum Allowable Stress, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
	23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
31	4.3	4.3	4.1	3.9	3.7	3.5	3.3	3.2	3.0	2.8	2.6	2.4	2.2	2.1	...	...
32	5.4	5.3	5.1	4.9	4.6	4.4	4.2	3.9	3.7	3.5	3.3	3.0	2.8	2.6	...	...
33	6.8	6.7	6.4	6.1	5.9	5.6	5.3	5.0	4.7	4.4	4.1	3.8	3.5	3.3	...	...
34	10.9	10.7	10.2	9.8	9.3	8.8	8.4	7.9	7.4	7.0	6.5	6.0	5.6	5.2	...	...
35	6.89	6.74	6.38	6.02	5.68	5.35	5.03	4.72	4.41	4.18	3.96	3.75	3.54	3.34	...	...
36	8.62	8.43	7.97	7.53	7.10	6.69	6.28	5.89	5.52	5.23	4.95	4.68	4.42	4.17	...	...
37	17.2	16.9	16.0	15.1	14.2	13.4	12.6	11.8	11.0	10.5	9.91	9.37	8.85	8.34	...	...
38	8.69	8.52	8.10	7.69	7.29	6.91	6.54	6.19	5.84	5.50	5.17	4.86	4.55	4.25	...	...
39	10.9	10.6	10.1	9.61	9.12	8.64	8.18	7.73	7.30	6.88	6.47	6.07	5.68	5.31	...	...
40	21.7	21.3	20.2	19.2	18.2	17.3	16.4	15.5	14.6	13.8	12.9	12.1	11.4	10.6	...	...
41	8.6	8.4	8.1	7.7	7.3	7.0	6.6	6.3	6.0	5.6	5.2	4.8	4.5	4.1	...	...
42	10.7	10.5	10.1	9.6	9.2	8.7	8.3	7.8	7.5	7.0	6.5	6.1	5.6	5.2	...	...
43	13.5	13.3	12.7	12.1	11.6	11.0	10.4	9.9	9.4	8.8	8.2	7.6	7.1	6.5	...	...
44	21.4	21.1	20.2	19.3	18.4	17.5	16.6	15.7	15.0	13.9	13.0	12.1	11.2	10.3	...	...
45	2.76	2.72	2.64	2.56	2.49	2.41	2.34	2.27	2.21	...	...	...	...	...	...	...
46	3.45	3.41	3.30	3.21	3.11	3.02	2.93	2.84	2.76	...	...	...	...	...	...	...
47	5.43	5.36	5.20	5.05	4.90	4.75	4.61	4.48	4.34	...	...	...	...	...	...	...
48	8.62	8.51	8.26	8.01	7.78	7.55	7.32	7.10	6.89	...	...	...	...	...	...	...
49	2.76	2.70	2.57	2.44	2.31	2.19	2.07	1.96	1.85	1.74	1.63	1.53	1.43	...	...	...
50	3.45	3.38	3.21	3.05	2.89	2.74	2.59	2.45	2.31	2.17	2.04	1.91	1.79	...	...	...
51	5.43	5.32	5.06	4.80	4.55	4.31	4.08	3.85	3.63	3.42	3.22	3.02	2.82	...	...	...
52	8.62	8.45	8.03	7.62	7.23	6.84	6.48	6.12	5.77	5.43	5.11	4.79	4.48	...	...	...
53	2.76	2.72	2.64	2.56	2.49	2.41	2.34	2.27	2.21	...	...	...	...	...	...	...
54	3.45	3.41	3.30	3.21	3.11	3.02	2.93	2.84	2.76	...	...	...	...	...	...	...
55	5.43	5.36	5.20	5.05	4.90	4.75	4.61	4.48	4.34	...	...	...	...	...	...	...
56	8.62	8.51	8.26	8.01	7.78	7.55	7.32	7.10	6.89	...	...	...	...	...	...	...
57	2.76	2.70	2.57	2.44	2.31	2.19	2.07	1.96	1.85	1.74	1.63	1.53	1.43	...	...	...
58	3.45	3.38	3.21	3.05	2.89	2.74	2.59	2.45	2.31	2.17	2.04	1.91	1.79	...	...	...
59	5.43	5.32	5.06	4.80	4.55	4.31	4.08	3.85	3.63	3.42	3.22	3.02	2.82	...	...	...
60	8.62	8.45	8.03	7.62	7.23	6.84	6.48	6.12	5.77	5.43	5.11	4.79	4.48	...	...	...
61	2.76	2.72	2.64	2.56	2.49	2.41	2.34	2.27	2.21	...	...	...	...	...	...	...
62	3.45	3.41	3.30	3.21	3.11	3.02	2.93	2.84	2.76	...	...	...	...	...	...	...
63	5.43	5.36	5.20	5.05	4.90	4.75	4.61	4.48	4.34	...	...	...	...	...	...	...
64	8.62	8.51	8.26	8.01	7.78	7.55	7.32	7.10	6.89	...	...	...	...	...	...	...

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
65	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	82.2	D04	M05, M07
66	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	82.2	D05	M05, M07
67	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	82.2	D07	M05, M07
68	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	82.2	D08	M05, M07
69	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	60.0	D04	M05, M06
70	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	60.0	D05	M05, M06
71	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	60.0	D07	M05, M06
72	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	60.0	D08	M05, M06
73	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	D04	M05, M07
74	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	D05	M05, M07
75	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	D07	M05, M07
76	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	D08	M05, M07
77	Polyethylene	Extruded pipe	SF-714	PE2708	...	17.9	60.0	D04	M06, M08
78	Polyethylene	Extruded pipe	SF-714	PE2708	...	17.9	60.0	D05	M06, M08
79	Polyethylene	Extruded pipe	SF-714	PE2708	...	17.9	60.0	D07	M06, M08
80	Polyethylene	Extruded pipe	SF-714	PE2708	...	17.9	60.0	D08	M06, M08
81	Polyethylene	Extruded pipe	SF-714	PE2708	...	17.9	82.2	D04	M07, M08
82	Polyethylene	Extruded pipe	SF-714	PE2708	...	17.9	82.2	D05	M07, M08
83	Polyethylene	Extruded pipe	SF-714	PE2708	...	17.9	82.2	D07	M07, M08
84	Polyethylene	Extruded pipe	SF-714	PE2708	...	17.9	82.2	D08	M07, M08
85	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D04	M05, M09
86	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D05	M05, M09
87	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D06	M05, M09
88	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D08	M05, M09
89	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D04	M05, M10
90	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D05	M05, M10
91	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D06	M05, M10
92	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D08	M05, M10
93	Polyethylene	Extruded pipe	SD-2239	PE4608	...	20.7	60.0	D04	M05, M10
94	Polyethylene	Extruded pipe	SD-2239	PE4608	...	20.7	60.0	D05	M05, M10
95	Polyethylene	Extruded pipe	SD-2239	PE4608	...	20.7	60.0	D06	M05, M10
96	Polyethylene	Extruded pipe	SD-2239	PE4608	...	20.7	60.0	D08	M05, M10
97	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D04	M05, M11
98	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D05	M05, M11
99	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D07	M05, M11
100	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D08	M05, M11
101	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D04	M05, M12
102	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D05	M05, M12
103	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D07	M05, M12
104	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D08	M05, M12

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Maximum Allowable Stress, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
	23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
65	2.76	2.70	2.57	2.44	2.31	2.19	2.07	1.96	1.85	1.74	1.63	1.53	1.43	...	...	...
66	3.45	3.38	3.21	3.05	2.89	2.74	2.59	2.45	2.31	2.17	2.04	1.91	1.79	...	...	...
67	5.43	5.32	5.06	4.80	4.55	4.31	4.08	3.85	3.63	3.42	3.22	3.02	2.82	...	...	...
68	8.62	8.45	8.03	7.62	7.23	6.84	6.48	6.12	5.77	5.43	5.11	4.79	4.48	...	...	...
69	2.76	2.72	2.64	2.56	2.49	2.41	2.34	2.27	2.21	...	...	...	...	...	...	...
70	3.45	3.41	3.30	3.21	3.11	3.02	2.93	2.84	2.76	...	...	...	...	...	...	...
71	5.43	5.36	5.20	5.05	4.90	4.75	4.61	4.48	4.34	...	...	...	...	...	...	...
72	8.62	8.51	8.26	8.01	7.78	7.55	7.32	7.10	6.89	...	...	...	...	...	...	...
73	2.76	2.70	2.57	2.44	2.31	2.19	2.07	1.96	1.85	1.74	1.63	1.53	1.43	...	...	...
74	3.45	3.38	3.21	3.05	2.89	2.74	2.59	2.45	2.31	2.17	2.04	1.91	1.79	...	...	...
75	5.43	5.32	5.06	4.80	4.55	4.31	4.08	3.85	3.63	3.42	3.22	3.02	2.82	...	...	...
76	8.62	8.45	8.03	7.62	7.23	6.84	6.48	6.12	5.77	5.43	5.11	4.79	4.48	...	...	...
77	2.76	2.72	2.64	2.56	2.49	2.41	2.34	2.27	2.21	...	...	...	...	...	...	...
78	3.45	3.41	3.30	3.21	3.11	3.02	2.93	2.84	2.76	...	...	...	...	...	...	...
79	5.43	5.36	5.20	5.05	4.90	4.75	4.61	4.48	4.34	...	...	...	...	...	...	...
80	8.62	8.51	8.26	8.01	7.78	7.55	7.32	7.10	6.89	...	...	...	...	...	...	...
81	2.76	2.70	2.57	2.44	2.31	2.19	2.07	1.96	1.85	1.74	1.63	1.53	1.43	...	...	...
82	3.45	3.38	3.21	3.05	2.89	2.74	2.59	2.45	2.31	2.17	2.04	1.91	1.79	...	...	...
83	5.43	5.32	5.06	4.80	4.55	4.31	4.08	3.85	3.63	3.42	3.22	3.02	2.82	...	...	...
84	8.62	8.45	8.03	7.62	7.23	6.84	6.48	6.12	5.77	5.43	5.11	4.79	4.48	...	...	...
85	3.53	3.42	3.16	2.91	2.67	2.43	2.20	1.98	1.77	...	...	...	...	...	...	...
86	4.41	4.28	3.95	3.64	3.33	3.04	2.75	2.48	2.21	...	...	...	...	...	...	...
87	5.52	5.35	4.94	4.55	4.17	3.80	3.44	3.09	2.76	...	...	...	...	...	...	...
88	11.0	10.7	9.88	9.10	8.34	7.60	6.88	6.19	5.52	...	...	...	...	...	...	...
89	3.53	3.45	3.25	3.07	2.88	2.71	2.53	2.37	2.21	...	...	...	...	...	...	...
90	4.41	4.31	4.07	3.83	3.60	3.38	3.17	2.96	2.76	...	...	...	...	...	...	...
91	5.52	5.39	5.09	4.79	4.50	4.23	3.96	3.70	3.45	...	...	...	...	...	...	...
92	11.0	10.8	10.2	9.58	9.01	8.46	7.92	7.40	6.89	...	...	...	...	...	...	...
93	3.53	3.45	3.25	3.07	2.88	2.71	2.53	2.37	2.21	...	...	...	...	...	...	...
94	4.41	4.31	4.07	3.83	3.60	3.38	3.17	2.96	2.76	...	...	...	...	...	...	...
95	5.52	5.39	5.09	4.79	4.50	4.23	3.96	3.70	3.45	...	...	...	...	...	...	...
96	11.0	10.8	10.2	9.58	9.01	8.46	7.92	7.40	6.89	...	...	...	...	...	...	...
97	3.53	3.42	3.16	2.91	2.67	2.43	2.20	1.98	1.77	...	...	...	...	...	...	...
98	4.41	4.28	3.95	3.64	3.33	3.04	2.75	2.48	2.21	...	...	...	...	...	...	...
99	6.95	6.74	6.23	5.73	5.25	4.79	4.34	3.90	3.47	...	...	...	...	...	...	...
100	11.0	10.7	9.88	9.10	8.34	7.60	6.88	6.19	5.52	...	...	...	...	...	...	...
101	3.53	3.45	3.25	3.07	2.88	2.71	2.53	2.37	2.21	...	...	...	...	...	...	...
102	4.41	4.31	4.07	3.83	3.60	3.38	3.17	2.96	2.76	...	...	...	...	...	...	...
103	6.95	6.79	6.41	6.04	5.68	5.33	4.99	4.66	4.34	...	...	...	...	...	...	...
104	11.0	10.8	10.2	9.58	9.01	8.46	7.92	7.40	6.89	...	...	...	...	...	...	...

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
105	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	82.2	D04	M05, M13
106	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	82.2	D05	M05, M13
107	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	82.2	D07	M05, M13
108	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	82.2	D08	M05, M13
109	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D04	M08, M11
110	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D05	M08, M11
111	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D07	M08, M11
112	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D08	M08, M11
113	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D04	M08, M12
114	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D05	M08, M12
115	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D07	M08, M12
116	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D08	M08, M12
117	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	82.2	D04	M08, M13
118	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	82.2	D05	M08, M13
119	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	82.2	D07	M08, M13
120	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	82.2	D08	M08, M13
121	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D04	M05, M09
122	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D05	M05, M09
123	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D06	M05, M09
124	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D08	M05, M09
125	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D04	M05, M10
126	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D05	M05, M10
127	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D06	M05, M10
128	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D08	M05, M10
129	Polyethylene	Extruded tube	SD-2737	PE4608	...	20.7	60.0	D04	M05, M10
130	Polyethylene	Extruded tube	SD-2737	PE4608	...	20.7	60.0	D05	M05, M10
131	Polyethylene	Extruded tube	SD-2737	PE4608	...	20.7	60.0	D06	M05, M10
132	Polyethylene	Extruded tube	SD-2737	PE4608	...	20.7	60.0	D08	M05, M10
133	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D04	M05, M11
134	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D05	M05, M11
135	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D07	M05, M11
136	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D08	M05, M11
137	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D04	M05, M12
138	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D05	M05, M12
139	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D07	M05, M12
140	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D08	M05, M12
141	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	82.2	D04	M05, M13
142	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	82.2	D05	M05, M13
143	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	82.2	D07	M05, M13
144	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	82.2	D08	M05, M13

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Maximum Allowable Stress, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
	23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
105	3.53	3.46	3.29	3.12	2.96	2.80	2.65	2.50	2.35	2.21	2.08	1.95	1.82	...	...	...
106	4.41	4.32	4.11	3.90	3.69	3.50	3.31	3.12	2.94	2.77	2.60	2.44	2.28	...	...	...
107	6.95	6.81	6.47	6.14	5.82	5.51	5.21	4.92	4.63	4.36	4.09	3.84	3.58	...	...	...
108	11.0	10.8	10.3	9.74	9.23	8.74	8.27	7.80	7.36	6.92	6.50	6.09	5.69	...	...	...
109	3.53	3.42	3.16	2.91	2.67	2.43	2.20	1.98	1.77	...	...	...	...	...	...	...
110	4.41	4.28	3.95	3.64	3.33	3.04	2.75	2.48	2.21	...	...	...	...	...	...	...
111	6.95	6.74	6.23	5.73	5.25	4.79	4.34	3.90	3.47	...	...	...	...	...	...	...
112	11.0	10.7	9.88	9.10	8.34	7.60	6.88	6.19	5.52	...	...	...	...	...	...	...
113	3.53	3.45	3.25	3.07	2.88	2.71	2.53	2.37	2.21	...	...	...	...	...	...	...
114	4.41	4.31	4.07	3.83	3.60	3.38	3.17	2.96	2.76	...	...	...	...	...	...	...
115	6.95	6.79	6.41	6.04	5.68	5.33	4.99	4.66	4.34	...	...	...	...	...	...	...
116	11.0	10.8	10.2	9.58	9.01	8.46	7.92	7.40	6.89	...	...	...	...	...	...	...
117	3.53	3.46	3.29	3.12	2.96	2.80	2.65	2.50	2.35	2.21	2.08	1.95	1.82	...	...	...
118	4.41	4.32	4.11	3.90	3.69	3.50	3.31	3.12	2.94	2.77	2.60	2.44	2.28	...	...	...
119	6.95	6.81	6.47	6.14	5.82	5.51	5.21	4.92	4.63	4.36	4.09	3.84	3.58	...	...	...
120	11.0	10.8	10.3	9.74	9.23	8.74	8.27	7.80	7.36	6.92	6.50	6.09	5.69	...	...	...
121	3.53	3.42	3.16	2.91	2.67	2.43	2.20	1.98	1.77	...	...	...	...	...	...	...
122	4.41	4.28	3.95	3.64	3.33	3.04	2.75	2.48	2.21	...	...	...	...	...	...	...
123	5.52	5.35	4.94	4.55	4.17	3.80	3.44	3.09	2.76	...	...	...	...	...	...	...
124	11.0	10.7	9.88	9.10	8.34	7.60	6.88	6.19	5.52	...	...	...	...	...	...	...
125	3.53	3.45	3.25	3.07	2.88	2.71	2.53	2.37	2.21	...	...	...	...	...	...	...
126	4.41	4.31	4.07	3.83	3.60	3.38	3.17	2.96	2.76	...	...	...	...	...	...	...
127	5.52	5.39	5.09	4.79	4.50	4.23	3.96	3.70	3.45	...	...	...	...	...	...	...
128	11.0	10.8	10.2	9.58	9.01	8.46	7.92	7.40	6.89	...	...	...	...	...	...	...
129	3.53	3.45	3.25	3.07	2.88	2.71	2.53	2.37	2.21	...	...	...	...	...	...	...
130	4.41	4.31	4.07	3.83	3.60	3.38	3.17	2.96	2.76	...	...	...	...	...	...	...
131	5.52	5.39	5.09	4.79	4.50	4.23	3.96	3.70	3.45	...	...	...	...	...	...	...
132	11.0	10.8	10.2	9.58	9.01	8.46	7.92	7.40	6.89	...	...	...	...	...	...	...
133	3.53	3.42	3.16	2.91	2.67	2.43	2.20	1.98	1.77	...	...	...	...	...	...	...
134	4.41	4.28	3.95	3.64	3.33	3.04	2.75	2.48	2.21	...	...	...	...	...	...	...
135	6.95	6.74	6.23	5.73	5.25	4.79	4.34	3.90	3.47	...	...	...	...	...	...	...
136	11.0	10.7	9.88	9.10	8.34	7.60	6.88	6.19	5.52	...	...	...	...	...	...	...
137	3.53	3.45	3.25	3.07	2.88	2.71	2.53	2.37	2.21	...	...	...	...	...	...	...
138	4.41	4.31	4.07	3.83	3.60	3.38	3.17	2.96	2.76	...	...	...	...	...	...	...
139	6.95	6.79	6.41	6.04	5.68	5.33	4.99	4.66	4.34	...	...	...	...	...	...	...
140	11.0	10.8	10.2	9.58	9.01	8.46	7.92	7.40	6.89	...	...	...	...	...	...	...
141	3.53	3.46	3.29	3.12	2.96	2.80	2.65	2.50	2.35	2.21	2.08	1.95	1.82	...	...	...
142	4.41	4.32	4.11	3.90	3.69	3.50	3.31	3.12	2.94	2.77	2.60	2.44	2.28	...	...	...
143	6.95	6.81	6.47	6.14	5.82	5.51	5.21	4.92	4.63	4.36	4.09	3.84	3.58	...	...	...
144	11.0	10.8	10.3	9.74	9.23	8.74	8.27	7.80	7.36	6.92	6.50	6.09	5.69	...	...	...

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
145	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D04	M05, M09
146	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D05	M05, M09
147	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D06	M05, M09
148	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D08	M05, M09
149	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D04	M05, M10
150	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D05	M05, M10
151	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D06	M05, M10
152	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D08	M05, M10
153	Polyethylene	Extruded pipe	SD-3035	PE4608	...	20.7	60.0	D04	M05, M10
154	Polyethylene	Extruded pipe	SD-3035	PE4608	...	20.7	60.0	D05	M05, M10
155	Polyethylene	Extruded pipe	SD-3035	PE4608	...	20.7	60.0	D06	M05, M10
156	Polyethylene	Extruded pipe	SD-3035	PE4608	...	20.7	60.0	D08	M05, M10
157	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D04	M05, M11
158	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D05	M05, M11
159	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D07	M05, M11
160	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D08	M05, M11
161	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D04	M05, M12
162	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D05	M05, M12
163	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D07	M05, M12
164	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D08	M05, M12
165	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	82.2	D04	M05, M13
166	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	82.2	D05	M05, M13
167	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	82.2	D07	M05, M13
168	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	82.2	D08	M05, M13
169	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D04	M08, M09
170	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D05	M08, M09
171	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D06	M08, M09
172	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D08	M08, M09
173	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D04	M08, M10
174	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D05	M08, M10
175	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D06	M08, M10
176	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D08	M08, M10
177	Polyethylene	Extruded pipe	SF-714	PE4608	...	20.7	60.0	D04	M08, M10
178	Polyethylene	Extruded pipe	SF-714	PE4608	...	20.7	60.0	D05	M08, M10
179	Polyethylene	Extruded pipe	SF-714	PE4608	...	20.7	60.0	D06	M08, M10
180	Polyethylene	Extruded pipe	SF-714	PE4608	...	20.7	60.0	D08	M08, M10
181	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D04	M08, M11
182	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D05	M08, M11
183	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D07	M08, M11

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Maximum Allowable Stress, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
	23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
145	3.53	3.42	3.16	2.91	2.67	2.43	2.20	1.98	1.77	...	...	...	...	...	...	...
146	4.41	4.28	3.95	3.64	3.33	3.04	2.75	2.48	2.21	...	...	...	...	...	...	...
147	5.52	5.35	4.94	4.55	4.17	3.80	3.44	3.09	2.76	...	...	...	...	...	...	...
148	11.0	10.7	9.88	9.10	8.34	7.60	6.88	6.19	5.52	...	...	...	...	...	...	...
149	3.53	3.45	3.25	3.07	2.88	2.71	2.53	2.37	2.21	...	...	...	...	...	...	...
150	4.41	4.31	4.07	3.83	3.60	3.38	3.17	2.96	2.76	...	...	...	...	...	...	...
151	5.52	5.39	5.09	4.79	4.50	4.23	3.96	3.70	3.45	...	...	...	...	...	...	...
152	11.0	10.8	10.2	9.58	9.01	8.46	7.92	7.40	6.89	...	...	...	...	...	...	...
153	3.53	3.45	3.25	3.07	2.88	2.71	2.53	2.37	2.21	...	...	...	...	...	...	...
154	4.41	4.31	4.07	3.83	3.60	3.38	3.17	2.96	2.76	...	...	...	...	...	...	...
155	5.52	5.39	5.09	4.79	4.50	4.23	3.96	3.70	3.45	...	...	...	...	...	...	...
156	11.0	10.8	10.2	9.58	9.01	8.46	7.92	7.40	6.89	...	...	...	...	...	...	...
157	3.53	3.42	3.16	2.91	2.67	2.43	2.20	1.98	1.77	...	...	...	...	...	...	...
158	4.41	4.28	3.95	3.64	3.33	3.04	2.75	2.48	2.21	...	...	...	...	...	...	...
159	6.95	6.74	6.23	5.73	5.25	4.79	4.34	3.90	3.47	...	...	...	...	...	...	...
160	11.0	10.7	9.88	9.10	8.34	7.60	6.88	6.19	5.52	...	...	...	...	...	...	...
161	3.53	3.45	3.25	3.07	2.88	2.71	2.53	2.37	2.21	...	...	...	...	...	...	...
162	4.41	4.31	4.07	3.83	3.60	3.38	3.17	2.96	2.76	...	...	...	...	...	...	...
163	6.95	6.79	6.41	6.04	5.68	5.33	4.99	4.66	4.34	...	...	...	...	...	...	...
164	11.0	10.8	10.2	9.58	9.01	8.46	7.92	7.40	6.89	...	...	...	...	...	...	...
165	3.53	3.46	3.29	3.12	2.96	2.80	2.65	2.50	2.35	2.21	2.08	1.95	1.82	...	...	...
166	4.41	4.32	4.11	3.90	3.69	3.50	3.31	3.12	2.94	2.77	2.60	2.44	2.28	...	...	...
167	6.95	6.81	6.47	6.14	5.82	5.51	5.21	4.92	4.63	4.36	4.09	3.84	3.58	...	...	...
168	11.0	10.8	10.3	9.74	9.23	8.74	8.27	7.80	7.36	6.92	6.50	6.09	5.69	...	...	...
169	3.53	3.42	3.16	2.91	2.67	2.43	2.20	1.98	1.77	...	...	...	...	...	...	...
170	4.41	4.28	3.95	3.64	3.33	3.04	2.75	2.48	2.21	...	...	...	...	...	...	...
171	5.52	5.35	4.94	4.55	4.17	3.80	3.44	3.09	2.76	...	...	...	...	...	...	...
172	11.0	10.7	9.88	9.10	8.34	7.60	6.88	6.19	5.52	...	...	...	...	...	...	...
173	3.53	3.45	3.25	3.07	2.88	2.71	2.53	2.37	2.21	...	...	...	...	...	...	...
174	4.41	4.31	4.07	3.83	3.60	3.38	3.17	2.96	2.76	...	...	...	...	...	...	...
175	5.52	5.39	5.09	4.79	4.50	4.23	3.96	3.70	3.45	...	...	...	...	...	...	...
176	11.0	10.8	10.2	9.58	9.01	8.46	7.92	7.40	6.89	...	...	...	...	...	...	...
177	3.53	3.45	3.25	3.07	2.88	2.71	2.53	2.37	2.21	...	...	...	...	...	...	...
178	4.41	4.31	4.07	3.83	3.60	3.38	3.17	2.96	2.76	...	...	...	...	...	...	...
179	5.52	5.39	5.09	4.79	4.50	4.23	3.96	3.70	3.45	...	...	...	...	...	...	...
180	11.0	10.8	10.2	9.58	9.01	8.46	7.92	7.40	6.89	...	...	...	...	...	...	...
181	3.53	3.42	3.16	2.91	2.67	2.43	2.20	1.98	1.77	...	...	...	...	...	...	...
182	4.41	4.28	3.95	3.64	3.33	3.04	2.75	2.48	2.21	...	...	...	...	...	...	...
183	6.95	6.74	6.23	5.73	5.25	4.79	4.34	3.90	3.47	...	...	...	...	...	...	...

