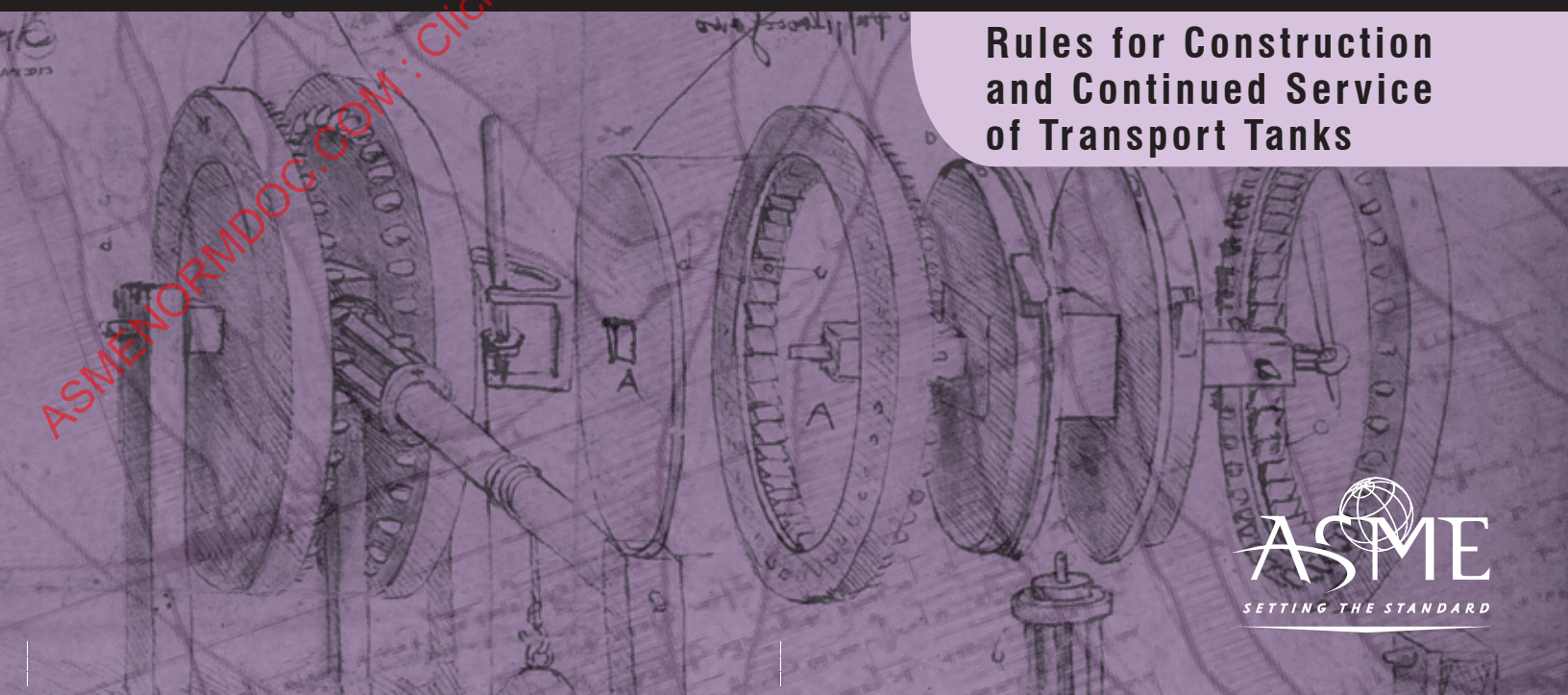
ASME BPVC.XII-2025

SECTION XII

2025 ASME Boiler and Pressure Vessel Code

An International Code

Rules for Construction and Continued Service of Transport Tanks



ASME
SETTING THE STANDARD

AN INTERNATIONAL CODE

2025 ASME Boiler & Pressure Vessel Code

2025 Edition July 1, 2025

XII

RULES FOR CONSTRUCTION AND CONTINUED SERVICE OF TRANSPORT TANKS

ASME Boiler and Pressure Vessel Committee
on Transport Tanks

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

Date of Issuance: July 1, 2025

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ASME Single Certification Mark

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FOREWORD*

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In 1911, The American Society of Mechanical Engineers established the Boiler and Pressure Vessel Committee to formulate standard rules for the construction of steam boilers and other pressure vessels. In 2009, the Boiler and Pressure Vessel Committee was superseded by the following committees:

(a) Committee on Power Boilers (I)
(b) Committee on Materials (II)
(c) Committee on Construction of Nuclear Facility Components (III)
(d) Committee on Heating Boilers (IV)
(e) Committee on Nondestructive Examination (V)
(f) Committee on Pressure Vessels (VIII)
(g) Committee on Welding, Brazing, and Fusing (IX)
(h) Committee on Fiber-Reinforced Plastic Pressure Vessels (X)
(i) Committee on Nuclear Inservice Inspection (XI)
(j) Committee on Transport Tanks (XII)
(k) Committee on Overpressure Protection (XIII)
(l) Technical Oversight Management Committee (TOMC)

Where reference is made to "the Committee" in this Foreword, each of these committees is included individually and collectively.