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
184	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D08	M08, M11
185	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D04	M08, M12
186	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D05	M08, M12
187	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D07	M08, M12
188	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D08	M08, M12
189	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	82.2	D04	M08, M13
190	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	82.2	D05	M08, M13
191	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	82.2	D07	M08, M13
192	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	82.2	D08	M08, M13
193	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D04	M09, M14
194	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D05	M09, M14
195	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D06	M09, M14
196	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D08	M09, M14
197	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D04	M10, M14
198	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D05	M10, M14
199	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D06	M10, M14
200	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D08	M10, M14
201	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D04	M11, M14
202	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D05	M11, M14
203	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D07	M11, M14
204	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D08	M11, M14
205	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D04	M12, M14
206	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D05	M12, M14
207	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D07	M12, M14
208	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D08	M12, M14
209	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	82.2	D04	M13, M14
210	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	82.2	D05	M13, M14
211	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	82.2	D07	M13, M14
212	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	82.2	D08	M13, M14
213	PVC	Extruded pipe	SD-1785	PVC2110	C01	41.4	60.0	D01	M15
214	PVC	Extruded pipe	SD-1785	PVC2110	C01	41.4	60.0	D02	M15
215	PVC	Extruded pipe	SD-1785	PVC2110	C01	41.4	60.0	D03	M15
216	PVC	Extruded pipe	SD-1785	PVC2112	C01	41.4	60.0	D01	M16
217	PVC	Extruded pipe	SD-1785	PVC2112	C01	41.4	60.0	D02	M16
218	PVC	Extruded pipe	SD-1785	PVC2112	C01	41.4	60.0	D03	M16
219	PVC	Extruded pipe	SD-1785	PVC2116	C01	41.4	60.0	D01	M17
220	PVC	Extruded pipe	SD-1785	PVC2116	C01	41.4	60.0	D02	M17
221	PVC	Extruded pipe	SD-1785	PVC2116	C01	41.4	60.0	D03	M17

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Maximum Allowable Stress, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
	23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
184	11.0	10.7	9.88	9.10	8.34	7.60	6.88	6.19	5.52	...	...	...	...	...	...	...
185	3.53	3.45	3.25	3.07	2.88	2.71	2.53	2.37	2.21	...	...	...	...	...	...	...
186	4.41	4.31	4.07	3.83	3.60	3.38	3.17	2.96	2.76	...	...	...	...	...	...	...
187	6.95	6.79	6.41	6.04	5.68	5.33	4.99	4.66	4.34	...	...	...	...	...	...	...
188	11.0	10.8	10.2	9.58	9.01	8.46	7.92	7.40	6.89	...	...	...	...	...	...	...
189	3.53	3.46	3.29	3.12	2.96	2.80	2.65	2.50	2.35	2.21	2.08	1.95	1.82	...	...	...
190	4.41	4.32	4.11	3.90	3.69	3.50	3.31	3.12	2.94	2.77	2.60	2.44	2.28	...	...	...
191	6.95	6.81	6.47	6.14	5.82	5.51	5.21	4.92	4.63	4.36	4.09	3.84	3.58	...	...	...
192	11.0	10.8	10.3	9.74	9.23	8.74	8.27	7.80	7.36	6.92	6.50	6.09	5.69	...	...	...
193	3.53	3.42	3.16	2.91	2.67	2.43	2.20	1.98	1.77	...	...	...	...	...	...	...
194	4.41	4.28	3.95	3.64	3.33	3.04	2.75	2.48	2.21	...	...	...	...	...	...	...
195	5.52	5.35	4.94	4.55	4.17	3.80	3.44	3.09	2.76	...	...	...	...	...	...	...
196	11.0	10.7	9.88	9.10	8.34	7.60	6.88	6.19	5.52	...	...	...	...	...	...	...
197	3.53	3.45	3.25	3.07	2.88	2.71	2.53	2.37	2.21	...	...	...	...	...	...	...
198	4.41	4.31	4.07	3.83	3.60	3.38	3.17	2.96	2.76	...	...	...	...	...	...	...
199	5.52	5.39	5.09	4.79	4.50	4.23	3.96	3.70	3.45	...	...	...	...	...	...	...
200	11.0	10.8	10.2	9.58	9.01	8.46	7.92	7.40	6.89	...	...	...	...	...	...	...
201	3.53	3.42	3.16	2.91	2.67	2.43	2.20	1.98	1.77	...	...	...	...	...	...	...
202	4.41	4.28	3.95	3.64	3.33	3.04	2.75	2.48	2.21	...	...	...	...	...	...	...
203	6.95	6.74	6.23	5.73	5.25	4.79	4.34	3.90	3.47	...	...	...	...	...	...	...
204	11.0	10.7	9.88	9.10	8.34	7.60	6.88	6.19	5.52	...	...	...	...	...	...	...
205	3.53	3.45	3.25	3.07	2.88	2.71	2.53	2.37	2.21	...	...	...	...	...	...	...
206	4.41	4.31	4.07	3.83	3.60	3.38	3.17	2.96	2.76	...	...	...	...	...	...	...
207	6.95	6.79	6.41	6.04	5.68	5.33	4.99	4.66	4.34	...	...	...	...	...	...	...
208	11.0	10.8	10.2	9.58	9.01	8.46	7.92	7.40	6.89	...	...	...	...	...	...	...
209	3.53	3.46	3.29	3.12	2.96	2.80	2.65	2.50	2.35	2.21	2.08	1.95	1.82	...	...	...
210	4.41	4.32	4.11	3.90	3.69	3.50	3.31	3.12	2.94	2.77	2.60	2.44	2.28	...	...	...
211	6.95	6.81	6.47	6.14	5.82	5.51	5.21	4.92	4.63	4.36	4.09	3.84	3.58	...	...	...
212	11.0	10.8	10.3	9.74	9.23	8.74	8.27	7.80	7.36	6.92	6.50	6.09	5.69	...	...	...
213	5.52	5.13	4.41	3.75	3.14	2.59	2.10	1.60	1.21	...	...	...	...	...	...	...
214	6.89	6.41	5.52	4.69	3.93	3.24	2.62	2.00	1.52	...	...	...	...	...	...	...
215	13.8	12.8	11.0	9.38	7.86	6.48	5.24	4.00	3.03	...	...	...	...	...	...	...
216	6.89	6.41	5.52	4.69	3.93	3.24	2.62	2.00	1.52	...	...	...	...	...	...	...
217	8.62	8.02	6.89	5.86	4.91	4.05	3.28	2.50	1.90	...	...	...	...	...	...	...
218	17.2	16.0	13.8	11.7	9.83	8.10	6.55	5.00	3.79	...	...	...	...	...	...	...
219	8.83	8.21	7.06	6.00	5.03	4.15	3.35	2.56	1.94	...	...	...	...	...	...	...
220	11.0	10.3	8.83	7.50	6.29	5.18	4.19	3.20	2.43	...	...	...	...	...	...	...
221	22.1	20.5	17.7	15.0	12.6	10.4	8.38	6.40	4.85	...	...	...	...	...	...	...

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
222	PVC	Extruded pipe	SD-1785	PVC2120	C01	41.4	60.0	D01	M18
223	PVC	Extruded pipe	SD-1785	PVC2120	C01	41.4	60.0	D02	M18
224	PVC	Extruded pipe	SD-1785	PVC2120	C01	41.4	60.0	D03	M18
225	PVC	Extruded tube	SD-2241	PVC2110	C01	41.4	60.0	D01	M15
226	PVC	Extruded tube	SD-2241	PVC2110	C01	41.4	60.0	D02	M15
227	PVC	Extruded tube	SD-2241	PVC2110	C01	41.4	60.0	D03	M15
228	PVC	Extruded tube	SD-2241	PVC2112	C01	41.4	60.0	D01	M16
229	PVC	Extruded tube	SD-2241	PVC2112	C01	41.4	60.0	D02	M16
230	PVC	Extruded tube	SD-2241	PVC2112	C01	41.4	60.0	D03	M16
231	PVC	Extruded tube	SD-2241	PVC2116	C01	41.4	60.0	D01	M17
232	PVC	Extruded tube	SD-2241	PVC2116	C01	41.4	60.0	D02	M17
233	PVC	Extruded tube	SD-2241	PVC2116	C01	41.4	60.0	D03	M17
234	PVC	Extruded tube	SD-2241	PVC2120	C01	41.4	60.0	D01	M18
235	PVC	Extruded tube	SD-2241	PVC2120	C01	41.4	60.0	D02	M18
236	PVC	Extruded tube	SD-2241	PVC2120	C01	41.4	60.0	D03	M18
237	PVC	Extruded pipe	SD-1785	PVC1120	C01	48.3	60.0	D01	M19
238	PVC	Extruded pipe	SD-1785	PVC1120	C01	48.3	60.0	D02	M19
239	PVC	Extruded pipe	SD-1785	PVC1120	C01	48.3	60.0	D03	M19
240	PVC	Extruded pipe	SD-1785	PVC1220	C01	48.3	60.0	D01	M19
241	PVC	Extruded pipe	SD-1785	PVC1220	C01	48.3	60.0	D02	M19
242	PVC	Extruded pipe	SD-1785	PVC1220	C01	48.3	60.0	D03	M19
243	PVC	Extruded pipe	SD-2241	PVC1120	C01	48.3	60.0	D01	M19
244	PVC	Extruded pipe	SD-2241	PVC1120	C01	48.3	60.0	D02	M19
245	PVC	Extruded pipe	SD-2241	PVC1120	C01	48.3	60.0	D03	M19
246	PVC	Extruded pipe	SD-2241	PVC1220	C01	48.3	60.0	D01	M19
247	PVC	Extruded pipe	SD-2241	PVC1220	C01	48.3	60.0	D02	M19
248	PVC	Extruded pipe	SD-2241	PVC1220	C01	48.3	60.0	D03	M19
249	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	48.3	54.4	D01	M20, M21
250	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	48.3	54.4	D02	M20, M21
251	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	48.3	54.4	D03	M20, M21
252	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	76.5	54.4	D01	M20, M22
253	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	76.5	54.4	D02	M20, M22
254	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	76.5	54.4	D03	M20, M22
255	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	44.8	93.3	D02	M23
256	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	44.8	93.3	D03	M23
257	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	53.0	93.3	D02	M24
258	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	53.0	93.3	D03	M24

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

Line No.	Maximum Allowable Stress, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
	23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
222	11.0	10.3	8.83	7.50	6.29	5.18	4.19	3.20	2.43	...	...	...	...	...	...	...
223	13.8	12.8	11.0	9.38	7.86	6.48	5.24	4.00	3.03	...	...	...	...	...	...	...
224	27.6	25.6	22.1	18.8	15.7	13.0	10.5	8.00	6.07	...	...	...	...	...	...	...
225	5.52	5.13	4.41	3.75	3.14	2.59	2.10	1.60	1.21	...	...	...	...	...	...	...
226	6.89	6.41	5.52	4.69	3.93	3.24	2.62	2.00	1.52	...	...	...	...	...	...	...
227	13.8	12.8	11.0	9.38	7.86	6.48	5.24	4.00	3.03	...	...	...	...	...	...	...
228	6.89	6.41	5.52	4.69	3.93	3.24	2.62	2.00	1.52	...	...	...	...	...	...	...
229	8.62	8.02	6.89	5.86	4.91	4.05	3.28	2.50	1.90	...	...	...	...	...	...	...
230	17.2	16.0	13.8	11.7	9.83	8.10	6.55	5.00	3.79	...	...	...	...	...	...	...
231	8.83	8.21	7.06	6.00	5.03	4.15	3.35	2.56	1.94	...	...	...	...	...	...	...
232	11.0	10.3	8.83	7.50	6.29	5.18	4.19	3.20	2.43	...	...	...	...	...	...	...
233	22.1	20.5	17.7	15.0	12.6	10.4	8.38	6.40	4.85	...	...	...	...	...	...	...
234	11.0	10.3	8.83	7.50	6.29	5.18	4.19	3.20	2.43	...	...	...	...	...	...	...
235	13.8	12.8	11.0	9.38	7.86	6.48	5.24	4.00	3.03	...	...	...	...	...	...	...
236	27.6	25.6	22.1	18.8	15.7	13.0	10.5	8.00	6.07	...	...	...	...	...	...	...
237	11.0	10.3	8.83	7.50	6.29	5.18	4.19	3.20	2.43	...	...	...	...	...	...	...
238	13.8	12.8	11.0	9.38	7.86	6.48	5.24	4.00	3.03	...	...	...	...	...	...	...
239	27.6	25.6	22.1	18.8	15.7	13.0	10.5	8.00	6.07	...	...	...	...	...	...	...
240	11.0	10.3	8.83	7.50	6.29	5.18	4.19	3.20	2.43	...	...	...	...	...	...	...
241	13.8	12.8	11.0	9.38	7.86	6.48	5.24	4.00	3.03	...	...	...	...	...	...	...
242	27.6	25.6	22.1	18.8	15.7	13.0	10.5	8.00	6.07	...	...	...	...	...	...	...
243	11.0	10.3	8.83	7.50	6.29	5.18	4.19	3.20	2.43	...	...	...	...	...	...	...
244	13.8	12.8	11.0	9.38	7.86	6.48	5.24	4.00	3.03	...	...	...	...	...	...	...
245	27.6	25.6	22.1	18.8	15.7	13.0	10.5	8.00	6.07	...	...	...	...	...	...	...
246	11.0	10.3	8.83	7.50	6.29	5.18	4.19	3.20	2.43	...	...	...	...	...	...	...
247	13.8	12.8	11.0	9.38	7.86	6.48	5.24	4.00	3.03	...	...	...	...	...	...	...
248	27.6	25.6	22.1	18.8	15.7	13.0	10.5	8.00	6.07	...	...	...	...	...	...	...
249	11.0	10.3	8.83	7.50	6.29	5.18	4.19	3.20	...	...	...	...	...	...	...	...
250	13.8	12.8	11.0	9.38	7.86	6.48	5.24	4.00	...	...	...	...	...	...	...	...
251	27.6	25.6	22.1	18.8	15.7	13.0	10.5	8.00	...	...	...	...	...	...	...	...
252	19.6	18.2	15.7	13.3	11.2	9.20	7.44	5.68	...	...	...	...	...	...	...	...
253	24.5	22.8	19.6	16.6	14.0	11.5	9.30	7.10	...	...	...	...	...	...	...	...
254	49.0	45.5	39.2	33.3	27.9	23.0	18.6	14.2	...	...	...	...	...	...	...	...
255	13.8	13.5	12.7	11.9	11.1	10.4	9.66	8.97	8.30	7.65	7.02	6.41	5.82	5.24	4.68	4.13
256	27.6	26.9	25.3	23.7	22.2	20.8	19.3	17.9	16.6	15.3	14.1	12.8	11.6	10.5	9.35	8.26
257	17.2	16.9	16.0	15.2	14.4	13.6	12.9	12.1	11.4	10.7	10.1	9.41	8.78	8.17	7.57	6.99
258	34.5	33.8	32.1	30.4	28.8	27.2	25.7	24.3	22.8	21.5	20.1	18.8	17.6	16.3	15.1	14.0

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

GENERAL NOTES:

(a) The stress values in this Table may be interpolated to determine values for intermediate temperatures. The values at intermediate temperatures shall be rounded to the same number of decimal places as the value at the higher temperature between which values are being interpolated. The rounding rule is: when the next digit beyond the last place to be retained is less than 5, retain unchanged the digit in the last place retained; when the next digit beyond the last place to be retained is 5 or greater, increase by 1 the digit in the last place retained.

(b) The following abbreviations are used: CPVC, chlorinated poly(vinyl chloride); PEX, cross-linked polyethylene; PVC, poly(vinyl chloride); and PVDF, poly(vinylidene fluoride).

NOTE: (1) Multiply MPa by 1 000 to obtain kPa.

CONSTRUCTION CODE NOTES (ASME NM.1):

C01 Compounding ingredients may vary between material manufacturers for the same grade of CPVC or PVC. While these different ingredients do not impact the allowable stress values provided in this Table, they can influence the acceptability of the various joining methods allowed by ASME NM.1. In addition to the material and joining requirements set forth in ASME NM.1, the joining method to be used shall be approved by the piping component manufacturer.

C02 Cross-linking method may vary between material manufacturers for the same grade of PEX. While these different methods do not impact the allowable stress values provided in this Table, they can influence the acceptability of the various joining methods allowed by ASME NM.1. In addition to the material and joining requirements set forth in ASME NM.1, the joining method to be used shall be approved by the piping component manufacturer.

DESIGN FACTOR NOTES (ASME NM.1):

D01 The allowable stress values are based on the hydrostatic design basis (HDB) as determined in accordance with ASTM D2837 multiplied by a design factor (DF) of 0.40.

D02 The allowable stress values are based on the hydrostatic design basis (HDB) as determined in accordance with ASTM D2837 multiplied by a design factor (DF) of 0.50.

D03 The allowable stress values are based on the hydrostatic design basis (HDB) as determined in accordance with ASTM D2837 multiplied by a design factor (DF) of 1.0. These values are only to be used when the DF is incorporated in the construction code equations.

D04 The allowable stress values are based on the hydrostatic design basis (HDB) as identified in PPI TR-4 multiplied by a design factor (DF) of 0.32.

D05 The allowable stress values are based on the hydrostatic design basis (HDB) as identified in PPI TR-4 multiplied by a design factor (DF) of 0.40.

D06 The allowable stress values are based on the hydrostatic design basis (HDB) as identified in PPI TR-4 multiplied by a design factor (DF) of 0.50.

D07 The allowable stress values are based on the hydrostatic design basis (HDB) as identified in PPI TR-4 multiplied by a design factor (DF) of 0.63.

D08 The allowable stress values are based on the hydrostatic design basis (HDB) as identified in PPI TR-4 multiplied by a design factor (DF) of 1.0. These values are only to be used when the DF is incorporated in the construction code equations.

MATERIAL NOTES:

M01 Material shall have a

(a) minimum impact resistance of 80.1 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 482 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 100°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 23°C and 1,000 psi at 82.2°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 23°C and 500 psi at 82.2°C in accordance with ASTM D2837

M02 Material shall have a

(a) minimum impact resistance of 80.1 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 482 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 100°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 23°C and 1,250 psi at 82.2°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 23°C and 625 psi at 82.2°C in accordance with ASTM D2837

M03 Material shall have a

(a) classification of Group 3, Class 2, and Grade 3 in accordance with ASTM D4066.
(b) minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ± 10% at 23°C ± 2°C and 50% ± 5% relative humidity.
(c) minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ± 50% at 23°C ± 2°C and 50% ± 5% relative humidity.
(d) minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.
(e) minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.
(f) hydrostatic design basis (HDB) of 2,500 psi at 23°C, 1,600 psi at 60°C, and 1,250 psi at 82.2°C in accordance with ASTM D2837.
(g) hydrostatic design stress (HDS) of 1,250 psi at 23°C, 800 psi at 60°C, and 625 psi at 82.2°C in accordance with ASTM D2837.

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

M04 Material shall have a

(a) classification of Group 3, Class 2, and Grade 3 in accordance with ASTM D4066.

(b) minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ± 10% at 23°C ± 2°C and 50% ± 5% relative humidity.

(c) minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ± 50% at 23°C ± 2°C and 50% ± 5% relative humidity.

(d) minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.

(e) minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.

(f) hydrostatic design basis (HDB) of 3,150 psi at 23°C and 1,600 psi at 82.2°C in accordance with ASTM D2837.

(g) hydrostatic design stress (HDS) of 1,600 psi at 23°C and 800 psi at 82.2°C in accordance with ASTM D2837.

M05 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, natural with UV stabilizer, or colored with UV stabilizer.

M06 Material shall have a

(a) thermal stability of over 220°C in accordance with ASTM D3350

(b) maximum brittleness temperature of −60°C in accordance with ASTM D746

(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C

(d) slow crack growth resistance of over 500 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air

(e) hydrostatic design basis (HDB) of 1,250 psi at 23°C and 1,000 psi at 60°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

(f) hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M07 Material shall have a

(a) thermal stability of over 220°C in accordance with ASTM D3350

(b) maximum brittleness temperature of −60°C in accordance with ASTM D746

(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C

(d) slow crack growth resistance of over 500 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air

(e) hydrostatic design basis (HDB) of 1,250 psi at 23°C and 630 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

(f) hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M08 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, or colored with UV stabilizer.

M09 Material shall have a

(a) thermal stability of over 220°C in accordance with ASTM D3350

(b) maximum brittleness temperature of −60°C in accordance with ASTM D746

(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C

(d) slow crack growth resistance of over 100 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air

(e) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 800 psi at 60°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

(f) hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M10 Material shall have a

(a) thermal stability of over 220°C in accordance with ASTM D3350

(b) maximum brittleness temperature of −60°C in accordance with ASTM D746

(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C

(d) slow crack growth resistance of over 100 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air

(e) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 1,000 psi at 60°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

(f) hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M11 Material shall have a

(a) thermal stability of over 220°C in accordance with ASTM D3350

(b) maximum brittleness temperature of −60°C in accordance with ASTM D746

(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C

(d) slow crack growth resistance of over 500 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air

(e) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 800 psi at 60°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

(f) hydrostatic design stress (HDS) of 1,000 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M12 Material shall have a

(a) thermal stability of over 220°C in accordance with ASTM D3350

(b) maximum brittleness temperature of −60°C in accordance with ASTM D746

(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C

(d) slow crack growth resistance of over 500 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air

(e) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 1,000 psi at 60°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

(f) hydrostatic design stress (HDS) of 1,000 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M13 Material shall have a

(a) thermal stability of over 220°C in accordance with ASTM D3350

(b) maximum brittleness temperature of −60°C in accordance with ASTM D746

(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C

(d) slow crack growth resistance of over 500 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air

(e) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 800 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

(f) hydrostatic design stress (HDS) of 1,000 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M14 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603.

M15 Material shall have a

(a) minimum impact resistance of 266.9 J/m of notch at 23°C in accordance with ASTM D256

(b) minimum modulus of elasticity in tension of 2 206 MPa at 23°C in accordance with ASTM D638

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

(c) minimum deflection temperature under load of 60°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 2,000 psi at 23°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,000 psi at 23°C in accordance with ASTM D2837

M16 Material shall have a
(a) minimum impact resistance of 266.9 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 206 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 60°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 2,500 psi at 23°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,250 psi at 23°C in accordance with ASTM D2837

M17 Material shall have a
(a) minimum impact resistance of 266.9 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 206 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 60°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 3,200 psi at 23°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,600 psi at 23°C in accordance with ASTM D2837

M18 Material shall have a
(a) minimum impact resistance of 266.9 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 206 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 60°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 23°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 23°C in accordance with ASTM D2837

M19 Material shall have a
(a) minimum impact resistance of 34.7 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 758 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 70°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 23°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 23°C in accordance with ASTM D2837

M20 Material shall have a
(a) minimum impact resistance of 266.9 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 206 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 60°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 7,100 psi at 23°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 3,550 psi at 23°C in accordance with ASTM D2837

M21 Allowable stress values apply to the unoriented directions only.

M22 Allowable stress values apply to the oriented direction only.

M23 Material shall have a
(a) classification of Type I in accordance with ASME SD-3222
(b) minimum impact resistance of 80.0 J/m of notch at 23°C in accordance with ASTM D256
(c) minimum flexural modulus of 1.38 GPa at 23°C in accordance with ASTM D790, using Method I
(d) minimum tensile elongation at break of 10% in accordance with ASTM D638, using a Type I tensile bar at 51 mm/min at 23°C
(e) hydrostatic design basis (HDB) of 4,000 psi at 23°C and 1,250 psi at 93.3°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 23°C and 625 psi at 93.3°C in accordance with ASTM D2837

M24 Material shall have a
(a) classification of Type II in accordance with ASME SD-3222
(b) minimum flexural modulus of 1.38 GPa at 23°C in accordance with ASTM D790, using Method I
(c) minimum tensile elongation at break of 10% in accordance with ASTM D638, using a Type I tensile bar at 51 mm/min at 23°C
(d) hydrostatic design basis (HDB) of 5,000 psi at 23°C and 1,250 psi at 120°C in accordance with ASTM D2837
(e) hydrostatic design stress (HDS) of 2,500 psi at 23°C and 625 psi at 120°C in accordance with ASTM D2837

M25 The first two digits (XX) of the PEX Type/Grade designation may be any designation permitted by ASTM F2788. They relate to end-use properties such as oxidation and UV resistance and do not affect strength.

M26 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, natural with UV stabilizer, or colored with UV stabilizer. The degree of cross-linking for PEX pipe material shall be within the range from 65% to 89%, inclusive.
(a) PEX cross-linked using peroxides shall have a minimum degree of cross-linking of 70%.
(b) PEX cross-linked using silane compounds shall have a minimum degree of cross-linking of 65%.
(c) PEX cross-linked using electron beam compounds shall have a minimum degree of cross-linking of 65%.

M27 Material shall have a
(a) minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
(b) hydrostatic design basis (HDB) of 1,250 psi at 23°C and 630 psi at 93.3°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
(c) hydrostatic design stress (HDS) of 625 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M28 Material shall have a
(a) minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.

Table 1-1-1M Maximum Allowable Stress Values, *S*, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

(b) hydrostatic design basis (HDB) of 1,250 psi at 23°C and 800 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(c) hydrostatic design stress (HDS) of 625 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M29 Material shall have a

(a) minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.

(b) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 630 psi at 93.3°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(c) hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M30 Material shall have a

(a) minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.

(b) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 800 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(c) hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M31 Material shall have a

(a) classification of Group 4, Class 2, and Grade 3 in accordance with ASTM D6779.

(b) minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ± 10% at 23°C and 50% ± 5% relative humidity.

(c) minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ± 50% at 23°C ± 2°C and 50% ± 5% relative humidity.

(d) minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.

(e) minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.

(f) hydrostatic design basis (HDB) of 3,150 psi at 23°C and 1,600 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(g) hydrostatic design stress (HDS) of 1,600 psi at 23°C and 800 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(20) **Table 1-1-2M Maximum Allowable Compression Stress Values, S_{comp}, for Thermoplastic Materials**

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Notes
1	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	48.3	93.3	M01
2	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	48.3	93.3	M02
3	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	48.3	93.3	M01
4	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	48.3	93.3	M02
5	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	48.3	93.3	M01
6	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	48.3	93.3	M02
7	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	20.0	93.3	M25, M26, M27
8	PEX	Extruded pipe	F2788/F2788M	PEX XX06	C02	20.0	82.2	M25, M26, M28
9	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	20.0	93.3	M25, M26, M29
10	PEX	Extruded pipe	F2788/F2788M	PEX XX08	C02	20.0	82.2	M25, M26, M30
11	Polyamide	Extruded pipe	SF-2945	PA 32312	...	48.0	82.2	M03
12	Polyamide	Extruded pipe	SF-2945	PA 32316	...	48.0	82.2	M04
13	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	40	82.2	M31
14	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	60.0	M05, M06
15	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	82.2	M05, M07
16	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	60.0	M06, M08
17	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	82.2	M07, M08
18	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	60.0	M05, M06
19	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	82.2	M05, M07
20	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	60.0	M05, M06
21	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	M05, M07
22	Polyethylene	Extruded pipe	SF-714	PE2708	...	17.9	60.0	M06, M08
23	Polyethylene	Extruded pipe	SF-714	PE2708	...	17.9	82.2	M07, M08
24	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	M05, M09
25	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	M05, M10
26	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	M08, M11
27	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	M08, M12
28	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	82.2	M08, M13
29	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	M05, M09
30	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	M05, M10
31	Polyethylene	Extruded tube	SD-2737	PE4608	...	20.7	60.0	M05, M10
32	Polyethylene	Extruded pipe	SD-2737	PE4710	...	20.7	60.0	M05, M11
33	Polyethylene	Extruded pipe	SD-2737	PE4710	...	20.7	60.0	M05, M12
34	Polyethylene	Extruded pipe	SD-2737	PE4710	...	20.7	82.2	M05, M13
35	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	M05, M09
36	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	M05, M10
37	Polyethylene	Extruded pipe	SD-3035	PE4608	...	20.7	60.0	M05, M10
38	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	M05, M11
39	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	M05, M12
40	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	82.2	M05, M13
41	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	M08, M09
42	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	M08, M10

Table 1-1-2M Maximum Allowable Compression Stress Values, S_{comp}, for Thermoplastic Materials

Line No.	Maximum Allowable Compression Stress, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
	23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
1	17.2	16.7	15.5	14.2	13.0	11.9	10.8	9.67	8.62	7.60	6.61	5.65	4.72	3.81	2.92	2.07
2	17.2	16.8	15.6	14.5	13.4	12.3	11.3	10.3	9.34	8.40	7.50	6.62	5.76	4.93	4.12	3.33
3	17.2	16.7	15.5	14.2	13.0	11.9	10.8	9.67	8.62	7.60	6.61	5.65	4.72	3.81	2.92	2.07
4	17.2	16.8	15.6	14.5	13.4	12.3	11.3	10.3	9.34	8.40	7.50	6.62	5.76	4.93	4.12	3.33
5	17.2	16.7	15.5	14.2	13.0	11.9	10.8	9.67	8.62	7.60	6.61	5.65	4.72	3.81	2.92	2.07
6	17.2	16.8	15.6	14.5	13.4	12.3	11.3	10.3	9.34	8.40	7.50	6.62	5.76	4.93	4.12	3.33
7	5.50	5.39	5.13	4.87	4.62	4.38	4.14	3.91	3.69	3.47	3.26	3.06	2.87	2.68	2.50	2.33
8	5.50	5.39	5.13	4.87	4.62	4.38	4.14	3.91	3.69	3.47	3.26	3.06	2.87	...	...	...
9	7.91	7.76	7.37	7.00	6.63	6.28	5.93	5.60	5.28	4.97	4.66	4.37	4.09	3.82	3.56	3.31
10	7.91	7.76	7.37	7.00	6.63	6.28	5.93	5.60	5.28	4.97	4.66	4.37	4.09	...	...	...
11	10.8	10.5	9.97	9.41	8.88	8.36	7.86	7.37	6.89	6.54	6.19	5.86	5.53	5.21	...	...
12	13.6	13.3	12.7	12.0	11.4	10.8	10.2	9.67	9.12	8.60	8.08	7.59	7.10	6.64	...	...
13	13.4	13.1	12.6	12.0	11.5	10.9	10.3	9.8	9.2	8.7	8.1	7.5	7.0	6.4	...	...
14	5.52	5.45	5.29	5.13	4.98	4.83	4.69	4.55	4.42	...	...	...	...	...	...	...
15	5.52	5.41	5.14	4.88	4.63	4.38	4.15	3.92	3.70	3.48	3.27	3.07	2.87	...	...	...
16	5.52	5.45	5.29	5.13	4.98	4.83	4.69	4.55	4.42	...	...	...	...	...	...	...
17	5.52	5.41	5.14	4.88	4.63	4.38	4.15	3.92	3.70	3.48	3.27	3.07	2.87	...	...	...
18	5.52	5.45	5.29	5.13	4.98	4.83	4.69	4.55	4.42	...	...	...	...	...	...	...
19	5.52	5.41	5.14	4.88	4.63	4.38	4.15	3.92	3.70	3.48	3.27	3.07	2.87	...	...	...
20	5.52	5.45	5.29	5.13	4.98	4.83	4.69	4.55	4.42	...	...	...	...	...	...	...
21	5.52	5.41	5.14	4.88	4.63	4.38	4.15	3.92	3.70	3.48	3.27	3.07	2.87	...	...	...
22	5.52	5.45	5.29	5.13	4.98	4.83	4.69	4.55	4.42	...	...	...	...	...	...	...
23	5.52	5.41	5.14	4.88	4.63	4.38	4.15	3.92	3.70	3.48	3.27	3.07	2.87	...	...	...
24	6.90	6.69	6.18	5.69	5.21	4.75	4.30	3.87	3.45	...	...	...	...	...	...	...
25	6.90	6.74	6.36	5.99	5.64	5.29	4.95	4.63	4.31	...	...	...	...	...	...	...
26	7.93	7.69	7.11	6.54	5.99	5.46	4.95	4.45	3.97	...	...	...	...	...	...	...
27	7.93	7.75	7.31	6.89	6.48	6.08	5.69	5.32	4.96	...	...	...	...	...	...	...
28	7.93	7.77	7.38	7.00	6.64	6.28	5.94	5.61	5.29	4.97	4.67	4.38	4.09	...	...	...
29	6.90	6.69	6.18	5.69	5.21	4.75	4.30	3.87	3.45	...	...	...	...	...	...	...
30	6.90	6.74	6.36	5.99	5.64	5.29	4.95	4.63	4.31	...	...	...	...	...	...	...
31	6.90	6.74	6.36	5.99	5.64	5.29	4.95	4.63	4.31	...	...	...	...	...	...	...
32	7.93	7.69	7.11	6.54	5.99	5.46	4.95	4.45	3.97	...	...	...	...	...	...	...
33	7.93	7.75	7.31	6.89	6.48	6.08	5.69	5.32	4.96	...	...	...	...	...	...	...
34	7.93	7.77	7.38	7.00	6.64	6.28	5.94	5.61	5.29	4.97	4.67	4.38	4.09	...	...	...
35	6.90	6.69	6.18	5.69	5.21	4.75	4.30	3.87	3.45	...	...	...	...	...	...	...
36	6.90	6.74	6.36	5.99	5.64	5.29	4.95	4.63	4.31	...	...	...	...	...	...	...
37	6.90	6.74	6.36	5.99	5.64	5.29	4.95	4.63	4.31	...	...	...	...	...	...	...
38	7.93	7.69	7.11	6.54	5.99	5.46	4.95	4.45	3.97	...	...	...	...	...	...	...
39	7.93	7.75	7.31	6.89	6.48	6.08	5.69	5.32	4.96	...	...	...	...	...	...	...
40	7.93	7.77	7.38	7.00	6.64	6.28	5.94	5.61	5.29	4.97	4.67	4.38	4.09	...	...	...
41	6.90	6.69	6.18	5.69	5.21	4.75	4.30	3.87	3.45	...	...	...	...	...	...	...
42	6.90	6.74	6.36	5.99	5.64	5.29	4.95	4.63	4.31	...	...	...	...	...	...	...

Table 1-1-2M Maximum Allowable Compression Stress Values, S_{comp}, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Notes
43	Polyethylene	Extruded pipe	SF-714	PE4608	...	20.7	60.0	M08, M10
44	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	M08, M11
45	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	M08, M12
46	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	82.2	M08, M13
47	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	M09, M14
48	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	M10, M14
49	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	M11, M14
50	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	M12, M14
51	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	82.2	M13, M14
52	Polyethylene	Extruded pipe	SD-2239	PE4608	...	20.7	60.0	M05, M10
53	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	M05, M11
54	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	M05, M12
55	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	82.2	M05, M13
56	PVC	Extruded pipe	SD-1785	PVC2110	C01	41.4	60.0	M15
57	PVC	Extruded pipe	SD-1785	PVC2112	C01	41.4	60.0	M16
58	PVC	Extruded pipe	SD-1785	PVC2116	C01	41.4	60.0	M17
59	PVC	Extruded pipe	SD-1785	PVC2120	C01	41.4	60.0	M18
60	PVC	Extruded tube	SD-2241	PVC2110	C01	41.4	60.0	M15
61	PVC	Extruded tube	SD-2241	PVC2112	C01	41.4	60.0	M16
62	PVC	Extruded tube	SD-2241	PVC2116	C01	41.4	60.0	M17
63	PVC	Extruded tube	SD-2241	PVC2120	C01	41.4	60.0	M18
64	PVC	Extruded pipe	SD-1785	PVC1120	C01	48.3	60.0	M19
65	PVC	Extruded pipe	SD-1785	PVC1220	C01	48.3	60.0	M19
66	PVC	Extruded pipe	SD-2241	PVC1120	C01	48.3	60.0	M19
67	PVC	Extruded pipe	SD-2241	PVC1220	C01	48.3	60.0	M19
68	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	48.3	54.4	M20, M21
69	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	76.5	54.4	M20, M22
70	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	44.8	93.3	M23
71	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	53.0	93.3	M24

Table 1-1-2M Maximum Allowable Compression Stress Values, S_{comp}, for Thermoplastic Materials (Cont'd)

Line No.	Maximum Allowable Compression Stress, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
	23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
43	6.90	6.74	6.36	5.99	5.64	5.29	4.95	4.63	4.31	...	...	...	...	...	...	...
44	7.93	7.69	7.11	6.54	5.99	5.46	4.95	4.45	3.97	...	...	...	...	...	...	...
45	7.93	7.75	7.31	6.89	6.48	6.08	5.69	5.32	4.96	...	...	...	...	...	...	...
46	7.93	7.77	7.38	7.00	6.64	6.28	5.94	5.61	5.29	4.97	4.67	4.38	4.09	...	...	...
47	6.90	6.69	6.18	5.69	5.21	4.75	4.30	3.87	3.45	...	...	...	...	...	...	...
48	6.90	6.74	6.36	5.99	5.64	5.29	4.95	4.63	4.31	...	...	...	...	...	...	...
49	7.93	7.69	7.11	6.54	5.99	5.46	4.95	4.45	3.97	...	...	...	...	...	...	...
50	7.93	7.75	7.31	6.89	6.48	6.08	5.69	5.32	4.96	...	...	...	...	...	...	...
51	7.93	7.77	7.38	7.00	6.64	6.28	5.94	5.61	5.29	4.97	4.67	4.38	4.09	...	...	...
52	6.90	6.74	6.36	5.99	5.64	5.29	4.95	4.63	4.31	...	...	...	...	...	...	...
53	7.93	7.69	7.11	6.54	5.99	5.46	4.95	4.45	3.97	...	...	...	...	...	...	...
54	7.93	7.75	7.31	6.89	6.48	6.08	5.69	5.32	4.96	...	...	...	...	...	...	...
55	7.93	7.77	7.38	7.00	6.64	6.28	5.94	5.61	5.29	4.97	4.67	4.38	4.09	...	...	...
56	8.62	8.02	6.89	5.86	4.91	4.05	3.28	2.50	1.90	...	...	...	...	...	...	...
57	10.8	10.0	8.62	7.33	6.14	5.06	4.09	3.12	2.37	...	...	...	...	...	...	...
58	13.8	12.8	11.0	9.38	7.86	6.48	5.24	4.00	3.03	...	...	...	...	...	...	...
59	17.2	16.0	13.8	11.7	9.83	8.10	6.55	5.00	3.79	...	...	...	...	...	...	...
60	8.62	8.02	6.89	5.86	4.91	4.05	3.28	2.50	1.90	...	...	...	...	...	...	...
61	10.8	10.0	8.62	7.33	6.14	5.06	4.09	3.12	2.37	...	...	...	...	...	...	...
62	13.8	12.8	11.0	9.38	7.86	6.48	5.24	4.00	3.03	...	...	...	...	...	...	...
63	17.2	16.0	13.8	11.7	9.83	8.10	6.55	5.00	3.79	...	...	...	...	...	...	...
64	17.2	16.0	13.8	11.7	9.83	8.10	6.55	5.00	3.79	...	...	...	...	...	...	...
65	17.2	16.0	13.8	11.7	9.83	8.10	6.55	5.00	3.79	...	...	...	...	...	...	...
66	17.2	16.0	13.8	11.7	9.83	8.10	6.55	5.00	3.79	...	...	...	...	...	...	...
67	17.2	16.0	13.8	11.7	9.83	8.10	6.55	5.00	3.79	...	...	...	...	...	...	...
68	17.2	16.0	13.8	11.7	9.83	8.10	6.55	5.00	...	...	...	...	...	...	...	...
69	30.6	28.5	24.5	20.8	17.4	14.4	11.6	8.87	...	...	...	...	...	...	...	...
70	17.2	16.8	15.8	14.8	13.9	13.0	12.1	11.2	10.4	9.57	8.78	8.01	7.27	6.55	5.84	5.16
71	21.6	21.1	20.0	19.0	18.0	17.0	16.1	15.2	14.3	13.4	12.6	11.8	11.0	10.2	9.46	8.74

Table 1-1-2M Maximum Allowable Compression Stress Values, S_{comp}, for Thermoplastic Materials (Cont'd)

GENERAL NOTES:

(a) The stress values in this Table may be interpolated to determine values for intermediate temperatures. The values at intermediate temperatures shall be rounded to the same number of decimal places as the value at the higher temperature between which values are being interpolated. The rounding rule is: when the next digit beyond the last place to be retained is less than 5, retain unchanged the digit in the last place retained; when the next digit beyond the last place to be retained is 5 or greater, increase by 1 the digit in the last place retained.

(b) The following abbreviations are used: CPVC, chlorinated poly(vinyl chloride); PEX, cross-linked polyethylene; PVC, poly(vinyl chloride); and PVDF, poly(vinylidene fluoride).

NOTE: (1) Multiply MPa by 1 000 to obtain kPa.

CONSTRUCTION CODE NOTES (ASME NM.1):

C01 Compounding ingredients may vary between material manufacturers for the same grade of CPVC or PVC. While these different ingredients do not impact the allowable stress values provided in this Table, they can influence the acceptability of the various joining methods allowed by ASME NM.1. In addition to the material and joining requirements set forth in ASME NM.1, the joining method to be used shall be approved by the piping component manufacturer.

C02 Cross-linking method may vary between material manufacturers for the same grade of PEX. While these different methods do not impact the allowable stress values provided in this Table, they can influence the acceptability of the various joining methods allowed by ASME NM.1. In addition to the material and joining requirements set forth in ASME NM.1, the joining method to be used shall be approved by the piping component manufacturer.

MATERIAL NOTES:

M01 Material shall have a
- *(a)* minimum impact resistance of 80.1 J/m of notch at 23°C in accordance with ASTM D256
- *(b)* minimum modulus of elasticity in tension of 2 482 MPa at 23°C in accordance with ASTM D638
- *(c)* minimum deflection temperature under load of 100°C at a load of 1.82 MPa in accordance with ASTM D648
- *(d)* average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
- *(e)* hydrostatic design basis (HDB) of 4,000 psi at 23°C and 1,000 psi at 82.2°C in accordance with ASTM D2837
- *(f)* hydrostatic design stress (HDS) of 2,000 psi at 23°C and 500 psi at 82.2°C in accordance with ASTM D2837

M02 Material shall have a
- *(a)* minimum impact resistance of 80.1 J/m of notch at 23°C in accordance with ASTM D256
- *(b)* minimum modulus of elasticity in tension of 2 482 MPa at 23°C in accordance with ASTM D638
- *(c)* minimum deflection temperature under load of 100°C at a load of 1.82 MPa in accordance with ASTM D648
- *(d)* average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
- *(e)* hydrostatic design basis (HDB) of 4,000 psi at 23°C and 1,250 psi at 82.2°C in accordance with ASTM D2837
- *(f)* hydrostatic design stress (HDS) of 2,000 psi at 23°C and 625 psi at 82.2°C in accordance with ASTM D2837

M03 Material shall have a
- *(a)* classification of Group 3, Class 2, and Grade 3 in accordance with ASTM D4066.
- *(b)* minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ± 10% at 23°C ± 2°C and 50% ± 5% relative humidity.
- *(c)* minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ± 50% at 23°C ± 2°C and 50% ± 5% relative humidity.
- *(d)* minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.
- *(e)* minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.
- *(f)* hydrostatic design basis (HDB) of 2,500 psi at 23°C, 1,600 psi at 60°C, and 1,250 psi at 82.2°C in accordance with ASTM D2837.
- *(g)* hydrostatic design stress (HDS) of 1,250 psi at 23°C, 800 psi at 60°C, and 625 psi at 82.2°C in accordance with ASTM D2837.

M04 Material shall have a
- *(a)* classification of Group 3, Class 2, and Grade 3 in accordance with ASTM D4066.
- *(b)* minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ± 10% at 23°C ± 2°C and 50% ± 5% relative humidity.
- *(c)* minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ± 50% at 23°C ± 2°C and 50% ± 5% relative humidity.
- *(d)* minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.
- *(e)* minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.
- *(f)* hydrostatic design basis (HDB) of 3,150 psi at 23°C and 1,600 psi at 82.2°C in accordance with ASTM D2837.
- *(g)* hydrostatic design stress (HDS) of 1,600 psi at 23°C and 800 psi at 82.2°C in accordance with ASTM D2837.

M05 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, natural with UV stabilizer, or colored with UV stabilizer.

M06 Material shall have a
- *(a)* thermal stability of over 220°C in accordance with ASTM D3350
- *(b)* maximum brittleness temperature of −60°C in accordance with ASTM D746
- *(c)* minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C
- *(d)* slow crack growth resistance of over 500 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air

Table 1-1-2M Maximum Allowable Compression Stress Values, S_{comp}, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

(e) hydrostatic design basis (HDB) of 1,250 psi at 23°C and 1,000 psi at 60°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) a hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M07 Material shall have a
(a) thermal stability of over 220°C in accordance with ASTM D3350
(b) maximum brittleness temperature of −60°C in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C
(d) slow crack growth resistance of over 500 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,250 psi at 23°C and 630 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M08 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, or colored with UV stabilizer.

M09 Material shall have a
(a) thermal stability of over 220°C in accordance with ASTM D3350
(b) maximum brittleness temperature of −60°C in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C
(d) slow crack growth resistance of over 100 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 800 psi at 60°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M10 Material shall have a
(a) thermal stability of over 200°F in accordance with ASTM D3350
(b) maximum brittleness temperature of −60°C in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C
(d) slow crack growth resistance of over 100 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 1,000 psi at 60°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M11 Material shall have a
(a) thermal stability of over 220°C in accordance with ASTM D3350
(b) maximum brittleness temperature of −60°C in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C
(d) slow crack growth resistance of over 500 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 800 psi at 60°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 1,000 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M12 Material shall have a
(a) thermal stability of over 220°C in accordance with ASTM D3350
(b) maximum brittleness temperature of −60°C in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C
(d) slow crack growth resistance of over 500 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 1,000 psi at 60°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 1,000 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M13 Material shall have a
(a) thermal stability of over 220°C in accordance with ASTM D3350
(b) maximum brittleness temperature of −60°C in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C
(d) slow crack growth resistance of over 500 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 800 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 1,000 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M14 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603.

M15 Material shall have a
(a) minimum impact resistance of 266.9 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 206 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 60°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 2,000 psi at 23°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,000 psi at 23°C in accordance with ASTM D2837

M16 Material shall have a
(a) minimum impact resistance of 226.9 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 206 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 60°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 2,500 psi at 23°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,250 psi at 23°C in accordance with ASTM D2837

M17 Material shall have a
(a) minimum impact resistance of 266.9 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 206 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 60°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 3,200 psi at 23°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,600 psi at 23°C in accordance with ASTM D2837

Table 1-1-2M Maximum Allowable Compression Stress Values, S_{comp}, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

M18 Material shall have a
- *(a)* minimum impact resistance of 266.9 J/m of notch at 23°C in accordance with ASTM D256
- *(b)* minimum modulus of elasticity in tension of 2 206 MPa at 23°C in accordance with ASTM D638
- *(c)* minimum deflection temperature under load of 60°C at a load of 1.82 MPa in accordance with ASTM D648
- *(d)* average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
- *(e)* hydrostatic design basis (HDB) of 4,000 psi at 23°C in accordance with ASTM D2837
- *(f)* hydrostatic design stress (HDS) of 2,000 psi at 23°C in accordance with ASTM D2837

M19 Material shall have a
- *(a)* minimum impact resistance of 34.7 J/m of notch at 23°C in accordance with ASTM D256
- *(b)* minimum modulus of elasticity in tension of 2 758 MPa at 23°C in accordance with ASTM D638
- *(c)* minimum deflection temperature under load of 70°C at a load of 1.82 MPa in accordance with ASTM D648
- *(d)* average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
- *(e)* hydrostatic design basis (HDB) of 4,000 psi at 23°C in accordance with ASTM D2837
- *(f)* hydrostatic design stress (HDS) of 2,000 psi at 23°C in accordance with ASTM D2837

M20 Material shall have a
- *(a)* minimum impact resistance of 266.9 J/m of notch at 23°C in accordance with ASTM D256
- *(b)* minimum modulus of elasticity in tension of 2 206 MPa at 23°C in accordance with ASTM D638
- *(c)* minimum deflection temperature under load of 60°C at a load of 1.82 MPa in accordance with ASTM D648
- *(d)* average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
- *(e)* hydrostatic design basis (HDB) of 7,100 psi at 23°C in accordance with ASTM D2837
- *(f)* hydrostatic design stress (HDS) of 3,550 psi at 23°C in accordance with ASTM D2837

M21 Allowable stress values apply to the unoriented directions only.

M22 Allowable stress values apply to the oriented direction only.

M23 Material shall have a
- *(a)* classification of Type I in accordance with ASME SD-3222
- *(b)* minimum impact resistance of 80.0 J/m of notch at 23°C in accordance with ASTM D256
- *(c)* minimum flexural modulus of 1.38 GPa at 23°C in accordance with ASTM D790, using Method I
- *(d)* minimum tensile elongation at break of 10% in accordance with ASTM D638, using a Type I tensile bar at 51 mm/min at 23°C
- *(e)* hydrostatic design basis (HDB) of 4,000 psi at 23°C and 1,250 psi at 93.3°C in accordance with ASTM D2837
- *(f)* hydrostatic design stress (HDS) of 2,000 psi at 23°C and 625 psi at 93.3°C in accordance with ASTM D2837

M24 Material shall have a
- *(a)* classification of Type II in accordance with ASME SD-3222
- *(b)* minimum flexural modulus of 1.38 GPa at 23°C in accordance with ASTM D790, using Method I
- *(c)* minimum tensile elongation at break of 10% in accordance with ASTM D638, using a Type I tensile bar at 51 mm/min at 23°C
- *(d)* hydrostatic design basis (HDB) of 5,000 psi at 23°C and 1,250 psi at 120°C in accordance with ASTM D2837
- *(e)* hydrostatic design stress (HDS) of 2,500 psi at 23°C and 625 psi at 120°C in accordance with ASTM D2837

M25 The first two digits (XX) of the PEX Type/Grade designation may be any designation permitted by ASTM F2788. They relate to end-use properties such as oxidation and UV resistance and do not affect strength.

M26 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, natural with UV stabilizer, or colored with UV stabilizer. The degree of cross-linking for PEX pipe material shall be within the range from 65% to 89%, inclusive.
- *(a)* PEX cross-linked using peroxides shall have a minimum degree of cross-linking of 70%.
- *(b)* PEX cross-linked using silane compounds shall have a minimum degree of cross-linking of 65%.
- *(c)* PEX cross-linked using electron beam compounds shall have a minimum degree of cross-linking of 65%.

M27 Material shall have a
- *(a)* minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
- *(b)* hydrostatic design basis (HDB) of 1,250 psi at 23°C and 630 psi at 93.3°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
- *(c)* hydrostatic design stress (HDS) of 625 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M28 Material shall have a
- *(a)* minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
- *(b)* hydrostatic design basis (HDB) of 1,250 psi at 23°C and 800 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
- *(c)* hydrostatic design stress (HDS) of 625 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M29 Material shall have a
- *(a)* minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
- *(b)* hydrostatic design basis (HDB) of 1,600 psi at 23°C and 630 psi at 93.3°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
- *(c)* hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M30 Material shall have a
- *(a)* minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
- *(b)* hydrostatic design basis (HDB) of 1,600 psi at 23°C and 800 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
- *(c)* hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M31 Material shall have a
- *(a)* classification of Group 4, Class 2, and Grade 3 in accordance with ASTM D6779.
- *(b)* minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ± 10% at 23°C and 50% ± 5% relative humidity.
- *(c)* minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ± 50% at 23°C ± 2°C and 50% ± 5% relative humidity.

Table 1-1-2M Maximum Allowable Compression Stress Values, S_{comp}, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

(d) minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.

(e) minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.

(f) hydrostatic design basis (HDB) of 3,150 psi at 23°C and 1,600 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(g) hydrostatic design stress (HDS) of 1,600 psi at 23°C and 800 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(20) **Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials**

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
1	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	48.3	93.3	D01	M01
2	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	48.3	93.3	D01	M01
3	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	48.3	93.3	D01	M01
4	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	48.3	93.3	D01	M01
5	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	48.3	93.3	D01	M01
6	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	C01	48.3	93.3	D01	M01
7	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	48.3	93.3	D01	M02
8	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	48.3	93.3	D01	M02
9	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	48.3	93.3	D01	M02
10	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	48.3	93.3	D01	M02
11	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	48.3	93.3	D01	M02
12	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	C01	48.3	93.3	D01	M02
13	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	48.3	93.3	D01	M01
14	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	48.3	93.3	D01	M01
15	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	48.3	93.3	D01	M01
16	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	48.3	93.3	D01	M01
17	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	48.3	93.3	D01	M01
18	CPVC	Extruded pipe	SF-441	CPVC 4120-05	C01	48.3	93.3	D01	M01
19	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	48.3	93.3	D01	M02
20	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	48.3	93.3	D01	M02
21	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	48.3	93.3	D01	M02
22	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	48.3	93.3	D01	M02
23	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	48.3	93.3	D01	M02
24	CPVC	Extruded pipe	SF-441	CPVC 4120-06	C01	48.3	93.3	D01	M02
25	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	48.3	93.3	D01	M01
26	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	48.3	93.3	D01	M01
27	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	48.3	93.3	D01	M01
28	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	48.3	93.3	D01	M01
29	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	48.3	93.3	D01	M01
30	CPVC	Extruded pipe	SF-442	CPVC 4120-05	C01	48.3	93.3	D01	M01
31	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	48.3	93.3	D01	M02
32	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	48.3	93.3	D01	M02
33	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	48.3	93.3	D01	M02
34	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	48.3	93.3	D01	M02
35	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	48.3	93.3	D01	M02
36	CPVC	Extruded pipe	SF-442	CPVC 4120-06	C01	48.3	93.3	D01	M02
37	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	93.3	D01 (0.5)	M24, M25, M26
38	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	93.3	D01 (0.5)	M24, M25, M26
39	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	93.3	D01 (0.5)	M24, M25, M26
40	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	93.3	D01 (0.5)	M24, M25, M26

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
		23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
1	$N \le 1\,000$	21.4	20.9	20.1	19.2	18.4	17.7	16.9	16.0	15.2	14.3	13.5	12.6	11.7	10.9	9.84	8.63
2	$1\,000 < N \le 10\,000$	12.8	12.5	12.0	11.5	11.0	10.6	10.1	9.57	9.06	8.55	8.04	7.53	7.02	6.51	5.88	5.16
3	$10\,000 < N \le 25\,000$	10.5	10.2	9.83	9.41	8.99	8.68	8.26	7.84	7.42	7.00	6.59	6.17	5.75	5.33	4.81	4.22
4	$25\,000 < N \le 50\,000$	8.98	8.80	8.44	8.08	7.72	7.45	7.09	6.73	6.37	6.01	5.66	5.30	4.94	4.58	4.13	3.63
5	$50\,000 < N \le 75\,000$	8.20	8.03	7.71	7.38	7.05	6.80	6.48	6.15	5.82	5.49	5.16	4.84	4.51	4.18	3.78	3.31
6	$75\,000 < N \le 100\,000$	7.69	7.53	7.23	6.92	6.61	6.38	6.07	5.77	5.46	5.15	4.84	4.54	4.23	3.92	3.54	3.11
7	$N \le 1\,000$	21.4	20.9	20.1	19.2	18.4	17.7	16.9	16.0	15.2	14.3	13.5	12.6	11.7	10.9	9.84	8.63
8	$1\,000 < N \le 10\,000$	12.8	12.5	12.0	11.5	11.0	10.6	10.1	9.57	9.06	8.55	8.04	7.53	7.02	6.51	5.88	5.16
9	$10\,000 < N \le 25\,000$	10.5	10.2	9.83	9.41	8.99	8.68	8.26	7.84	7.42	7.00	6.59	6.17	5.75	5.33	4.81	4.22
10	$25\,000 < N \le 50\,000$	8.98	8.80	8.44	8.08	7.72	7.45	7.09	6.73	6.37	6.01	5.66	5.30	4.94	4.58	4.13	3.63
11	$50\,000 < N \le 75\,000$	8.20	8.03	7.71	7.38	7.05	6.80	6.48	6.15	5.82	5.49	5.16	4.84	4.51	4.18	3.78	3.31
12	$75\,000 < N \le 100\,000$	7.69	7.53	7.23	6.92	6.61	6.38	6.07	5.77	5.46	5.15	4.84	4.54	4.23	3.92	3.54	3.11
13	$N \le 1\,000$	21.4	20.9	20.1	19.2	18.4	17.7	16.9	16.0	15.2	14.3	13.5	12.6	11.7	10.9	9.84	8.63
14	$1\,000 < N \le 10\,000$	12.8	12.5	12.0	11.5	11.0	10.6	10.1	9.57	9.06	8.55	8.04	7.53	7.02	6.51	5.88	5.16
15	$10\,000 < N \le 25\,000$	10.5	10.2	9.83	9.41	8.99	8.68	8.26	7.84	7.42	7.00	6.59	6.17	5.75	5.33	4.81	4.22
16	$25\,000 < N \le 50\,000$	8.98	8.80	8.44	8.08	7.72	7.45	7.09	6.73	6.37	6.01	5.66	5.30	4.94	4.58	4.13	3.63
17	$50\,000 < N \le 75\,000$	8.20	8.03	7.71	7.38	7.05	6.80	6.48	6.15	5.82	5.49	5.16	4.84	4.51	4.18	3.78	3.31
18	$75\,000 < N \le 100\,000$	7.69	7.53	7.23	6.92	6.61	6.38	6.07	5.77	5.46	5.15	4.84	4.54	4.23	3.92	3.54	3.11
19	$N \le 1\,000$	21.4	20.9	20.1	19.2	18.4	17.7	16.9	16.0	15.2	14.3	13.5	12.6	11.7	10.9	9.84	8.63
20	$1\,000 < N \le 10\,000$	12.8	12.5	12.0	11.5	11.0	10.6	10.1	9.57	9.06	8.55	8.04	7.53	7.02	6.51	5.88	5.16
21	$10\,000 < N \le 25\,000$	10.5	10.2	9.83	9.41	8.99	8.68	8.26	7.84	7.42	7.00	6.59	6.17	5.75	5.33	4.81	4.22
22	$25\,000 < N \le 50\,000$	8.98	8.80	8.44	8.08	7.72	7.45	7.09	6.73	6.37	6.01	5.66	5.30	4.94	4.58	4.13	3.63
23	$50\,000 < N \le 75\,000$	8.20	8.03	7.71	7.38	7.05	6.80	6.48	6.15	5.82	5.49	5.16	4.84	4.51	4.18	3.78	3.31
24	$75\,000 < N \le 100\,000$	7.69	7.53	7.23	6.92	6.61	6.38	6.07	5.77	5.46	5.15	4.84	4.54	4.23	3.92	3.54	3.11
25	$N \le 1\,000$	21.4	20.9	20.1	19.2	18.4	17.7	16.9	16.0	15.2	14.3	13.5	12.6	11.7	10.9	9.84	8.63
26	$1\,000 < N \le 10\,000$	12.8	12.5	12.0	11.5	11.0	10.6	10.1	9.57	9.06	8.55	8.04	7.53	7.02	6.51	5.88	5.16
27	$10\,000 < N \le 25\,000$	10.5	10.2	9.83	9.41	8.99	8.68	8.26	7.84	7.42	7.00	6.59	6.17	5.75	5.33	4.81	4.22
28	$25\,000 < N \le 50\,000$	8.98	8.80	8.44	8.08	7.72	7.45	7.09	6.73	6.37	6.01	5.66	5.30	4.94	4.58	4.13	3.63
29	$50\,000 < N \le 75\,000$	8.20	8.03	7.71	7.38	7.05	6.80	6.48	6.15	5.82	5.49	5.16	4.84	4.51	4.18	3.78	3.31
30	$75\,000 < N \le 100\,000$	7.69	7.53	7.23	6.92	6.61	6.38	6.07	5.77	5.46	5.15	4.84	4.54	4.23	3.92	3.54	3.11
31	$N \le 1\,000$	21.4	20.9	20.1	19.2	18.4	17.7	16.9	16.0	15.2	14.3	13.5	12.6	11.7	10.9	9.84	8.63
32	$1\,000 < N \le 10\,000$	12.8	12.5	12.0	11.5	11.0	10.6	10.1	9.57	9.06	8.55	8.04	7.53	7.02	6.51	5.88	5.16
33	$10\,000 < N \le 25\,000$	10.5	10.2	9.83	9.41	8.99	8.68	8.26	7.84	7.42	7.00	6.59	6.17	5.75	5.33	4.81	4.22
34	$25\,000 < N \le 50\,000$	8.98	8.80	8.44	8.08	7.72	7.45	7.09	6.73	6.37	6.01	5.66	5.30	4.94	4.58	4.13	3.63
35	$50\,000 < N \le 75\,000$	8.20	8.03	7.71	7.38	7.05	6.80	6.48	6.15	5.82	5.49	5.16	4.84	4.51	4.18	3.78	3.31
36	$75\,000 < N \le 100\,000$	7.69	7.53	7.23	6.92	6.61	6.38	6.07	5.77	5.46	5.15	4.84	4.54	4.23	3.92	3.54	3.11
37	$N \le 1\,000$	4.26	4.21	4.08	3.95	3.82	3.69	3.56	3.43	3.30	3.17	3.04	2.91	2.88	2.61	2.35	2.09
38	$1\,000 < N \le 10\,000$	4.26	4.21	4.08	3.95	3.82	3.69	3.56	3.43	3.30	3.17	3.04	2.91	2.88	2.61	2.35	2.09
39	$10\,000 < N \le 25\,000$	4.26	4.21	4.08	3.95	3.82	3.69	3.56	3.43	3.30	3.17	3.04	2.91	2.88	2.61	2.35	2.09
40	$25\,000 < N \le 50\,000$	4.26	4.21	4.08	3.95	3.82	3.69	3.56	3.43	3.30	3.17	3.04	2.91	2.88	2.61	2.35	2.09

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
41	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	93.3	D01 (0.5)	M24, M25, M26
42	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	93.3	D01 (0.5)	M24, M25, M26
43	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	82.2	D01 (0.5)	M24, M25, M27
44	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	82.2	D01 (0.5)	M24, M25, M27
45	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	82.2	D01 (0.5)	M24, M25, M27
46	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	82.2	D01 (0.5)	M24, M25, M27
47	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	82.2	D01 (0.5)	M24, M25, M27
48	PEX	Extruded pipe	F2788/ F2788M	PEX XX06	C02	20.0	82.2	D01 (0.5)	M24, M25, M27
49	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	93.3	D01 (0.5)	M24, M25, M28
50	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	93.3	D01 (0.5)	M24, M25, M28
51	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	93.3	D01 (0.5)	M24, M25, M28
52	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	93.3	D01 (0.5)	M24, M25, M28
53	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	93.3	D01 (0.5)	M24, M25, M28
54	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	93.3	D01 (0.5)	M24, M25, M28
55	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	82.2	D01 (0.5)	M24, M25, M29
56	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	82.2	D01 (0.5)	M24, M25, M29
57	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	82.2	D01 (0.5)	M24, M25, M29
58	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	82.2	D01 (0.5)	M24, M25, M29
59	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	82.2	D01 (0.5)	M24, M25, M29
60	PEX	Extruded pipe	F2788/ F2788M	PEX XX08	C02	20.0	82.2	D01 (0.5)	M24, M25, M29
61	Polyamide	Extruded pipe	SF-2945	PA 32312	...	48.0	82.2	D01	M03
62	Polyamide	Extruded pipe	SF-2945	PA 32312	...	48.0	82.2	D01	M03
63	Polyamide	Extruded pipe	SF-2945	PA 32312	...	48.0	82.2	D01	M03
64	Polyamide	Extruded pipe	SF-2945	PA 32312	...	48.0	82.2	D01	M03
65	Polyamide	Extruded pipe	SF-2945	PA 32312	...	48.0	82.2	D01	M03
66	Polyamide	Extruded pipe	SF-2945	PA 32312	...	48.0	82.2	D01	M03
67	Polyamide	Extruded pipe	SF-2945	PA 32316	...	48.0	82.2	D01	M04

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
		23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
41	50 000 < N ≤ 75 000	4.26	4.21	4.08	3.95	3.82	3.69	3.56	3.43	3.30	3.17	3.04	2.91	2.88	2.61	2.35	2.09
42	75 000 < N ≤ 100 000	4.26	4.21	4.08	3.95	3.82	3.69	3.56	3.43	3.30	3.17	3.04	2.91	2.88	2.61	2.35	2.09
43	N ≤ 1 000	4.26	4.21	4.08	3.95	3.82	3.69	3.56	3.43	3.30	3.17	3.04	2.91	2.88	2.61	...	...
44	1 000 < N ≤ 10 000	4.26	4.21	4.08	3.95	3.82	3.69	3.56	3.43	3.30	3.17	3.04	2.91	2.88	2.61	...	...
45	10 000 < N ≤ 25 000	4.26	4.21	4.08	3.95	3.82	3.69	3.56	3.43	3.30	3.17	3.04	2.91	2.88	2.61	...	...
46	25 000 < N≤ 50 000	4.26	4.21	4.08	3.95	3.82	3.69	3.56	3.43	3.30	3.17	3.04	2.91	2.88	2.61	...	...
47	50 000 < N ≤ 75 000	4.26	4.21	4.08	3.95	3.82	3.69	3.56	3.43	3.30	3.17	3.04	2.91	2.88	2.61	...	...
48	75 000 < N ≤ 100 000	4.26	4.21	4.08	3.95	3.82	3.69	3.56	3.43	3.30	3.17	3.04	2.91	2.88	2.61	...	...
49	N ≤ 1 000	5.43	5.34	5.11	4.88	4.64	4.41	4.18	3.95	3.72	3.48	3.25	3.02	2.79	2.61	2.35	2.09
50	1 000 < N ≤ 10 000	5.43	5.34	5.11	4.88	4.64	4.41	4.18	3.95	3.72	3.48	3.25	3.02	2.79	2.61	2.35	2.09
51	10 000 < N ≤ 25 000	5.43	5.34	5.11	4.88	4.64	4.41	4.18	3.95	3.72	3.48	3.25	3.02	2.79	2.61	2.35	2.09
52	25 000 < N ≤ 50 000	5.43	5.34	5.11	4.88	4.64	4.41	4.18	3.95	3.72	3.48	3.25	3.02	2.79	2.61	2.35	2.09
53	50 000 < N ≤ 75 000	5.43	5.34	5.11	4.88	4.64	4.41	4.18	3.95	3.72	3.48	3.25	3.02	2.79	2.61	2.35	2.09
54	75 000 < N ≤ 100 000	5.43	5.34	5.11	4.88	4.64	4.41	4.18	3.95	3.72	3.48	3.25	3.02	2.79	2.61	2.35	2.09
55	N≤ 1 000	5.43	5.34	5.11	4.88	4.64	4.41	4.18	3.95	3.72	3.48	3.25	3.02	2.79	2.61	...	...
56	1 000 < N ≤ 10 000	5.43	5.34	5.11	4.88	4.64	4.41	4.18	3.95	3.72	3.48	3.25	3.02	2.79	2.61	...	...
57	10 000 < N ≤ 25 000	5.43	5.34	5.11	4.88	4.64	4.41	4.18	3.95	3.72	3.48	3.25	3.02	2.79	2.61	...	...
58	25 000 < N ≤ 50 000	5.43	5.34	5.11	4.88	4.64	4.41	4.18	3.95	3.72	3.48	3.25	3.02	2.79	2.61	...	...
59	50 000 < N ≤ 75 000	5.43	5.34	5.11	4.88	4.64	4.41	4.18	3.95	3.72	3.48	3.25	3.02	2.79	2.61	...	...
60	75 000 < N ≤ 100 000	5.43	5.34	5.11	4.88	4.64	4.41	4.18	3.95	3.72	3.48	3.25	3.02	2.79	2.61	...	...
61	N ≤ 1 000	8.62	8.43	7.97	7.53	7.10	6.69	6.28	5.89	5.52	5.23	4.95	4.68	4.42	4.17	...	...
62	1 000 < N ≤ 10 000	8.62	8.43	7.97	7.53	7.10	6.69	6.28	5.89	5.52	5.23	4.95	4.68	4.42	4.17	...	...
63	10 000 < N ≤ 25 000	8.62	8.43	7.97	7.53	7.10	6.69	6.28	5.89	5.52	5.23	4.95	4.68	4.42	4.17	...	...
64	25 000 < N ≤ 50 000	8.62	8.43	7.97	7.53	7.10	6.69	6.28	5.89	5.52	5.23	4.95	4.68	4.42	4.17	...	...
65	50 000 < N ≤ 75 000	8.62	8.43	7.97	7.53	7.10	6.69	6.28	5.89	5.52	5.23	4.95	4.68	4.42	4.17	...	...
66	75 000 < N ≤ 100 000	8.62	8.43	7.97	7.53	7.10	6.69	6.28	5.89	5.52	5.23	4.95	4.68	4.42	4.17	...	...
67	N ≤ 1 000	8.62	8.43	7.97	7.53	7.10	6.69	6.28	5.89	5.52	5.23	4.95	4.68	4.42	4.17	...	...

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
68	Polyamide	Extruded pipe	SF-2945	PA 32316	...	48.0	82.2	D01	M04
69	Polyamide	Extruded pipe	SF-2945	PA 32316	...	48.0	82.2	D01	M04
70	Polyamide	Extruded pipe	SF-2945	PA 32316	...	48.0	82.2	D01	M04
71	Polyamide	Extruded pipe	SF-2945	PA 32316	...	48.0	82.2	D01	M04
72	Polyamide	Extruded pipe	SF-2945	PA 32316	...	48.0	82.2	D01	M04
73	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	40.0	82.2	D01 (0.5)	M30
74	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	40.0	82.2	D01 (0.5)	M30
75	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	40.0	82.2	D01 (0.5)	M30
76	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	40.0	82.2	D01 (0.5)	M30
77	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	40.0	82.2	D01 (0.5)	M30
78	Polyamide-12	Extruded pipe	SF-2785	PA 42316	...	40.0	82.2	D01 (0.5)	M30
79	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	60.0	D01	M05, M06
80	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	60.0	D01	M05, M06
81	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	60.0	D01	M05, M06
82	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	60.0	D01	M05, M06
83	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	60.0	D01	M05, M06
84	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	60.0	D01	M05, M06
85	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	82.2	D01	M05, M07
86	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	82.2	D01	M05, M07
87	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	82.2	D01	M05, M07
88	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	82.2	D01	M05, M07
89	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	82.2	D01	M05, M07
90	Polyethylene	Extruded pipe	SD-2239	PE2708	...	17.9	82.2	D01	M05, M07
91	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	60.0	D01	M06, M08
92	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	60.0	D01	M06, M08
93	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	60.0	D01	M06, M08
94	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	60.0	D01	M06, M08
95	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	60.0	D01	M06, M08
96	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	60.0	D01	M06, M08
97	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	82.2	D01	M07, M08
98	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	82.2	D01	M07, M08
99	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	82.2	D01	M07, M08
100	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	82.2	D01	M07, M08
101	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	82.2	D01	M07, M08
102	Polyethylene	Extruded pipe	SD-2513	PE2708	...	17.9	82.2	D01	M07, M08
103	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	60.0	D01	M05, M06
104	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	60.0	D01	M05, M06
105	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	60.0	D01	M05, M06
106	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	60.0	D01	M05, M06
107	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	60.0	D01	M05, M06
108	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	60.0	D01	M05, M06
109	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	82.2	D01	M05, M07

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
		23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
68	1 000 < N ≤ 10 000	8.62	8.43	7.97	7.53	7.10	6.69	6.28	5.89	5.52	5.23	4.95	4.68	4.42	4.17	...	...
69	10 000 < N ≤ 25 000	8.62	8.43	7.97	7.53	7.10	6.69	6.28	5.89	5.52	5.23	4.95	4.68	4.42	4.17	...	...
70	25 000 < N ≤ 50 000	8.62	8.43	7.97	7.53	7.10	6.69	6.28	5.89	5.52	5.23	4.95	4.68	4.42	4.17	...	...
71	50 000 < N ≤ 75 000	8.62	8.43	7.97	7.53	7.10	6.69	6.28	5.89	5.52	5.23	4.95	4.68	4.42	4.17	...	...
72	75 000 < N ≤ 100 000	8.62	8.43	7.97	7.53	7.10	6.69	6.28	5.89	5.52	5.23	4.95	4.68	4.42	4.17	...	...
73	N ≤ 1 000	10.71	10.53	10.08	9.63	9.19	8.74	8.29	7.85	7.49	6.95	6.50	6.06	5.61	5.16	...	...
74	1 000 < N ≤ 10 000	10.71	10.53	10.08	9.63	9.19	8.74	8.29	7.85	7.49	6.95	6.50	6.06	5.61	5.16	...	...
75	10 000 < N ≤ 25 000	10.71	10.53	10.08	9.63	9.19	8.74	8.29	7.85	7.49	6.95	6.50	6.06	5.61	5.16	...	...
76	25 000 < N ≤ 50 000	10.71	10.53	10.08	9.63	9.19	8.74	8.29	7.85	7.49	6.95	6.50	6.06	5.61	5.16	...	...
77	50 000 < N ≤ 75 000	10.71	10.53	10.08	9.63	9.19	8.74	8.29	7.85	7.49	6.95	6.50	6.06	5.61	5.16	...	...
78	75 000 < N ≤ 100 000	10.71	10.53	10.08	9.63	9.19	8.74	8.29	7.85	7.49	6.95	6.50	6.06	5.61	5.16	...	...
79	N ≤ 1 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
80	1 000 < N ≤ 10 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
81	10 000 < N ≤ 25 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
82	25 000 < N ≤ 50 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
83	50 000 < N ≤ 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
84	N > 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
85	N ≤ 1 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
86	1 000 < N ≤ 10 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
87	10 000 < N ≤ 25 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
88	25 000 < N ≤ 50 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
89	50 000 < N ≤ 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
90	N > 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
91	N ≤ 1 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
92	1 000 < N ≤ 10 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
93	10 000 < N ≤ 25 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
94	25 000 < N ≤ 50 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
95	50 000 < N ≤ 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
96	N > 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
97	N ≤ 1 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
98	1 000 < N ≤ 10 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
99	10 000 < N ≤ 25 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
100	25 000 < N ≤ 50 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
101	50 000 < N ≤ 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
102	N > 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
103	N ≤ 1 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
104	1 000 < N ≤ 10 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
105	10 000 < N ≤ 25 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
106	25 000 < N ≤ 50 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
107	50 000 < N ≤ 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
108	N > 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
109	N ≤ 1 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
110	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	82.2	D01	M05, M07
111	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	82.2	D01	M05, M07
112	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	82.2	D01	M05, M07
113	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	82.2	D01	M05, M07
114	Polyethylene	Extruded tube	SD-2737	PE2708	...	17.9	82.2	D01	M05, M07
115	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	60.0	D01	M05, M06
116	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	60.0	D01	M05, M06
117	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	60.0	D01	M05, M06
118	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	60.0	D01	M05, M06
119	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	60.0	D01	M05, M06
120	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	60.0	D01	M05, M06
121	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	D01	M05, M07
122	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	D01	M05, M07
123	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	D01	M05, M07
124	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	D01	M05, M07
125	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	D01	M05, M07
126	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	D01	M05, M07
127	Polyethylene	Extruded pipe	SF-714	PE2708	...	17.9	60.0	D01	M06, M08
128	Polyethylene	Extruded pipe	SF-714	PE2708	...	17.9	60.0	D01	M06, M08
129	Polyethylene	Extruded pipe	SF-714	PE2708	...	17.9	60.0	D01	M06, M08
130	Polyethylene	Extruded pipe	SF-714	PE2708	...	17.9	60.0	D01	M06, M08
131	Polyethylene	Extruded pipe	SF-714	PE2708	...	17.9	60.0	D01	M06, M08
132	Polyethylene	Extruded pipe	SF-714	PE2708	...	17.9	60.0	D01	M06, M08
133	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	D01	M07, M08
134	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	D01	M07, M08
135	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	D01	M07, M08
136	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	D01	M07, M08
137	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	D01	M07, M08
138	Polyethylene	Extruded pipe	SD-3035	PE2708	...	17.9	82.2	D01	M07, M08
139	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D01	M05, M09
140	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D01	M05, M09
141	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D01	M05, M09
142	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D01	M05, M09
143	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D01	M05, M09
144	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D01	M05, M09
145	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D01	M05, M10
146	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D01	M05, M10
147	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D01	M05, M10
148	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D01	M05, M10
149	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D01	M05, M10
150	Polyethylene	Extruded pipe	SD-2239	PE3608	...	20.7	60.0	D01	M05, M10

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
		23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
110	1 000 < N ≤ 10 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
111	10 000 < N ≤ 25 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
112	25 000 < N ≤ 50 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
113	50 000 < N ≤ 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
114	N > 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
115	N ≤ 1 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
116	1 000 < N ≤ 10 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
117	10 000 < N ≤ 25 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
118	25 000 < N ≤ 50 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
119	50 000 < N ≤ 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
120	N > 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
121	N ≤ 1 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
122	1 000 < N ≤ 10 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
123	10 000 < N ≤ 25 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
124	25 000 < N ≤ 50 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
125	50 000 < N ≤ 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
126	N > 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
127	N ≤ 1 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
128	1 000 < N ≤ 10 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
129	10 000 < N ≤ 25 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
130	25 000 < N ≤ 50 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
131	50 000 < N ≤ 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
132	N > 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
133	N ≤ 1 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
134	1 000 < N ≤ 10 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
135	10 000 < N ≤ 25 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
136	25 000 < N ≤ 50 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
137	50 000 < N ≤ 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
138	N > 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
139	N ≤ 1 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
140	1 000 < N ≤ 10 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
141	10 000 < N ≤ 25 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
142	25 000 < N ≤ 50 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
143	50 000 < N ≤ 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
144	N > 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
145	N ≤ 1 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
146	1 000 < N ≤ 10 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
147	10 000 < N ≤ 25 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
148	25 000 < N ≤ 50 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
149	50 000 < N ≤ 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
150	N > 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
151	Polyethylene	Extruded pipe	SD-2239	PE4608	...	20.7	60.0	D01	M05, M10
152	Polyethylene	Extruded pipe	SD-2239	PE4608	...	20.7	60.0	D01	M05, M10
153	Polyethylene	Extruded pipe	SD-2239	PE4608	...	20.7	60.0	D01	M05, M10
154	Polyethylene	Extruded pipe	SD-2239	PE4608	...	20.7	60.0	D01	M05, M10
155	Polyethylene	Extruded pipe	SD-2239	PE4608	...	20.7	60.0	D01	M05, M10
156	Polyethylene	Extruded pipe	SD-2239	PE4608	...	20.7	60.0	D01	M05, M10
157	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D01	M05, M11
158	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D01	M05, M11
159	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D01	M05, M11
160	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D01	M05, M11
161	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D01	M05, M11
162	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D01	M05, M11
163	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D01	M05, M12
164	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D01	M05, M12
165	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D01	M05, M12
166	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D01	M05, M12
167	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D01	M05, M12
168	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	60.0	D01	M05, M12
169	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	82.2	D01	M05, M13
170	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	82.2	D01	M05, M13
171	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	82.2	D01	M05, M13
172	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	82.2	D01	M05, M13
173	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	82.2	D01	M05, M13
174	Polyethylene	Extruded pipe	SD-2239	PE4710	...	20.7	82.2	D01	M05, M13
175	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D01	M08, M11
176	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D01	M08, M11
177	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D01	M08, M11
178	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D01	M08, M11
179	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D01	M08, M11
180	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D01	M08, M11
181	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D01	M08, M12
182	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D01	M08, M12
183	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D01	M08, M12
184	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D01	M08, M12
185	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D01	M08, M12
186	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	60.0	D01	M08, M12
187	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	82.2	D01	M08, M13
188	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	82.2	D01	M08, M13
189	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	82.2	D01	M08, M13
190	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	82.2	D01	M08, M13
191	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	82.2	D01	M08, M13
192	Polyethylene	Extruded pipe	SD-2513	PE4710	...	20.7	82.2	D01	M08, M13

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
		23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
151	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
152	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
153	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
154	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
155	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
156	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
157	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
158	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
159	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
160	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
161	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
162	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
163	$N \le 1\,000$	26.8	26.3	25.3	24.3	23.3	22.2	21.2	20.1	19.0	...	...	...	...	...	...	...
164	$1\,000 < N \le 10\,000$	17.7	17.4	16.8	16.2	15.5	14.9	14.2	13.5	12.8	...	...	...	...	...	...	...
165	$10\,000 < N \le 25\,000$	15.0	14.8	14.3	13.8	13.2	12.7	12.1	11.6	11.0	...	...	...	...	...	...	...
166	$25\,000 < N \le 50\,000$	13.3	13.1	12.6	12.2	11.7	11.2	10.8	10.3	9.77	...	...	...	...	...	...	...
167	$50\,000 < N \le 75\,000$	12.3	12.1	11.7	11.3	10.9	10.5	10.0	9.59	9.11	...	...	...	...	...	...	...
168	$N > 75\,000$	11.7	11.5	11.2	10.8	10.4	9.97	9.55	9.12	8.68	...	...	...	...	...	...	...
169	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
170	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
171	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
172	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
173	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
174	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
175	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
176	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
177	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
178	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
179	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
180	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
181	$N \le 1\,000$	26.8	26.3	25.3	24.3	23.3	22.2	21.2	20.1	19.0	...	...	...	...	...	...	...
182	$1\,000 < N \le 10\,000$	17.7	17.4	16.8	16.2	15.5	14.9	14.2	13.5	12.8	...	...	...	...	...	...	...
183	$10\,000 < N \le 25\,000$	15.0	14.8	14.3	13.8	13.2	12.7	12.1	11.6	11.0	...	...	...	...	...	...	...
184	$25\,000 < N \le 50\,000$	13.3	13.1	12.6	12.2	11.7	11.2	10.8	10.3	9.77	...	...	...	...	...	...	...
185	$50\,000 < N \le 75\,000$	12.3	12.1	11.7	11.3	10.9	10.5	10.0	9.59	9.11	...	...	...	...	...	...	...
186	$N > 75\,000$	11.7	11.5	11.2	10.8	10.4	9.97	9.55	9.12	8.68	...	...	...	...	...	...	...
187	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
188	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
189	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
190	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
191	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
192	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
193	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D01	M05, M09
194	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D01	M05, M09
195	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D01	M05, M09
196	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D01	M05, M09
197	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D01	M05, M09
198	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D01	M05, M09
199	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D01	M05, M10
200	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D01	M05, M10
201	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D01	M05, M10
202	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D01	M05, M10
203	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D01	M05, M10
204	Polyethylene	Extruded tube	SD-2737	PE3608	...	20.7	60.0	D01	M05, M10
205	Polyethylene	Extruded tube	SD-2737	PE4608	...	20.7	60.0	D01	M05, M10
206	Polyethylene	Extruded tube	SD-2737	PE4608	...	20.7	60.0	D01	M05, M10
207	Polyethylene	Extruded tube	SD-2737	PE4608	...	20.7	60.0	D01	M05, M10
208	Polyethylene	Extruded tube	SD-2737	PE4608	...	20.7	60.0	D01	M05, M10
209	Polyethylene	Extruded tube	SD-2737	PE4608	...	20.7	60.0	D01	M05, M10
210	Polyethylene	Extruded tube	SD-2737	PE4608	...	20.7	60.0	D01	M05, M10
211	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D01	M05, M11
212	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D01	M05, M11
213	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D01	M05, M11
214	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D01	M05, M11
215	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D01	M05, M11
216	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D01	M05, M11
217	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D01	M05, M12
218	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D01	M05, M12
219	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D01	M05, M12
220	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D01	M05, M12
221	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D01	M05, M12
222	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	60.0	D01	M05, M12
223	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	82.2	D01	M05, M13
224	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	82.2	D01	M05, M13
225	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	82.2	D01	M05, M13
226	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	82.2	D01	M05, M13
227	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	82.2	D01	M05, M13
228	Polyethylene	Extruded tube	SD-2737	PE4710	...	20.7	82.2	D01	M05, M13
229	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D01	M05, M09
230	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D01	M05, M09
231	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D01	M05, M09
232	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D01	M05, M09
233	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D01	M05, M09

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
		23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
193	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
194	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
195	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
196	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
197	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
198	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
199	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
200	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
201	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
202	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
203	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
204	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
205	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
206	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
207	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
208	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
209	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
210	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
211	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
212	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
213	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
214	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
215	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
216	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
217	$N \le 1\,000$	26.8	26.3	25.3	24.3	23.3	22.2	21.2	20.1	19.0	...	...	...	...	...	...	...
218	$1\,000 < N \le 10\,000$	17.7	17.4	16.8	16.2	15.5	14.9	14.2	13.5	12.8	...	...	...	...	...	...	...
219	$10\,000 < N \le 25\,000$	15.0	14.8	14.3	13.8	13.2	12.7	12.1	11.6	11.0	...	...	...	...	...	...	...
220	$25\,000 < N \le 50\,000$	13.3	13.1	12.6	12.2	11.7	11.2	10.8	10.3	9.77	...	...	...	...	...	...	...
221	$50\,000 < N \le 75\,000$	12.3	12.1	11.7	11.3	10.9	10.5	10.0	9.59	9.11	...	...	...	...	...	...	...
222	$N > 75\,000$	11.7	11.5	11.2	10.8	10.4	9.97	9.55	9.12	8.68	...	...	...	...	...	...	...
223	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
224	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
225	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
226	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
227	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
228	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
229	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
230	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
231	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
232	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
233	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
234	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D01	M05, M09
235	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D01	M05, M10
236	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D01	M05, M10
237	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D01	M05, M10
238	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D01	M05, M10
239	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D01	M05, M10
240	Polyethylene	Extruded pipe	SD-3035	PE3608	...	20.7	60.0	D01	M05, M10
241	Polyethylene	Extruded pipe	SD-3035	PE4608	...	20.7	60.0	D01	M05, M10
242	Polyethylene	Extruded pipe	SD-3035	PE4608	...	20.7	60.0	D01	M05, M10
243	Polyethylene	Extruded pipe	SD-3035	PE4608	...	20.7	60.0	D01	M05, M10
244	Polyethylene	Extruded pipe	SD-3035	PE4608	...	20.7	60.0	D01	M05, M10
245	Polyethylene	Extruded pipe	SD-3035	PE4608	...	20.7	60.0	D01	M05, M10
246	Polyethylene	Extruded pipe	SD-3035	PE4608	...	20.7	60.0	D01	M05, M10
247	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D01	M05, M11
248	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D01	M05, M11
249	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D01	M05, M11
250	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D01	M05, M11
251	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D01	M05, M11
252	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D01	M05, M11
253	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D01	M05, M12
254	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D01	M05, M12
255	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D01	M05, M12
256	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D01	M05, M12
257	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D01	M05, M12
258	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	60.0	D01	M05, M12
259	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	82.2	D01	M05, M13
260	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	82.2	D01	M05, M13
261	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	82.2	D01	M05, M13
262	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	82.2	D01	M05, M13
263	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	82.2	D01	M05, M13
264	Polyethylene	Extruded pipe	SD-3035	PE4710	...	20.7	82.2	D01	M05, M13
265	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D01	M08, M09
266	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D01	M08, M09
267	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D01	M08, M09
268	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D01	M08, M09
269	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D01	M08, M09
270	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D01	M08, M09
271	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D01	M08, M10
272	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D01	M08, M10
273	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D01	M08, M10
274	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D01	M08, M10

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
		23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
234	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
235	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
236	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
237	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
238	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
239	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
240	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
241	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
242	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
243	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
244	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
245	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
246	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
247	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
248	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
249	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
250	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
251	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
252	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
253	$N \le 1\,000$	26.8	26.3	25.3	24.3	23.3	22.2	21.2	20.1	19.0	...	...	...	...	...	...	...
254	$1\,000 < N \le 10\,000$	17.7	17.4	16.8	16.2	15.5	14.9	14.2	13.5	12.8	...	...	...	...	...	...	...
255	$10\,000 < N \le 25\,000$	15.0	14.8	14.3	13.8	13.2	12.7	12.1	11.6	11.0	...	...	...	...	...	...	...
256	$25\,000 < N \le 50\,000$	13.3	13.1	12.6	12.2	11.7	11.2	10.8	10.3	9.77	...	...	...	...	...	...	...
257	$50\,000 < N \le 75\,000$	12.3	12.1	11.7	11.3	10.9	10.5	10.0	9.59	9.11	...	...	...	...	...	...	...
258	$N > 75\,000$	11.7	11.5	11.2	10.8	10.4	9.97	9.55	9.12	8.68	...	...	...	...	...	...	...
259	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
260	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
261	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
262	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
263	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
264	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
265	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
266	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
267	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
268	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
269	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
270	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
271	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
272	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
273	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
274	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
275	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D01	M08, M10
276	Polyethylene	Extruded pipe	SF-714	PE3608	...	20.7	60.0	D01	M08, M10
277	Polyethylene	Extruded pipe	SF-714	PE4608	...	20.7	60.0	D01	M08, M10
278	Polyethylene	Extruded pipe	SF-714	PE4608	...	20.7	60.0	D01	M08, M10
279	Polyethylene	Extruded pipe	SF-714	PE4608	...	20.7	60.0	D01	M08, M10
280	Polyethylene	Extruded pipe	SF-714	PE4608	...	20.7	60.0	D01	M08, M10
281	Polyethylene	Extruded pipe	SF-714	PE4608	...	20.7	60.0	D01	M08, M10
282	Polyethylene	Extruded pipe	SF-714	PE4608	...	20.7	60.0	D01	M08, M10
283	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D01	M08, M11
284	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D01	M08, M11
285	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D01	M08, M11
286	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D01	M08, M11
287	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D01	M08, M11
288	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D01	M08, M11
289	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D01	M08, M12
290	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D01	M08, M12
291	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D01	M08, M12
292	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D01	M08, M12
293	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D01	M08, M12
294	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	60.0	D01	M08, M12
295	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	82.2	D01	M08, M13
296	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	82.2	D01	M08, M13
297	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	82.2	D01	M08, M13
298	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	82.2	D01	M08, M13
299	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	82.2	D01	M08, M13
300	Polyethylene	Extruded pipe	SF-714	PE4710	...	20.7	82.2	D01	M08, M13
301	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D01	M09, M14
302	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D01	M09, M14
303	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D01	M09, M14
304	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D01	M09, M14
305	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D01	M09, M14
306	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D01	M09, M14
307	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D01	M10, M14
308	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D01	M10, M14
309	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D01	M10, M14
310	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D01	M10, M14
311	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D01	M10, M14
312	Polyethylene	Extruded pipe	SF-2619	PE3608	...	20.7	60.0	D01	M10, M14
313	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D01	M11, M14
314	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D01	M11, M14
315	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D01	M11, M14

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
		23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
275	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
276	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
277	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
278	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
279	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
280	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
281	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
282	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
283	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
284	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
285	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
286	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
287	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
288	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
289	$N \le 1\,000$	26.8	26.3	25.3	24.3	23.3	22.2	21.2	20.1	19.0	...	...	...	...	...	...	...
290	$1\,000 < N \le 10\,000$	17.7	17.4	16.8	16.2	15.5	14.9	14.2	13.5	12.8	...	...	...	...	...	...	...
291	$10\,000 < N \le 25\,000$	15.0	14.8	14.3	13.8	13.2	12.7	12.1	11.6	11.0	...	...	...	...	...	...	...
292	$25\,000 < N \le 50\,000$	13.3	13.1	12.6	12.2	11.7	11.2	10.8	10.3	9.77	...	...	...	...	...	...	...
293	$50\,000 < N \le 75\,000$	12.3	12.1	11.7	11.3	10.9	10.5	10.0	9.59	9.11	...	...	...	...	...	...	...
294	$N > 75\,000$	11.7	11.5	11.2	10.8	10.4	9.97	9.55	9.12	8.68	...	...	...	...	...	...	...
295	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
296	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
297	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
298	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
299	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
300	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
301	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
302	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
303	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
304	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
305	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
306	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
307	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
308	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
309	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
310	$25\,000 < N \le 50\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
311	$50\,000 < N \le 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
312	$N > 75\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
313	$N \le 1\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
314	$1\,000 < N \le 10\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
315	$10\,000 < N \le 25\,000$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
316	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D01	M11, M14
317	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D01	M11, M14
318	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D01	M11, M14
319	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D01	M12, M14
320	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D01	M12, M14
321	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D01	M12, M14
322	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D01	M12, M14
323	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D01	M12, M14
324	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	60.0	D01	M12, M14
325	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	82.2	D01	M13, M14
326	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	82.2	D01	M13, M14
327	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	82.2	D01	M13, M14
328	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	82.2	D01	M13, M14
329	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	82.2	D01	M13, M14
330	Polyethylene	Extruded pipe	SF-2619	PE4710	...	20.7	82.2	D01	M13, M14
331	PVC	Extruded pipe	SD-1785	PVC2110	C01	41.4	60.0	D01	M15
332	PVC	Extruded pipe	SD-1785	PVC2110	C01	41.4	60.0	D01	M15
333	PVC	Extruded pipe	SD-1785	PVC2110	C01	41.4	60.0	D01	M15
334	PVC	Extruded pipe	SD-1785	PVC2110	C01	41.4	60.0	D01	M15
335	PVC	Extruded pipe	SD-1785	PVC2110	C01	41.4	60.0	D01	M15
336	PVC	Extruded pipe	SD-1785	PVC2110	C01	41.4	60.0	D01	M15
337	PVC	Extruded pipe	SD-1785	PVC2112	C01	41.4	60.0	D01	M16
338	PVC	Extruded pipe	SD-1785	PVC2112	C01	41.4	60.0	D01	M16
339	PVC	Extruded pipe	SD-1785	PVC2112	C01	41.4	60.0	D01	M16
340	PVC	Extruded pipe	SD-1785	PVC2112	C01	41.4	60.0	D01	M16
341	PVC	Extruded pipe	SD-1785	PVC2112	C01	41.4	60.0	D01	M16
342	PVC	Extruded pipe	SD-1785	PVC2112	C01	41.4	60.0	D01	M16
343	PVC	Extruded pipe	SD-1785	PVC2116	C01	41.4	60.0	D01	M17
344	PVC	Extruded pipe	SD-1785	PVC2116	C01	41.4	60.0	D01	M17
345	PVC	Extruded pipe	SD-1785	PVC2116	C01	41.4	60.0	D01	M17
346	PVC	Extruded pipe	SD-1785	PVC2116	C01	41.4	60.0	D01	M17
347	PVC	Extruded pipe	SD-1785	PVC2116	C01	41.4	60.0	D01	M17
348	PVC	Extruded pipe	SD-1785	PVC2116	C01	41.4	60.0	D01	M17
349	PVC	Extruded pipe	SD-1785	PVC2120	C01	41.4	60.0	D01	M18
350	PVC	Extruded pipe	SD-1785	PVC2120	C01	41.4	60.0	D01	M18
351	PVC	Extruded pipe	SD-1785	PVC2120	C01	41.4	60.0	D01	M18
352	PVC	Extruded pipe	SD-1785	PVC2120	C01	41.4	60.0	D01	M18
353	PVC	Extruded pipe	SD-1785	PVC2120	C01	41.4	60.0	D01	M18
354	PVC	Extruded pipe	SD-1785	PVC2120	C01	41.4	60.0	D01	M18
355	PVC	Extruded tube	SD-2241	PVC2110	C01	41.4	60.0	D01	M15
356	PVC	Extruded tube	SD-2241	PVC2110	C01	41.4	60.0	D01	M15

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
		23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
316	25 000 < N ≤ 50 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
317	50 000 < N ≤ 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
318	N > 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
319	N ≤ 1 000	26.8	26.3	25.3	24.3	23.3	22.2	21.2	20.1	19.0	...	...	...	...	...	...	...
320	1 000 < N ≤ 10 000	17.7	17.4	16.8	16.2	15.5	14.9	14.2	13.5	12.8	...	...	...	...	...	...	...
321	10 000 < N ≤ 25 000	15.0	14.8	14.3	13.8	13.2	12.7	12.1	11.6	11.0	...	...	...	...	...	...	...
322	25 000 < N ≤ 50 000	13.3	13.1	12.6	12.2	11.7	11.2	10.8	10.3	9.77	...	...	...	...	...	...	...
323	50 000 < N ≤ 75 000	12.3	12.1	11.7	11.3	10.9	10.5	10.0	9.59	9.11	...	...	...	...	...	...	...
324	N > 75 000	11.7	11.5	11.2	10.8	10.4	9.97	9.55	9.12	8.68	...	...	...	...	...	...	...
325	N ≤ 1 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
326	1 000 < N ≤ 10 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
327	10 000 < N ≤ 25 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
328	25 000 < N ≤ 50 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
329	50 000 < N ≤ 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
330	N > 75 000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
331	N ≤ 1 000	21.4	20.7	19.2	17.7	16.2	14.7	13.0	11.5	10.0	...	...	...	...	...	...	...
332	1 000 < N ≤ 10 000	12.8	12.4	11.5	10.6	9.69	8.80	7.78	6.89	5.99	...	...	...	...	...	...	...
333	10 000 < N ≤ 25 000	10.5	10.1	9.41	8.68	7.94	7.21	6.38	5.64	4.91	...	...	...	...	...	...	...
334	25 000 < N ≤ 50 000	8.98	8.71	8.08	7.45	6.82	6.19	5.48	4.85	4.22	...	...	...	...	...	...	...
335	50 000 < N ≤ 75 000	8.20	7.95	7.38	6.80	6.23	5.66	5.00	4.43	3.85	...	...	...	...	...	...	...
336	75 000 < N ≤ 100 000	7.69	7.46	6.92	6.38	5.84	5.30	4.69	4.15	3.61	...	...	...	...	...	...	...
337	N ≤ 1 000	21.4	20.7	19.2	17.7	16.2	14.7	13.0	11.5	10.0	...	...	...	...	...	...	...
338	1 000 < N ≤ 10 000	12.8	12.4	11.5	10.6	9.69	8.80	7.78	6.89	5.99	...	...	...	...	...	...	...
339	10 000 < N ≤ 25 000	10.5	10.1	9.41	8.68	7.94	7.21	6.38	5.64	4.91	...	...	...	...	...	...	...
340	25 000 < N ≤ 50 000	8.98	8.71	8.08	7.45	6.82	6.19	5.48	4.85	4.22	...	...	...	...	...	...	...
341	50 000 < N ≤ 75 000	8.20	7.95	7.38	6.80	6.23	5.66	5.00	4.43	3.85	...	...	...	...	...	...	...
342	75 000 < N ≤ 100 000	7.69	7.46	6.92	6.38	5.84	5.30	4.69	4.15	3.61	...	...	...	...	...	...	...
343	N ≤ 1 000	21.4	20.7	19.2	17.7	16.2	14.7	13.0	11.5	10.0	...	...	...	...	...	...	...
344	1 000 < N ≤ 10 000	12.8	12.4	11.5	10.6	9.69	8.80	7.78	6.89	5.99	...	...	...	...	...	...	...
345	10 000 < N ≤ 25 000	10.5	10.1	9.41	8.68	7.94	7.21	6.38	5.64	4.91	...	...	...	...	...	...	...
346	25 000 < N ≤ 50 000	8.98	8.71	8.08	7.45	6.82	6.19	5.48	4.85	4.22	...	...	...	...	...	...	...
347	50 000 < N ≤ 75 000	8.20	7.95	7.38	6.80	6.23	5.66	5.00	4.43	3.85	...	...	...	...	...	...	...
348	75 000 < N ≤ 100 000	7.69	7.46	6.92	6.38	5.84	5.30	4.69	4.15	3.61	...	...	...	...	...	...	...
349	N ≤ 1 000	21.4	20.7	19.2	17.7	16.2	14.7	13.0	11.5	10.0	...	...	...	...	...	...	...
350	1 000 < N ≤ 10 000	12.8	12.4	11.5	10.6	9.69	8.80	7.78	6.89	5.99	...	...	...	...	...	...	...
351	10 000 < N ≤ 25 000	10.5	10.1	9.41	8.68	7.94	7.21	6.38	5.64	4.91	...	...	...	...	...	...	...
352	25 000 < N ≤ 50 000	8.98	8.71	8.08	7.45	6.82	6.19	5.48	4.85	4.22	...	...	...	...	...	...	...
353	50 000 < N ≤ 75 000	8.20	7.95	7.38	6.80	6.23	5.66	5.00	4.43	3.85	...	...	...	...	...	...	...
354	75 000 < N ≤ 100 000	7.69	7.46	6.92	6.38	5.84	5.30	4.69	4.15	3.61	...	...	...	...	...	...	...
355	N ≤ 1 000	21.4	20.7	19.2	17.7	16.2	14.7	13.0	11.5	10.0	...	...	...	...	...	...	...
356	1 000 < N ≤ 10 000	12.8	12.4	11.5	10.6	9.69	8.80	7.78	6.89	5.99	...	...	...	...	...	...	...

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
357	PVC	Extruded tube	SD-2241	PVC2110	C01	41.4	60.0	D01	M15
358	PVC	Extruded tube	SD-2241	PVC2110	C01	41.4	60.0	D01	M15
359	PVC	Extruded tube	SD-2241	PVC2110	C01	41.4	60.0	D01	M15
360	PVC	Extruded tube	SD-2241	PVC2110	C01	41.4	60.0	D01	M15
361	PVC	Extruded tube	SD-2241	PVC2112	C01	41.4	60.0	D01	M16
362	PVC	Extruded tube	SD-2241	PVC2112	C01	41.4	60.0	D01	M16
363	PVC	Extruded tube	SD-2241	PVC2112	C01	41.4	60.0	D01	M16
364	PVC	Extruded tube	SD-2241	PVC2112	C01	41.4	60.0	D01	M16
365	PVC	Extruded tube	SD-2241	PVC2112	C01	41.4	60.0	D01	M16
366	PVC	Extruded tube	SD-2241	PVC2112	C01	41.4	60.0	D01	M16
367	PVC	Extruded tube	SD-2241	PVC2116	C01	41.4	60.0	D01	M17
368	PVC	Extruded tube	SD-2241	PVC2116	C01	41.4	60.0	D01	M17
369	PVC	Extruded tube	SD-2241	PVC2116	C01	41.4	60.0	D01	M17
370	PVC	Extruded tube	SD-2241	PVC2116	C01	41.4	60.0	D01	M17
371	PVC	Extruded tube	SD-2241	PVC2116	C01	41.4	60.0	D01	M17
372	PVC	Extruded tube	SD-2241	PVC2116	C01	41.4	60.0	D01	M17
373	PVC	Extruded tube	SD-2241	PVC2120	C01	41.4	60.0	D01	M18
374	PVC	Extruded tube	SD-2241	PVC2120	C01	41.4	60.0	D01	M18
375	PVC	Extruded tube	SD-2241	PVC2120	C01	41.4	60.0	D01	M18
376	PVC	Extruded tube	SD-2241	PVC2120	C01	41.4	60.0	D01	M18
377	PVC	Extruded tube	SD-2241	PVC2120	C01	41.4	60.0	D01	M18
378	PVC	Extruded tube	SD-2241	PVC2120	C01	41.4	60.0	D01	M18
379	PVC	Extruded pipe	SD-1785	PVC1120	C01	48.3	60.0	D01	M19
380	PVC	Extruded pipe	SD-1785	PVC1120	C01	48.3	60.0	D01	M19
381	PVC	Extruded pipe	SD-1785	PVC1120	C01	48.3	60.0	D01	M19
382	PVC	Extruded pipe	SD-1785	PVC1120	C01	48.3	60.0	D01	M19
383	PVC	Extruded pipe	SD-1785	PVC1120	C01	48.3	60.0	D01	M19
384	PVC	Extruded pipe	SD-1785	PVC1120	C01	48.3	60.0	D01	M19
385	PVC	Extruded pipe	SD-1785	PVC1220	C01	48.3	60.0	D01	M19
386	PVC	Extruded pipe	SD-1785	PVC1220	C01	48.3	60.0	D01	M19
387	PVC	Extruded pipe	SD-1785	PVC1220	C01	48.3	60.0	D01	M19
388	PVC	Extruded pipe	SD-1785	PVC1220	C01	48.3	60.0	D01	M19
389	PVC	Extruded pipe	SD-1785	PVC1220	C01	48.3	60.0	D01	M19
390	PVC	Extruded pipe	SD-1785	PVC1220	C01	48.3	60.0	D01	M19
391	PVC	Extruded pipe	SD-2241	PVC1120	C01	48.3	60.0	D01	M19
392	PVC	Extruded pipe	SD-2241	PVC1120	C01	48.3	60.0	D01	M19
393	PVC	Extruded pipe	SD-2241	PVC1120	C01	48.3	60.0	D01	M19
394	PVC	Extruded pipe	SD-2241	PVC1120	C01	48.3	60.0	D01	M19
395	PVC	Extruded pipe	SD-2241	PVC1120	C01	48.3	60.0	D01	M19
396	PVC	Extruded pipe	SD-2241	PVC1120	C01	48.3	60.0	D01	M19
397	PVC	Extruded pipe	SD-2241	PVC1220	C01	48.3	60.0	D01	M19
398	PVC	Extruded pipe	SD-2241	PVC1220	C01	48.3	60.0	D01	M19

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
		23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
357	10 000 < N ≤ 25 000	10.5	10.1	9.41	8.68	7.94	7.21	6.38	5.64	4.91	...	...	...	...	...	...	...
358	25 000 < N ≤ 50 000	8.98	8.71	8.08	7.45	6.82	6.19	5.48	4.85	4.22	...	...	...	...	...	...	...
359	50 000 < N ≤ 75 000	8.20	7.95	7.38	6.80	6.23	5.66	5.00	4.43	3.85	...	...	...	...	...	...	...
360	75 000 < N ≤ 100 000	7.69	7.46	6.92	6.38	5.84	5.30	4.69	4.15	3.61	...	...	...	...	...	...	...
361	N ≤ 1 000	21.4	20.7	19.2	17.7	16.2	14.7	13.0	11.5	10.0	...	...	...	...	...	...	...
362	1 000 < N ≤ 10 000	12.8	12.4	11.5	10.6	9.69	8.80	7.78	6.89	5.99	...	...	...	...	...	...	...
363	10 000 < N ≤ 25 000	10.5	10.1	9.41	8.68	7.94	7.21	6.38	5.64	4.91	...	...	...	...	...	...	...
364	25 000 < N ≤ 50 000	8.98	8.71	8.08	7.45	6.82	6.19	5.48	4.85	4.22	...	...	...	...	...	...	...
365	50 000 < N ≤ 75 000	8.20	7.95	7.38	6.80	6.23	5.66	5.00	4.43	3.85	...	...	...	...	...	...	...
366	75 000 < N ≤ 100 000	7.69	7.46	6.92	6.38	5.84	5.30	4.69	4.15	3.61	...	...	...	...	...	...	...
367	N ≤ 1 000	21.4	20.7	19.2	17.7	16.2	14.7	13.0	11.5	10.0	...	...	...	...	...	...	...
368	1 000 < N ≤ 10 000	12.8	12.4	11.5	10.6	9.69	8.80	7.78	6.89	5.99	...	...	...	...	...	...	...
369	10 000 < N ≤ 25 000	10.5	10.1	9.41	8.68	7.94	7.21	6.38	5.64	4.91	...	...	...	...	...	...	...
370	25 000 < N ≤ 50 000	8.98	8.71	8.08	7.45	6.82	6.19	5.48	4.85	4.22	...	...	...	...	...	...	...
371	50 000 < N ≤ 75 000	8.20	7.95	7.38	6.80	6.23	5.66	5.00	4.43	3.85	...	...	...	...	...	...	...
372	75 000 < N ≤ 100 000	7.69	7.46	6.92	6.38	5.84	5.30	4.69	4.15	3.61	...	...	...	...	...	...	...
373	N ≤ 1 000	21.4	20.7	19.2	17.7	16.2	14.7	13.0	11.5	10.0	...	...	...	...	...	...	...
374	1 000 < N ≤ 10 000	12.8	12.4	11.5	10.6	9.69	8.80	7.78	6.89	5.99	...	...	...	...	...	...	...
375	10 000 < N ≤ 25 000	10.5	10.1	9.41	8.68	7.94	7.21	6.38	5.64	4.91	...	...	...	...	...	...	...
376	25 000 < N ≤ 50 000	8.98	8.71	8.08	7.45	6.82	6.19	5.48	4.85	4.22	...	...	...	...	...	...	...
377	50 000 < N ≤ 75 000	8.20	7.95	7.38	6.80	6.23	5.66	5.00	4.43	3.85	...	...	...	...	...	...	...
378	75 000 < N ≤ 100 000	7.69	7.46	6.92	6.38	5.84	5.30	4.69	4.15	3.61	...	...	...	...	...	...	...
379	N ≤ 1 000	21.4	20.7	19.2	17.7	16.2	14.7	13.0	11.5	10.0	...	...	...	...	...	...	...
380	1 000 < N ≤ 10 000	12.8	12.4	11.5	10.6	9.69	8.80	7.78	6.89	5.99	...	...	...	...	...	...	...
381	10 000 < N ≤ 25 000	10.5	10.1	9.41	8.68	7.94	7.21	6.38	5.64	4.91	...	...	...	...	...	...	...
382	25 000 < N ≤ 50 000	8.98	8.71	8.08	7.45	6.82	6.19	5.48	4.85	4.22	...	...	...	...	...	...	...
383	50 000 < N ≤ 75 000	8.20	7.95	7.38	6.80	6.23	5.66	5.00	4.43	3.85	...	...	...	...	...	...	...
384	75 000 < N ≤ 100 000	7.69	7.46	6.92	6.38	5.84	5.30	4.69	4.15	3.61	...	...	...	...	...	...	...
385	N ≤ 1 000	21.4	20.7	19.2	17.7	16.2	14.7	13.0	11.5	10.0	...	...	...	...	...	...	...
386	1 000 < N ≤ 10 000	12.8	12.4	11.5	10.6	9.69	8.80	7.78	6.89	5.99	...	...	...	...	...	...	...
387	10 000 < N ≤ 25 000	10.5	10.1	9.41	8.68	7.94	7.21	6.38	5.64	4.91	...	...	...	...	...	...	...
388	25 000 < N ≤ 50 000	8.98	8.71	8.08	7.45	6.82	6.19	5.48	4.85	4.22	...	...	...	...	...	...	...
389	50 000 < N ≤ 75 000	8.20	7.95	7.38	6.80	6.23	5.66	5.00	4.43	3.85	...	...	...	...	...	...	...
390	75 000 < N ≤ 100 000	7.69	7.46	6.92	6.38	5.84	5.30	4.69	4.15	3.61	...	...	...	...	...	...	...
391	N ≤ 1 000	21.4	20.7	19.2	17.7	16.2	14.7	13.0	11.5	10.0	...	...	...	...	...	...	...
392	1 000 < N ≤ 10 000	12.8	12.4	11.5	10.6	9.69	8.80	7.78	6.89	5.99	...	...	...	...	...	...	...
393	10 000 < N ≤ 25 000	10.5	10.1	9.41	8.68	7.94	7.21	6.38	5.64	4.91	...	...	...	...	...	...	...
394	25 000 < N ≤ 50 000	8.98	8.71	8.08	7.45	6.82	6.19	5.48	4.85	4.22	...	...	...	...	...	...	...
395	50 000 < N ≤ 75 000	8.20	7.95	7.38	6.80	6.23	5.66	5.00	4.43	3.85	...	...	...	...	...	...	...
396	75 000 < N ≤ 100 000	7.69	7.46	6.92	6.38	5.84	5.30	4.69	4.15	3.61	...	...	...	...	...	...	...
397	N ≤ 1 000	21.4	20.7	19.2	17.7	16.2	14.7	13.0	11.5	10.0	...	...	...	...	...	...	...
398	1 000 < N ≤ 10 000	12.8	12.4	11.5	10.6	9.69	8.80	7.78	6.89	5.99	...	...	...	...	...	...	...

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Construction Code Notes	Minimum Yield Strength, MPa	Maximum Temperature Limit, °C	Design Factor	Notes
399	PVC	Extruded pipe	SD-2241	PVC1220	C01	48.3	60.0	D01	M19
400	PVC	Extruded pipe	SD-2241	PVC1220	C01	48.3	60.0	D01	M19
401	PVC	Extruded pipe	SD-2241	PVC1220	C01	48.3	60.0	D01	M19
402	PVC	Extruded pipe	SD-2241	PVC1220	C01	48.3	60.0	D01	M19
403	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	48.3	54.4	D01	M20, M21
404	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	48.3	54.4	D01	M20, M21
405	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	48.3	54.4	D01	M20, M21
406	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	48.3	54.4	D01	M20, M21
407	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	48.3	54.4	D01	M20, M21
408	PVC	Extruded pipe	SF-1483	PVCO 1135	C01	48.3	54.4	D01	M20, M21
409	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	44.8	93.3	D01	M22
410	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	44.8	93.3	D01	M22
411	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	44.8	93.3	D01	M22
412	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	44.8	93.3	D01	M22
413	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	44.8	93.3	D01	M22
414	PVDF	Extruded pipe	SF-1673	PVDF 2020	...	44.8	93.3	D01	M22
415	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	53.0	93.3	D01	M23
416	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	53.0	93.3	D01	M23
417	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	53.0	93.3	D01	M23
418	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	53.0	93.3	D01	M23
419	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	53.0	93.3	D01	M23
420	PVDF	Extruded pipe	SF-1673	PVDF 2025	...	53.0	93.3	D01	M23

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

Line No.	Number of Equivalent Thermal Cycles, N	Maximum Allowable Secondary Stress Range, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
		23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
399	10 000 < N ≤ 25 000	10.5	10.1	9.41	8.68	7.94	7.21	6.38	5.64	4.91	...	...	...	...	...	...	...
400	25 000 < N ≤ 50 000	8.98	8.71	8.08	7.45	6.82	6.19	5.48	4.85	4.22	...	...	...	...	...	...	...
401	50 000 < N ≤ 75 000	8.20	7.95	7.38	6.80	6.23	5.66	5.00	4.43	3.85	...	...	...	...	...	...	...
402	75 000 < N ≤ 100 000	7.69	7.46	6.92	6.38	5.84	5.30	4.69	4.15	3.61	...	...	...	...	...	...	...
403	N ≤ 1 000	21.4	20.7	19.2	17.7	16.2	14.7	13.0	11.5	...	...	...	...	...	...	...	...
404	1 000 < N ≤ 10 000	12.8	12.4	11.5	10.6	9.69	8.80	7.78	6.89	...	...	...	...	...	...	...	...
405	10 000 < N ≤ 25 000	10.5	10.1	9.41	8.68	7.94	7.21	6.38	5.64	...	...	...	...	...	...	...	...
406	25 000 < N ≤ 50 000	8.98	8.71	8.08	7.45	6.82	6.19	5.48	4.85	...	...	...	...	...	...	...	...
407	50 000 < N ≤ 75 000	8.20	7.95	7.38	6.80	6.23	5.66	5.00	4.43	...	...	...	...	...	...	...	...
408	75 000 < N ≤ 100 000	7.69	7.46	6.92	6.38	5.84	5.30	4.69	4.15	...	...	...	...	...	...	...	...
409	N ≤ 1 000	45.6	44.9	43.2	41.4	39.6	37.8	36.1	34.3	32.5	30.9	29.2	27.5	25.9	24.2	22.5	19.2
410	1 000 < N ≤ 10 000	43.5	42.9	41.3	39.6	38.0	36.4	34.8	33.2	31.6	29.9	28.3	26.7	25.0	23.4	21.8	18.5
411	10 000 < N ≤ 25 000	42.7	42.1	40.5	39.0	37.4	35.9	34.3	32.8	31.2	29.6	27.9	26.3	24.7	23.1	21.4	18.2
412	25 000 < N ≤ 50 000	42.0	41.4	39.9	38.4	36.9	35.4	33.9	32.4	30.9	29.3	27.7	26.1	24.4	22.8	21.2	18.0
413	50 000 < N ≤ 75 000	41.7	41.1	39.6	38.1	36.7	35.2	33.7	32.2	30.7	29.1	27.5	25.9	24.3	22.7	21.1	17.9
414	75 000 < N ≤ 100 000	41.4	40.8	39.4	37.9	36.5	35.0	33.5	32.1	30.6	29.0	27.4	25.8	24.2	22.6	21.0	17.8
415	N ≤ 1 000	53.9	53.1	51.0	48.9	46.8	44.7	42.7	40.6	38.5	36.5	34.5	32.6	30.6	28.6	26.7	22.7
416	1 000 < N ≤ 10 000	51.5	50.7	48.8	46.9	45.0	43.1	41.2	39.2	37.3	35.4	33.5	31.5	29.6	27.7	25.7	21.9
417	10 000 < N ≤ 25 000	50.5	49.7	47.9	46.1	44.2	42.4	40.6	38.7	36.9	35.0	33.0	31.1	29.2	27.3	25.4	21.5
418	25 000 < N ≤ 50 000	49.7	49.0	47.2	45.4	43.7	41.9	40.1	38.3	36.5	34.6	32.7	30.8	28.9	27.0	25.1	21.3
419	50 000 < N ≤ 75 000	49.3	48.6	46.8	45.1	43.3	41.6	39.8	38.1	36.3	34.4	32.5	30.6	28.7	26.8	24.9	21.1
420	75 000 < N ≤ 100 000	49.0	48.3	46.5	44.8	43.1	41.4	39.6	37.9	36.2	34.3	32.4	30.5	28.6	26.7	24.8	21.0

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

GENERAL NOTES:

(a) The stress values in this Table may be interpolated to determine values for intermediate temperatures. The values at intermediate temperatures shall be rounded to the same number of decimal places as the value at the higher temperature between which values are being interpolated. The rounding rule is: when the next digit beyond the last place to be retained is less than 5, retain unchanged the digit in the last place retained; when the next digit beyond the last place to be retained is 5 or greater, increase by 1 the digit in the last place retained.

(b) The following abbreviations are used: CPVC, chlorinated poly(vinyl chloride); PEX, cross-linked polyethylene; PVC, poly(vinyl chloride); and PVDF, poly(vinylidene fluoride).

NOTE: (1) Multiply MPa by 1 000 to obtain kPa.

CONSTRUCTION CODE NOTES (ASME NM.1):

C01 Compounding ingredients may vary between material manufacturers for the same grade of CPVC or PVC. While these different ingredients do not impact the allowable stress values provided in this Table, they can influence the acceptability of the various joining methods allowed by ASME NM.1. In addition to the material and joining requirements set forth in ASME NM.1, the joining method to be used shall be approved by the piping component manufacturer.

C02 Cross-linking method may vary between material manufacturers for the same grade of PEX. While these different methods do not impact the allowable stress values provided in this Table, they can influence the acceptability of the various joining methods allowed by ASME NM.1. In addition to the material and joining requirements set forth in ASME NM.1, the joining method to be used shall be approved by the piping component manufacturer.

DESIGN FACTOR NOTE (ASME NM.1):

D01 Allowable stress range values are based on a design factor (DF) of 0.50.

MATERIAL NOTES:

M01 Material shall have a
(a) minimum impact resistance of 80.1 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 482 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 100°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 23°C and 1,000 psi at 82.2°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 23°C and 500 psi at 82.2°C in accordance with ASTM D2837

M02 Material shall have a
(a) minimum impact resistance of 80.1 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 482 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 100°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 23°C and 1,250 psi at 82.2°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 23°C and 625 psi at 82.2°C in accordance with ASTM D2837

M03 Material shall have a
(a) classification of Group 3, Class 2, and Grade 3 in accordance with ASTM D4066.
(b) minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ± 10% at 23°C ± 2°C and 50% ± 5% relative humidity.
(c) minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ± 50% at 23°C ± 2°C and 50% ± 5% relative humidity.
(d) minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.
(e) minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.
(f) hydrostatic design basis (HDB) of 2,500 psi at 23°C, 1,600 psi at 60°C, and 1,250 psi at 82.2°C in accordance with ASTM D2837.
(g) hydrostatic design stress (HDS) of 1,250 psi at 23°C, 800 psi at 60°C, and 625 psi at 82.2°C in accordance with ASTM D2837.

M04 Material shall have a
(a) classification of Group 3, Class 2, and Grade 3 in accordance with ASTM D4066.
(b) minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ± 10% at 23°C ± 2°C and 50% ± 5% relative humidity.
(c) minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ± 50% at 23°C ± 2°C and 50% ± 5% relative humidity.
(d) minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.
(e) minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.
(f) hydrostatic design basis (HDB) of 3,150 psi at 23°C and 1,600 psi at 82.2°C in accordance with ASTM D2837.
(g) hydrostatic design stress (HDS) of 1,600 psi at 23°C and 800 psi at 82.2°C in accordance with ASTM D2837.

M05 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, natural with UV stabilizer, or colored with UV stabilizer.

M06 Material shall have a
(a) thermal stability of over 220°C in accordance with ASTM D3350

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

(b) maximum brittleness temperature of –60°C in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C
(d) slow crack growth resistance of over 500 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,250 psi at 23°C and 1,000 psi at 60°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M07 Material shall have a
(a) thermal stability of over 220°C in accordance with ASTM D3350
(b) maximum brittleness temperature of –60°C in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C
(d) slow crack growth resistance of over 500 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,250 psi at 23°C and 630 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M08 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, or colored with UV stabilizer.

M09 Material shall have a
(a) thermal stability of over 220°C in accordance with ASTM D3350
(b) maximum brittleness temperature of –60°C in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C
(d) slow crack growth resistance of over 100 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 800 psi at 60°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M10 Material shall have a
(a) thermal stability of over 220°C in accordance with ASTM D3350
(b) maximum brittleness temperature of –60°C in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C
(d) slow crack growth resistance of over 100 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 1,000 psi at 60°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M11 Material shall have a
(a) thermal stability of over 220°C in accordance with ASTM D3350
(b) maximum brittleness temperature of –60°C in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C
(d) slow crack growth resistance of over 500 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 800 psi at 60°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 1,000 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M12 Material shall have a
(a) thermal stability of over 220°C in accordance with ASTM D3350
(b) maximum brittleness temperature of –60°C in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C
(d) slow crack growth resistance of over 500 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 1,000 psi at 60°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 1,000 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M13 Material shall have a
(a) thermal stability of over 220°C in accordance with ASTM D3350
(b) maximum brittleness temperature of –60°C in accordance with ASTM D746
(c) minimum tensile elongation at break of 400% in accordance with ASTM D638, using a Type IV tensile bar at 50 mm/min at 23°C
(d) slow crack growth resistance of over 500 h in accordance with ASTM F1473 at 2.4 MPa and 80°C in air
(e) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 800 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4
(f) hydrostatic design stress (HDS) of 1,000 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4

M14 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603.

M15 Material shall have a
(a) minimum impact resistance of 266.9 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 206 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 60°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 2,000 psi at 23°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,000 psi at 23°C in accordance with ASTM D2837

M16 Material shall have a
(a) minimum impact resistance of 266.9 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 206 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 60°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 2,500 psi at 23°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,250 psi at 23°C in accordance with ASTM D2837

M17 Material shall have a
(a) minimum impact resistance of 266.9 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 206 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 60°C at a load of 1.82 MPa in accordance with ASTM D648

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 3,200 psi at 23°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 1,600 psi at 23°C in accordance with ASTM D2837

M18 Material shall have a
(a) minimum impact resistance of 266.9 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 206 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 60°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 23°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 23°C in accordance with ASTM D2837

M19 Material shall have a
(a) minimum impact resistance of 34.7 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 758 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 70°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 4,000 psi at 23°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 23°C in accordance with ASTM D2837

M20 Material shall have a
(a) minimum impact resistance of 266.9 J/m of notch at 23°C in accordance with ASTM D256
(b) minimum modulus of elasticity in tension of 2 206 MPa at 23°C in accordance with ASTM D638
(c) minimum deflection temperature under load of 60°C at a load of 1.82 MPa in accordance with ASTM D648
(d) average extent of burning of under 25 mm and an average time of burning of under 10 s in accordance with ASTM D635
(e) hydrostatic design basis (HDB) of 7,100 psi at 23°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 3,550 psi at 23°C in accordance with ASTM D2837

M21 Allowable stress values apply to both the oriented and unoriented directions.

M22 Material shall have a
(a) classification of Type I in accordance with ASME SD-3222
(b) minimum impact resistance of 80.0 J/m of notch at 23°C in accordance with ASTM D256
(c) minimum flexural modulus of 1.38 GPa at 23°C in accordance with ASTM D790, using Method I
(d) minimum tensile elongation at break of 10% in accordance with ASTM D638, using a Type I tensile bar at 51 mm/min at 23°C
(e) hydrostatic design basis (HDB) of 4,000 psi at 23°C and 1,250 psi at 93.3°C in accordance with ASTM D2837
(f) hydrostatic design stress (HDS) of 2,000 psi at 23°C and 625 psi at 93.3°C in accordance with ASTM D2837

M23 Material shall have a
(a) classification of Type II in accordance with ASME SD-3222
(b) minimum flexural modulus of 1.38 GPa at 23°C in accordance with ASTM D790, using Method I
(c) minimum tensile elongation at break of 10% in accordance with ASTM D638, using a Type I tensile bar at 51 mm/min at 23°C
(d) hydrostatic design basis (HDB) of 5,000 psi at 23°C and 1,250 psi at 120°C in accordance with ASTM D2837
(e) hydrostatic design stress (HDS) of 2,500 psi at 23°C and 625 psi at 120°C in accordance with ASTM D2837

M24 The first two digits (XX) of the PEX Type/Grade designation may be any designation permitted by ASTM F2788. They relate to end-use properties such as oxidation and UV resistance and do not affect strength.

M25 Material shall have a carbon black percentage of 2% to 3% in accordance with ASTM D4218 or ASTM D1603, natural with UV stabilizer, or colored with UV stabilizer. The degree of cross-linking for PEX pipe material shall be within the range from 65% to 89%, inclusive.
(a) PEX cross-linked using peroxides shall have a minimum degree of cross-linking of 70%.
(b) PEX cross-linked using silane compounds shall have a minimum degree of cross-linking of 65%.
(c) PEX cross-linked using electron beam compounds shall have a minimum degree of cross-linking of 65%.

M26 Material shall have a
(a) minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
(b) hydrostatic design basis (HDB) of 1,250 psi at 23°C and 630 psi at 93.3°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
(c) hydrostatic design stress (HDS) of 625 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M27 Material shall have a
(a) minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
(b) hydrostatic design basis (HDB) of 1,250 psi at 23°C and 800 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
(c) hydrostatic design stress (HDS) of 625 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M28 Material shall have a
(a) minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
(b) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 630 psi at 93.3°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
(c) hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M29 Material shall have a
(a) minimum elongation at break of 200% measured in accordance with ISO 6259-1 and ISO 6259-3. Test temperature shall be 23°C ± 2°C.
(b) hydrostatic design basis (HDB) of 1,600 psi at 23°C and 800 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.
(c) hydrostatic design stress (HDS) of 800 psi at 23°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

M30 Material shall have a
(a) classification of Group 4, Class 2, and Grade 3 in accordance with ASTM D6779.
(b) minimum elongation at break of 200% in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ± 10% at 23°C and 50% ± 5% relative humidity.
(c) minimum flexural modulus of 900 MPa in accordance with ASTM D790, Procedure A using a 3.2 mm × 12.7 mm × 127 mm test specimen. The testing shall be performed with a crosshead speed of 1.3 mm/min ± 50% at 23°C ± 2°C and 50% ± 5% relative humidity.

Table 1-1-3M Maximum Allowable Secondary Stress Range Values, S_A, for Thermoplastic Materials (Cont'd)

MATERIAL NOTES: (Cont'd)

(d) minimum izod impact resistance of 55 J/m in accordance with ASTM D256, using a test specimen with a 12.7-mm depth, a 3.17-mm width, and a notch radius of 0.25 mm.

(e) minimum deflection temperature of 40°C at 1.82 MPa in accordance with ASTM D648, using an unannealed test specimen 3.17 mm in width.

(f) hydrostatic design basis (HDB) of 3,150 psi at 23°C and 1,600 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(g) hydrostatic design stress (HDS) of 1,600 psi at 23°C and 800 psi at 82.2°C in accordance with ASTM D2837, PPI TR-3, and PPI TR-4.

(20)

Table 1-1-YM Yield Strength Values, S_y, for Thermoplastic Materials

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Minimum Yield Strength, MPa	Notes
1	CPVC	Extruded pipe	SD-2846	CPVC 4120-05	48.3	M01
2	CPVC	Extruded pipe	SD-2846	CPVC 4120-06	48.3	M01
3	CPVC	Extruded pipe	SF-441	CPVC 4120-05	48.3	M01
4	CPVC	Extruded pipe	SF-441	CPVC 4120-06	48.3	M01
5	CPVC	Extruded pipe	SF-442	CPVC 4120-05	48.3	M01
6	CPVC	Extruded pipe	SF-442	CPVC 4120-06	48.3	M01
7	PEX	Extruded pipe	F2788/F2788M	PEX XX06	20.0	M07, M08
8	PEX	Extruded pipe	F2788/F2788M	PEX XX08	20.0	M07, M08
9	Polyamide	Extruded pipe	SF-2945	PA 32312	48.0	M02
10	Polyamide	Extruded pipe	SF-2945	PA 32316	48.0	M02
11	Polyamide-12	Extruded pipe	SF-2785	PA 42316	40	M09
12	Polyethylene	Extruded pipe	SD-2239	PE2708	17.9	M03
13	Polyethylene	Extruded pipe	SD-2513	PE2708	17.9	M03
14	Polyethylene	Extruded tube	SD-2737	PE2708	17.9	M03
15	Polyethylene	Extruded pipe	SD-3035	PE2708	17.9	M03
16	Polyethylene	Extruded pipe	SF-714	PE2708	17.9	M03
17	Polyethylene	Extruded pipe	SD-2239	PE3608	20.7	M03
18	Polyethylene	Extruded pipe	SD-2239	PE4608	20.7	M03
19	Polyethylene	Extruded pipe	SD-2239	PE4710	20.7	M03
20	Polyethylene	Extruded pipe	SD-2513	PE4710	20.7	M03
21	Polyethylene	Extruded tube	SD-2737	PE3608	20.7	M03
22	Polyethylene	Extruded tube	SD-2737	PE4608	20.7	M03
23	Polyethylene	Extruded tube	SD-2737	PE4710	20.7	M03
24	Polyethylene	Extruded pipe	SD-3035	PE3608	20.7	M03
25	Polyethylene	Extruded pipe	SD-3035	PE4608	20.7	M03
26	Polyethylene	Extruded pipe	SD-3035	PE4710	20.7	M03
27	Polyethylene	Extruded pipe	SF-714	PE3608	20.7	M03
28	Polyethylene	Extruded pipe	SF-714	PE4608	20.7	M03
29	Polyethylene	Extruded pipe	SF-714	PE4710	20.7	M03
30	Polyethylene	Extruded pipe	SF-2619	PE3608	20.7	M03
31	Polyethylene	Extruded pipe	SF-2619	PE4710	20.7	M03
32	PVC	Extruded pipe	SD-1785	PVC2110	41.4	M01
33	PVC	Extruded pipe	SD-1785	PVC2112	41.4	M01
34	PVC	Extruded pipe	SD-1785	PVC2116	41.4	M01
35	PVC	Extruded pipe	SD-1785	PVC2120	41.4	M01

Table 1-1-YM Yield Strength Values, S_y, for Thermoplastic Materials

Line No.	Yield Strength, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
	23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
1	48.3	47.3	45.4	43.5	41.5	40.1	38.2	36.2	34.3	32.4	30.4	28.5	26.6	24.6	22.7	20.8
2	48.3	47.3	45.4	43.5	41.5	40.1	38.2	36.2	34.3	32.4	30.4	28.5	26.6	24.6	22.7	20.8
3	48.3	47.3	45.4	43.5	41.5	40.1	38.2	36.2	34.3	32.4	30.4	28.5	26.6	24.6	22.7	20.8
4	48.3	47.3	45.4	43.5	41.5	40.1	38.2	36.2	34.3	32.4	30.4	28.5	26.6	24.6	22.7	20.8
5	48.3	47.3	45.4	43.5	41.5	40.1	38.2	36.2	34.3	32.4	30.4	28.5	26.6	24.6	22.7	20.8
6	48.3	47.3	45.4	43.5	41.5	40.1	38.2	36.2	34.3	32.4	30.4	28.5	26.6	24.6	22.7	20.8
7	20.6	20.4	19.9	19.3	18.6	17.9	17.2	16.4	15.5	14.6	13.7	12.7	11.7	10.6	9.4	8.3
8	20.6	20.4	19.9	19.3	18.6	17.9	17.2	16.4	15.5	14.6	13.7	12.7	11.7	10.6	9.4	8.3
9	48.0	46.3	42.6	39.2	36.1	33.4	30.9	28.7	26.8	25.2	23.9	22.9	22.2	21.8	...	...
10	48.0	46.3	42.6	39.2	36.1	33.4	30.9	28.7	26.8	25.2	23.9	22.9	22.2	21.8	...	...
11	41.6	39.3	34.8	31.4	28.7	26.6	24.8	23.3	21.9	20.8	19.8	18.9	18.1	17.4	...	...
12	17.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
13	17.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
14	17.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
15	17.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
16	17.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17	20.7	20.1	18.7	17.3	15.9	14.5	13.1	11.7	10.3	8.89	7.49	...	...	...	...	...
18	20.7	20.1	18.7	17.2	15.8	14.4	13.0	11.6	10.2	8.81	7.41	6.00	4.59	...	...	...
19	20.7	20.1	18.7	17.2	15.8	14.4	13.0	11.6	10.2	8.81	7.41	6.00	4.59	...	...	...
20	20.7	20.1	18.7	17.2	15.8	14.4	13.0	11.6	10.2	8.81	7.41	6.00	4.59	...	...	...
21	20.7	20.1	18.7	17.3	15.9	14.5	13.1	11.7	10.3	8.89	7.49	...	...	...	...	...
22	20.7	20.1	18.7	17.2	15.8	14.4	13.0	11.6	10.2	8.81	7.41	6.00	4.59	...	...	...
23	20.7	20.1	18.7	17.2	15.8	14.4	13.0	11.6	10.2	8.81	7.41	6.00	4.59	...	...	...
24	20.7	20.1	18.7	17.3	15.9	14.5	13.1	11.7	10.3	8.89	7.49	...	...	...	...	...
25	20.7	20.1	18.7	17.2	15.8	14.4	13.0	11.6	10.2	8.81	7.41	6.00	4.59	...	...	...
26	20.7	20.1	18.7	17.2	15.8	14.4	13.0	11.6	10.2	8.81	7.41	6.00	4.59	...	...	...
27	20.7	20.1	18.7	17.3	15.9	14.5	13.1	11.7	10.3	8.89	7.49	...	...	...	...	...
28	20.7	20.1	18.7	17.2	15.8	14.4	13.0	11.6	10.2	8.81	7.41	6.00	4.59	...	...	...
29	20.7	20.1	18.7	17.2	15.8	14.4	13.0	11.6	10.2	8.81	7.41	6.00	4.59	...	...	...
30	20.7	20.1	18.7	17.3	15.9	14.5	13.1	11.7	10.3	8.89	7.49	...	...	...	...	...
31	20.7	20.1	18.7	17.2	15.8	14.4	13.0	11.6	10.2	8.81	7.41	6.00	4.59	...	...	...
32	41.4	40.2	37.3	34.4	31.5	28.6	25.3	22.4	18.9	...	...	...	...	...	...	...
33	41.4	40.2	37.3	34.4	31.5	28.6	25.3	22.4	18.9	...	...	...	...	...	...	...
34	41.4	40.2	37.3	34.4	31.5	28.6	25.3	22.4	18.9	...	...	...	...	...	...	...
35	41.4	40.2	37.3	34.4	31.5	28.6	25.3	22.4	18.9	...	...	...	...	...	...	...

Table 1-1-YM Yield Strength Values, S_y, for Thermoplastic Materials (Cont'd)

Line No.	Nominal Composition	Product Form	ASME or ASTM Spec. No.	Type/Grade	Minimum Yield Strength, MPa	Notes
36	PVC	Extruded tube	SD-2241	PVC2110	41.4	M01
37	PVC	Extruded tube	SD-2241	PVC2112	41.4	M01
38	PVC	Extruded tube	SD-2241	PVC2116	41.4	M01
39	PVC	Extruded tube	SD-2241	PVC2120	41.4	M01
40	PVC	Extruded pipe	SD-1785	PVC1120	48.3	M01
41	PVC	Extruded pipe	SD-1785	PVC1220	48.3	M01
42	PVC	Extruded pipe	SD-2241	PVC1120	48.3	M01
43	PVC	Extruded pipe	SD-2241	PVC1220	48.3	M01
44	PVC	Extruded pipe	SF-1483	PVCO 1135	48.3	M01, M04
45	PVC	Extruded pipe	SF-1483	PVCO 1135	76.5	M01, M05
46	PVDF	Extruded pipe	SF-1673	PVDF 2020	44.8	M06
47	PVDF	Extruded pipe	SF-1673	PVDF 2025	53.0	M06

Table 1-1-YM Yield Strength Values, S_y, for Thermoplastic Materials (Cont'd)

Line No.	Yield Strength, MPa [Note (1)], for Material Temperature, °C, Not Exceeding															
	23	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
36	41.4	40.2	37.3	34.4	31.5	28.6	25.3	22.4	18.9	...	...	...	...	...	...	...
37	41.4	40.2	37.3	34.4	31.5	28.6	25.3	22.4	18.9	...	...	...	...	...	...	...
38	41.4	40.2	37.3	34.4	31.5	28.6	25.3	22.4	18.9	...	...	...	...	...	...	...
39	41.4	40.2	37.3	34.4	31.5	28.6	25.3	22.4	18.9	...	...	...	...	...	...	...
40	48.3	46.9	43.5	40.1	36.7	33.3	29.5	26.1	22.0	...	...	...	...	...	...	...
41	48.3	46.9	43.5	40.1	36.7	33.3	29.5	26.1	22.0	...	...	...	...	...	...	...
42	48.3	46.9	43.5	40.1	36.7	33.3	29.5	26.1	22.0	...	...	...	...	...	...	...
43	48.3	46.9	43.5	40.1	36.7	33.3	29.5	26.1	22.0	...	...	...	...	...	...	...
44	48.3	46.9	43.5	40.1	36.7	33.3	29.5	26.1	...	...	...	...	...	...	...	...
45	76.5	74.2	68.9	63.5	58.1	52.8	46.7	41.3	...	...	...	...	...	...	...	...
46	44.8	44.1	42.4	40.8	39.1	37.5	35.8	34.2	32.5	30.9	29.2	27.6	25.9	24.3	22.6	21.0
47	53.0	51.8	49.3	47.0	44.8	42.8	40.9	39.1	37.3	35.6	33.9	32.3	30.6	29.0	27.4	25.7

Table 1-1-YM Yield Strength Values, S_y, for Thermoplastic Materials (Cont'd)

GENERAL NOTES:

(a) The tabulated values of yield strength are those that the Committee believes are suitable for use in design calculations. At temperatures above room temperature, the yield strength values correspond to the yield strength trend curve adjusted to the minimum specified room-temperature yield strength. The yield strength values do not correspond exactly to "minimum" or "average" as these terms are applied to a statistical treatment of a homogeneous set of data. Neither the ASME material specifications nor the rules of ASME NM.1 require elevated temperature testing for yield strengths of production material for use in Code components. It is not intended that results of such tests, if performed, be compared with these tabulated yield strength values for ASME Code acceptance/rejection purposes for materials. If some elevated temperature test results on production material appear lower than the tabulated values by a large amount (more than the typical variability of material and suggesting the possibility of some error), further investigation by retest or other means should be considered.

(b) Notes limiting applications of these materials appear in Tables 1-1-1M, 1-1-2M, and 1-1-3M.

(c) The stress values in this Table may be interpolated to determine values for intermediate temperatures. The values at intermediate temperatures shall be rounded to the same number of decimal places as the value at the higher temperature between which values are being interpolated. The rounding rule is: when the next digit beyond the last place to be retained is less than 5, retain unchanged the digit in the last place retained; when the next digit beyond the last place to be retained is 5 or greater, increase by 1 the digit in the last place retained.

(d) The following abbreviations are used: CPVC, chlorinated poly(vinyl chloride); PEX, cross-linked polyethylene; PVC, poly(vinyl chloride); and PVDF, poly(vinylidene fluoride).

(e) Chlorinated poly(vinyl chloride), polyamide, polyethylene, poly(vinyl chloride), and poly(vinylidene fluoride) are viscoelastic materials. The stress values in this Table are based on short-duration loads and are not appropriate for use as design stresses for long-term sustained loads.

NOTE: (1) Multiply MPa by 1 000 to obtain kPa.

MATERIAL NOTES:

M01 The stress values for chlorinated poly(vinyl chloride) and poly(vinyl chloride) in this Table are based on tensile testing in accordance with ASTM D638 using a Type I tensile bar at 5.1 mm/min at 23°C. At other strain rates, other values may apply.

M02 The stress values for polyamide in this Table are based on tensile testing in accordance with ASTM D638, using a 3.2 mm ± 0.4 mm thick test specimen. The speed of testing shall be 50 mm/min ± 10% at 23°C ± 2°C and 50% ± 5% relative humidity. At other strain rates, other values may apply.

M03 The stress values for polyethylene in this Table are based on tensile testing in accordance with ASTM D638 using a Type IV tensile bar at 51 mm/min at 23°C. At other strain rates, other values may apply.

M04 These stress values for oriented poly(vinyl chloride) apply to the unoriented directions only.

M05 These stress values for oriented poly(vinyl chloride) apply to the oriented direction only.

M06 The stress values for poly(vinylidene fluoride) in this Table are based on tensile testing in accordance with ASTM D638 using a Type I tensile bar at 51 mm/min at 23°C. At other strain rates, other values may apply.

M07 The first two digits (XX) of the PEX Type/Grade designation may be any designation permitted by ASTM F2788. They relate to end-use properties such as oxidation and UV resistance and do not affect strength.

M08 The stress values for PEX in this Table are based in tensile testing in accordance with ASTM D638 using Type IV tensile bar at 2 in./min at 23°C. At other strain rates, other values may apply.

M09 The stress values for Polyamide-12 in this Table are based in tensile testing at 23°C ± 2°C and 50% ± 5% relative humidity in accordance with ISO 527 on Type 1A specimens with a strain rate of 50 mm/min. At other strain rates, other values may apply.

Table 1-2.1-1M Data Sheet for Fiberglass Unsaturated Polyester Resin Type I (SC-582)

Description and Service Limits

Reinforcement material:	Fiberglass (Type E or ECR glass)
Resin material:	Unsaturated polyester resin
Reinforcement pattern:	Random glass
Structural wall thickness range, mm:	2.5 to 17.5
Liner thickness, mm:	2.5

Modulus Data [Notes (1), (2), and (3)]

			Modulus of Elasticity for Total Wall Thickness, mm (Including 2.5-mm Liner), and Temperature, °C											
			Up to and Including 25°C				65°C				93°C			
Property	Symbol	ASTM Test Method	5	10	15	20 and Over	5	10	15	20 and Over	5	10	15	20 and Over
Axial tensile, MPa	E_{AT}	D638, D1599, or D2105	7.72E+03	7.79E+03	7.79E+03	7.79E+03	6.84E+03	6.90E+03	6.97E+03	6.97E+03	5.99E+03	6.06E+03	6.08E+03	6.10E+03
Axial compressive, MPa	E_{AC}	D695	7.72E+03	7.79E+03	7.79E+03	7.79E+03	6.84E+03	6.90E+03	6.97E+03	6.97E+03	5.99E+03	6.06E+03	6.08E+03	6.10E+03
Axial flexural, MPa	E_{AF}	D790 or D2925	7.45E+03	7.59E+03	7.72E+03	7.72E+03	6.59E+03	6.76E+03	6.83E+03	6.88E+03	5.75E+03	5.92E+03	5.99E+03	6.03E+03
Hoop tensile, MPa	E_{HT}	D638, D1599, or D2290	7.72E+03	7.79E+03	7.79E+03	7.79E+03	6.84E+03	6.90E+03	6.97E+03	6.97E+03	5.99E+03	6.06E+03	6.08E+03	6.10E+03
Hoop flexural, MPa	E_{HF}	D790 or D2412	7.45E+03	7.59E+03	7.72E+03	7.72E+03	6.59E+03	6.76E+04	6.83E+03	6.88E+04	5.75E+03	5.92E+03	5.99E+03	6.03E+03
In–plane shear, MPa	G	D4255	2.88E+03	2.90E+03	2.92E+03	2.92E+03	2.56E+03	2.58E+03	2.59E+03	2.60E+03	2.24E+03	2.27E+03	2.28E+03	2.28E+03

Other Property Data [Notes (1), (2), and (3)]

Property	Symbol	ASTM Test Method	Value for 5-mm Thickness
Poisson's ratio: hoop–axial tensile	ν_{HAT}	...	0.34
Poisson's ratio: axial–hoop tensile	ν_{AHT}	...	0.34
Coefficient of thermal expansion, mm/mm/°C: axial	α_A	D696	3.79E–05
Coefficient of thermal expansion, mm/mm/°C: hoop	α_H	...	3.79E–05
Density, kg/m^3	ρ	D792	1411.675
Thermal conductivity, W/(m-K)	k	C1045	0.182506

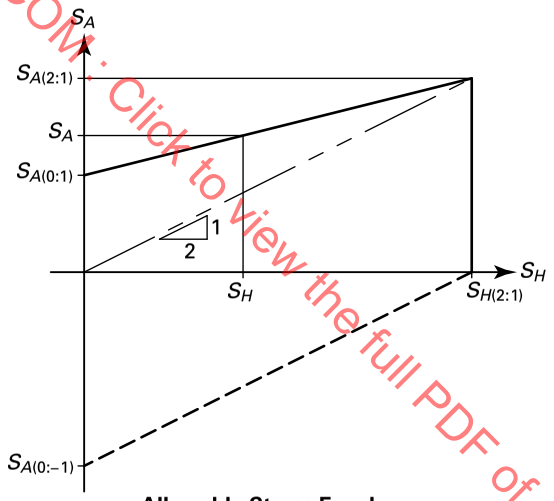
Allowable Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	25°C	65°C	93°C
Axial tensile, MPa	$S_{A(0:1)}$	D638 or D2105	7.79E+00	6.90E+00	6.06E+00
Axial flexural, MPa	$S_{Af(0:1)}$	D790 or D2925	1.14E+01	1.01E+01	8.90E+00
Axial compressive, MPa	$S_{A(0:-1)}$	D695	7.79E+00	6.90E+00	6.06E+00
Axial 2 × 1 biaxial tensile, MPa	$S_{A(2:1)}$	D1599	7.79E+00	6.90E+00	6.06E+00
Hoop 2 × 1 biaxial tensile, MPa	$S_{H(2:1)}$	D1599	7.79E+00	6.90E+00	6.06E+00
Hoop tensile, MPa	$S_{H(1:0)}$	D638, D1599, or D2290	7.79E+00	6.90E+00	6.06E+00
In-plane shear, MPa	τ	D4255	2.90E+00	2.58E+00	2.27E+00

Table 1-2.1-1M Data Sheet for Fiberglass Unsaturated Polyester Resin Type I (SC-582) (Cont'd)

Ultimate Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	25°C	65°C	93°C
Axial tensile, MPa	$S_{A(0:1)}$	D638 or D2105	7.79E+01	6.90E+01	6.06E+01
Axial flexural, MPa	$S_{Af(0:1)}$	D790 or D2925	1.14E+02	1.01E+02	8.90E+01
Axial compressive, MPa	$S_{A(0:-1)}$	D695	7.79E+01	6.90E+01	6.06E+01
Axial 2 × 1 biaxial tensile, MPa	$S_{A(2:1)}$	D1599	7.79E+01	6.90E+01	6.06E+01
Hoop 2 × 1 biaxial tensile, MPa	$S_{H(2:1)}$	D1599	7.79E+01	6.90E+01	6.06E+01
Hoop tensile, MPa	$S_{H(1:0)}$	D638, D1599, or D2290	7.79E+01	6.90E+01	6.06E+01
In-plane shear, MPa	τ	D4255	2.90E+01	2.58E+01	2.27E+01



Allowable Stress Envelope

GENERAL NOTES:

(a) The values in this table may be interpolated to determine values for intermediate temperatures and thicknesses.

(b) Refer to ASME NM.2, Table 3-3.1-1 for limitations on service based on temperature.

(c) The maximum allowable design stress value shall be 12 410 kPa for flanges constructed of Type I laminates.

NOTES:

(1) Elastic properties apply to total wall, not just to structural wall. This is to ensure that the loads on the piping, the supports, and the connected equipment, as calculated in the pipe stress analysis, are not understated.

(2) For modulus values of the structural wall only, or for pipe for which the liner thickness is 0.0 mm, it is permissible to use the modulus values applicable to a total wall thickness of 20 mm and over.

(3) Elastic properties may also be determined in accordance with ASME NM.2, Mandatory Appendix II.

(4) Allowable and ultimate stress values apply to the structural wall only, not the total wall thickness.

Table 1-2.1-2M Data Sheet for Fiberglass Unsaturated Polyester Resin Type II (SC-582)

Description and Service Limits

Reinforcement material:	Fiberglass (Type E or ECR glass)
Resin material:	Unsaturated polyester resin
Reinforcement pattern:	Random glass/WR (0/90)
Structural wall thickness range, mm:	2.5 to 17.5
Liner thickness, mm:	2.5

Modulus Data [Notes (1), (2), and (3)]

			Modulus of Elasticity for Total Wall Thickness, mm (Including 2.5-mm Liner), and Temperature, °C											
			Up to and Including 25°C				65°C				93°C			
Property	Symbol	ASTM Test Method	5	10	15	20 and Over	5	10	15	20 and Over	5	10	15	20 and Over
Axial tensile, MPa	E_{AT}	D638, D1599, or D2105	9.10E+03	1.04E+04	1.14E+04	1.15E+04	8.21E+03	9.52E+03	1.04E+04	1.06E+04	7.31E+03	8.62E+03	9.52E+03	9.66E+03
Axial compressive, MPa	E_{AC}	D695	9.10E+03	1.04E+04	1.14E+04	1.15E+04	8.21E+03	9.52E+03	1.04E+04	1.06E+04	7.31E+03	8.62E+03	9.52E+03	9.66E+03
Axial flexural, MPa	E_{AF}	D790 or D2925	8.14E+03	8.48E+03	9.93E+03	9.93E+03	7.24E+03	7.59E+03	9.03E+03	9.03E+03	6.35E+03	6.74E+03	8.14E+03	8.21E+03
Hoop tensile, MPa	E_{HT}	D638, D1599, or D2290	9.17E+03	1.04E+04	1.14E+04	1.15E+04	8.21E+03	9.52E+03	1.04E+04	1.06E+04	7.31E+03	8.62E+03	9.52E+03	9.66E+03
Hoop flexural, MPa	E_{HF}	D790 or D2412	8.14E+03	8.48E+03	9.93E+03	9.93E+03	7.59E+03	7.59E+03	9.03E+03	9.03E+03	6.30E+03	6.72E+04	8.14E+03	8.21E+03
In-plane shear, MPa	G	D4255	2.83E+03	2.83E+03	2.81E+03	2.81E+03	2.48E+03	2.46E+03	2.41E+03	2.42E+03	2.13E+03	2.09E+03	2.03E+03	2.03E+03

Other Property Data [Notes (1), (2), and (3)]

Property	Symbol	ASTM Test Method	Value for 5-mm Thickness
Poisson's ratio: hoop–axial tensile	ν_{HAT}	...	0.29
Poisson's ratio: axial–hoop tensile	ν_{AHT}	...	0.29
Coefficient of thermal expansion, mm/mm/°C: axial	α_A	D696	3.47E–05
Coefficient of thermal expansion, mm/mm/°C: hoop	α_H	...	3.47E–05
Density, kg/m^3	ρ	D792	2.53E–01
Thermal conductivity, W/(m-K)	k	C1045	1.7564

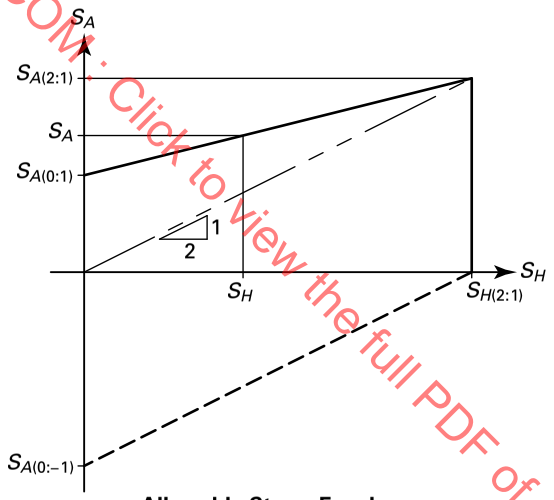
Allowable Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	25°C	65°C	93°C
Axial tensile, MPa	$S_{A(0:1)}$	D638 or D2105	1.35E+01	1.23E+01	1.12E+01
Axial flexural, MPa	$S_{Af(0:1)}$	D790 or D2925	1.70E+01	1.52E+01	1.34E+01
Axial compressive, MPa	$S_{A(0:-1)}$	D695	1.35E+01	1.23E+01	1.12E+01
Axial 2 × 1 biaxial tensile, MPa	$S_{A(2:1)}$	D1599	1.36E+01	1.23E+01	1.12E+01
Hoop 2 × 1 biaxial tensile, MPa	$S_{H(2:1)}$	D1599	1.36E+01	1.23E+01	1.12E+01
Hoop tensile, MPa	$S_{H(1:0)}$	D638, D1599, or D2290	1.36E+01	1.23E+01	1.12E+01
In-plane shear, MPa	τ	D4255	2.83E+00	2.46E+00	2.09E+00

Table 1-2.1-2M Data Sheet for Fiberglass Unsaturated Polyester Resin Type II (SC-582) (Cont'd)

Ultimate Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	25°C	65°C	93°C
Axial tensile, MPa	$S_{A(0:1)}$	D638 or D2105	1.35E+02	1.23E+02	1.12E+02
Axial flexural, MPa	$S_{Af(0:1)}$	D790 or D2925	1.70E+02	1.52E+02	1.34E+02
Axial compressive, MPa	$S_{A(0:-1)}$	D695	1.35E+02	1.23E+02	1.12E+02
Axial 2 × 1 biaxial tensile, MPa	$S_{A(2:1)}$	D1599	1.36E+02	1.23E+02	1.12E+02
Hoop 2 × 1 biaxial tensile, MPa	$S_{H(2:1)}$	D1599	1.36E+02	1.23E+02	1.12E+02
Hoop tensile, MPa	$S_{H(1:0)}$	D638, D1599, or D2290	1.36E+02	1.23E+02	1.12E+02
In-plane shear, MPa	τ	D4255	2.83E+01	2.46E+01	2.09E+01



Allowable Stress Envelope

GENERAL NOTES:

(a) The values in this table may be interpolated to determine values for intermediate temperatures and thicknesses.

(b) Refer to ASME NM.2, Table 3-3.1-1 for limitations on service based on temperature.

(c) The maximum allowable design stress value shall be 20 690 kPa for flanges constructed of Type II laminates.

NOTES:

(1) Elastic properties apply to total wall, not just to structural wall. This is to ensure that the loads on the piping, the supports, and the connected equipment, as calculated in the pipe stress analysis, are not understated.

(2) For modulus values of the structural wall only, or for pipe for which the liner thickness is 0.0 mm, it is permissible to use the modulus values applicable to a total wall thickness of 20 mm and over.

(3) Elastic properties may also be determined in accordance with ASME NM.2, Mandatory Appendix II.

(4) Allowable and ultimate stress values apply to the structural wall only, not the total wall thickness.

Table 1-2.1-3M Data Sheet for Fiberglass Unsaturated Polyester Resin Type III (55-deg Filament Wound; ASME NM.2, Mandatory Appendix IV) (20)

Description and Service Limits

Reinforcement material:	Fiberglass (Type E or ECR glass)
Resin material:	Unsaturated polyester resin
Reinforcement pattern:	FW (±55)
Structural wall thickness range, mm:	2.5 to 17.5
Liner thickness, mm:	2.5

Modulus Data [Notes (1), (2), and (3)]

			Modulus of Elasticity for Total Wall Thickness, mm (Including 2.5-mm Liner), and Temperature, °C											
			Up to and Including 25°C				65°C				93°C			
Property	Symbol	ASTM Test Method	5	10	15	20 and Over	5	10	15	20 and Over	5	10	15	20 and Over
Axial tensile, MPa	E_{AT}	D638, D1599, or D2105	8.21E+03	8.69E+03	8.83E+03	8.90E+03	6.97E+03	7.17E+03	7.17E+03	7.24E+03	5.66E+03	5.57E+03	5.54E+03	5.52E+04
Axial compressive, MPa	E_{AC}	D695	8.21E+03	8.69E+03	8.83E+03	8.90E+03	6.97E+03	7.17E+03	7.17E+03	7.24E+03	5.66E+03	5.57E+03	5.54E+03	5.52E+04
Axial flexural, MPa	E_{AF}	D790 or D2925	7.66E+03	8.21E+03	8.41E+03	8.55E+03	6.48E+04	6.86E+03	7.03E+03	7.10E+03	5.26E+03	5.50E+03	5.54E+03	5.55E+04
Hoop tensile, MPa	E_{HT}	D638, D1599, or D2290	1.04E+04	1.29E+04	1.37E+04	1.41E+04	9.17E+03	1.14E+04	1.21E+04	1.24E+04	8.00E+03	9.79E+03	1.03E+04	1.06E+04
Hoop flexural, MPa	E_{HF}	D790 or D2412	8.76E+03	1.10E+04	1.21E+04	1.28E+04	7.59E+03	9.72E+02	1.08E+04	1.14E+04	6.43E+03	8.41E+03	9.31E+03	9.79E+03
In-plane shear, MPa	G	D4255	4.73E+03	7.03E+03	7.93E+03	8.34E+03	4.32E+03	6.63E+03	7.52E+03	7.93E+03	3.90E+03	6.23E+03	7.10E+03	7.52E+03

Other Property Data [Notes (1), (2), and (3)]

Property	Symbol	ASTM Test Method	Value for 5-mm Thickness
Poisson's ratio: hoop–axial tensile	ν_{HAT}	...	0.52
Poisson's ratio: axial–hoop tensile	ν_{AHT}	...	0.39
Coefficient of thermal expansion, mm/mm/°C: axial	α_A	D696	3.56E−05
Coefficient of thermal expansion, mm/mm/°C: hoop	α_H	...	1.87E−05
Density, kg/m^3	ρ	D792	1633.114
Thermal conductivity, W/(m-K)	k	C1045	2.53E−01

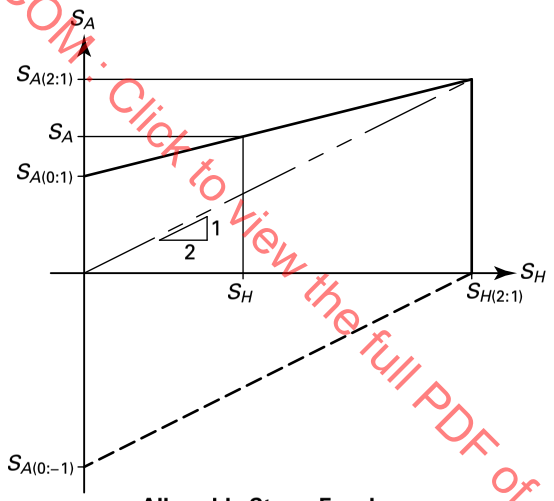
Allowable Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	25°C	65°C	93°C
Axial tensile, MPa	$S_{A(0:1)}$	D638 or D2105	5.63E+00	5.57E+00	4.46E+00
Axial flexural, MPa	$S_{Af(0:1)}$	D790 or D2925	1.23E+01	1.03E+01	8.28E+00
Axial compressive, MPa	$S_{A(0:-1)}$	D695	1.12E+01	9.31E+00	7.24E+00
Axial 2 × 1 biaxial tensile, MPa	$S_{A(2:1)}$	D1599	1.29E+01	1.26E+01	7.24E+00
Hoop 2 × 1 biaxial tensile, MPa	$S_{H(2:1)}$	D1599	1.67E+01	1.48E+01	1.03E+01
Hoop tensile, MPa	$S_{H(1:0)}$	D638, D1599, or D2290	1.67E+01	1.48E+01	1.03E+01
In-plane shear, MPa	τ	D4255	7.03E+00	6.63E+00	6.23E+00

Table 1-2.1-3M Data Sheet for Fiberglass Unsaturated Polyester Resin Type III (55-deg Filament Wound; ASME NM.2, Mandatory Appendix IV) (Cont'd)

Ultimate Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	25°C	65°C	93°C
Axial tensile, MPa	$S_{A(0:1)}$	D638 or D2105	5.63E+01	5.57E+01	4.46E+01
Axial flexural, MPa	$S_{Af(0:1)}$	D790 or D2925	1.23E+02	1.03E+02	8.28E+01
Axial compressive, MPa	$S_{A(0:-1)}$	D695	1.12E+02	9.31E+01	7.24E+01
Axial 2 × 1 biaxial tensile, MPa	$S_{A(2:1)}$	D1599	1.29E+02	1.26E+02	7.24E+01
Hoop 2 × 1 biaxial tensile, MPa	$S_{H(2:1)}$	D1599	1.67E+02	1.48E+02	1.03E+02
Hoop tensile, MPa	$S_{H(1:0)}$	D628, D1599, or D2290	1.67E+02	1.48E+02	1.03E+02
In–plane shear, MPa	τ	D4255	7.03E+01	6.63E+01	6.23E+01



Allowable Stress Envelope

GENERAL NOTES:

(a) The values in this table may be interpolated to determine values for intermediate temperatures and thicknesses.

(b) Refer to ASME NM.2, Table 3-3.1-1 for limitations on service based on temperature.

(c) The Type III laminate values are based on 60% to 65% glass content; slight variations on thermal expansion can be expected if the glass content of the laminate is greater than 65%.

NOTES:

(1) Elastic properties apply to total wall, not just to structural wall. This is to ensure that the loads on the piping, the supports, and the connected equipment, as calculated in the pipe stress analysis, are not understated.

(2) For modulus values of the structural wall only, or for pipe for which the liner thickness is 0.0 mm, it is permissible to use the modulus values applicable to a total wall thickness of 20 mm and over.

(3) Elastic properties may also be determined in accordance with ASME NM.2, Mandatory Appendix II.

(4) Allowable and ultimate stress values apply to the structural wall only, not the total wall thickness.

Table 1-2.2-1M Data Sheet for Vinyl Ester Resin Type I (SC-582)

Description and Service Limits

Reinforcement material:	Fiberglass (Type E or ECR glass)
Resin material:	Vinyl ester resin
Reinforcement pattern:	Random glass
Structural wall thickness range, mm:	2.5 to 17.5
Liner thickness, mm:	2.5

Modulus Data [Notes (1), (2), and (3)]

			Modulus of Elasticity for Total Wall Thickness, mm (Including 2.5-mm Liner), and Temperature, °C											
			Up to and Including 25°C				65°C				93°C			
Property	Symbol	ASTM Test Method	5	10	15	20 and Over	5	10	15	20 and Over	5	10	15	20 and Over
Axial tensile, MPa	E_{AT}	D638, D1599, or D2105	7.59E+03	7.66E+03	7.72E+03	7.72E+03	7.45E+03	7.52E+03	7.52E+03	7.72E+03	6.27E+03	6.34E+03	6.37E+03	6.38E+03
Axial compressive, MPa	E_{AC}	D695	7.59E+03	7.66E+03	7.72E+03	7.72E+03	7.45E+03	7.52E+03	7.52E+03	7.72E+03	6.27E+03	6.34E+03	6.37E+03	6.38E+03
Axial flexural, MPa	E_{AF}	D790 or D2925	7.31E+03	7.52E+03	7.59E+03	7.66E+03	7.17E+03	7.31E+03	7.45E+03	7.66E+03	6.03E+03	6.19E+03	6.27E+03	6.30E+03
Hoop tensile, MPa	E_{HT}	D638, D1599, or D2290	7.59E+03	7.66E+03	7.72E+03	7.72E+03	7.45E+03	7.52E+03	7.52E+03	7.72E+03	6.27E+03	6.34E+03	6.37E+03	6.38E+03
Hoop flexural, MPa	E_{HF}	D790 or D2412	7.31E+03	7.52E+03	7.59E+03	7.66E+03	7.17E+03	7.31E+03	7.45E+03	7.66E+03	6.03E+03	6.19E+03	6.27E+03	6.30E+03
In–plane shear, MPa	G	D4255	2.83E+03	2.88E+03	2.88E+03	2.89E+03	2.77E+03	2.80E+03	2.81E+03	2.89E+03	2.34E+03	2.37E+03	2.38E+03	2.39E+03

Other Property Data [Notes (1), (2), and (3)]

Property	Symbol	ASTM Test Method	Value for 5-mm Thickness
Poisson's ratio: hoop–axial tensile	ν_{HAT}	...	0.34
Poisson's ratio: axial–hoop tensile	ν_{AHT}	...	0.34
Coefficient of thermal expansion, mm/mm/°C: axial	α_A	D696	3.34E–05
Coefficient of thermal expansion, mm/mm/°C: hoop	α_H	...	3.34E–05
Density, kg/m^3	ρ	D792	1356.315
Thermal conductivity, W/(m-K)	k	C1045	2.23E–01

Allowable Stress Data [Note (4)]

Property	Symbol	ASTM Test Method	25°C	65°C	93°C
Axial tensile, MPa	$S_{A(0:1)}$	D638 or D2105	7.66E+00	7.52E+00	6.34E+00
Axial flexural, MPa	$S_{Af(0:1)}$	D790 or D2925	1.13E+01	1.10E+01	9.31E+00
Axial compressive, MPa	$S_{A(0:-1)}$	D695	7.66E+00	7.52E+00	6.34E+00
Axial 2 × 1 biaxial tensile, MPa	$S_{A(2:1)}$	D1599	7.66E+00	7.52E+00	6.34E+00
Hoop 2 × 1 biaxial tensile, MPa	$S_{H(2:1)}$	D1599	7.66E+00	7.52E+00	6.34E+00
Hoop tensile, MPa	$S_{H(1:0)}$	D638, D1599, or D2290	7.66E+00	7.52E+00	6.34E+00
In–plane shear, MPa	τ	D4255	2.88E+00	2.80E+00	2.37E+00