The Committee's function is to establish rules of safety relating to pressure integrity. The rules govern the construction** of boilers, pressure vessels, transport tanks, and nuclear components, and the inservice inspection of nuclear components and transport tanks. For nuclear items other than pressure-retaining components, the Committee also establishes rules of safety related to structural integrity. The Committee also interprets these rules when questions arise regarding their intent. The technical consistency of the Sections of the Code and coordination of standards development activities of the Committees is supported and guided by the Technical Oversight Management Committee. The Code does not address other safety issues relating to the construction of boilers, pressure vessels, transport tanks, or nuclear components, or the inservice inspection of nuclear components or transport tanks. Users of the Code should refer to the pertinent codes, standards, laws, regulations, or other relevant documents for safety issues other than those relating to pressure integrity and, for nuclear items other than pressure-retaining components, structural integrity. Except for Sections XI and XII, and with a few other exceptions, the rules do not, of practical necessity, reflect the likelihood and consequences of deterioration in service related to specific service fluids or external operating environments. In formulating the rules, the Committee considers the needs of users, manufacturers, and inspectors of components addressed by the Code. The objective of the rules is to afford reasonably certain protection of life and property, and to provide a margin for deterioration in service to give a reasonably long, safe period of usefulness. Advancements in design and materials and evidence of experience have been recognized.

The Code contains mandatory requirements, specific prohibitions, and nonmandatory guidance for construction activities and inservice inspection and testing activities. The Code does not address all aspects of these activities and those aspects that are not specifically addressed should not be considered prohibited. The Code is not a handbook and cannot replace education, experience, and the use of engineering judgment. The phrase *engineering judgment* refers to technical judgments made by knowledgeable engineers experienced in the application of the Code. Engineering judgments must be consistent with Code philosophy, and such judgments must never be used to overrule mandatory requirements or specific prohibitions of the Code.

The Committee recognizes that tools and techniques used for design and analysis change as technology progresses and expects engineers to use good judgment in the application of these tools. The designer is responsible for complying with Code rules and demonstrating compliance with Code equations when such equations are mandatory. The Code neither requires nor prohibits the use of computers for the design or analysis of components constructed to the requirements of the Code. However, designers and engineers using computer programs for design or analysis are cautioned that they are

* The information contained in this Foreword is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. Therefore, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the Code.

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

responsible for all technical assumptions inherent in the programs they use and the application of these programs to their design.

The rules established by the Committee 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 Code rules.

The Committee meets regularly to consider revisions of the rules, new rules as dictated by technological development, Code cases, and requests for interpretations. Only the Committee has the authority to provide official interpretations of the Code. Requests for revisions, new rules, Code cases, or interpretations shall be addressed to the staff secretary in writing and shall give full particulars in order to receive consideration and action (see the Correspondence With the Committee page). Proposed revisions to the Code resulting from inquiries will be presented to the Committee for appropriate action. The action of the Committee becomes effective only after confirmation by ballot of the Committee and approval by ASME. Proposed revisions to the Code approved by the Committee are submitted to the American National Standards Institute (ANSI) and published at http://go.asme.org/BPVCPublicReview to invite comments from all interested persons. After public review and final approval by ASME, revisions are published at regular intervals in Editions of the Code.

The Committee does not rule on whether a component shall or shall not be constructed to the provisions of the Code. The scope of each Section has been established to identify the components and parameters considered by the Committee in formulating the Code rules.

Questions or issues regarding compliance of a specific component with the Code rules are to be directed to the ASME Certificate Holder (Manufacturer). Inquiries concerning the interpretation of the Code are to be directed to the Committee. ASME is to be notified should questions arise concerning improper use of the ASME Single Certification Mark.

When required by context in the Code, the singular shall be interpreted as the plural, and vice versa.

The words "shall," "should," and "may" are used in the Code as follows:

- *Shall* is used to denote a requirement.
- *Should* is used to denote a recommendation.
- *May* is used to denote permission, neither a requirement nor a recommendation.

STATEMENT OF POLICY ON THE USE OF THE ASME SINGLE CERTIFICATION MARK AND CODE AUTHORIZATION IN ADVERTISING

ASME has established procedures to authorize qualified organizations to perform various activities in accordance with the requirements of the ASME Boiler and Pressure Vessel Code. It is the aim of the Society to provide recognition of organizations so authorized. An organization holding authorization to perform various activities in accordance with the requirements of the Code may state this capability in its advertising literature.

Organizations that are authorized to use the ASME Single Certification Mark for marking items or constructions that have been constructed and inspected in compliance with the ASME Boiler and Pressure Vessel Code are issued Certificates of Authorization. It is the aim of the Society to maintain the standing of the ASME Single Certification Mark for the benefit of the users, the enforcement jurisdictions, and the holders of the ASME Single Certification Mark who comply with all requirements.

Based on these objectives, the following policy has been established on the usage in advertising of facsimiles of the ASME Single Certification Mark, Certificates of Authorization, and reference to Code construction. The American Society of Mechanical Engineers does not "approve," "certify," "rate," or "endorse" any item, construction, or activity and there shall be no statements or implications that might so indicate. An organization holding the ASME Single Certification Mark and/or a Certificate of Authorization may state in advertising literature that items, constructions, or activities "are built (produced or performed) or activities conducted in accordance with the requirements of the ASME Boiler and Pressure Vessel Code," or "meet the requirements of the ASME Boiler and Pressure Vessel Code." An ASME corporate logo shall not be used by any organization other than ASME.

The ASME Single Certification Mark shall be used only for stamping and nameplates as specifically provided in the Code. However, facsimiles may be used for the purpose of fostering the use of such construction. Such usage may be by an association or a society, or by a holder of the ASME Single Certification Mark who may also use the facsimile in advertising to show that clearly specified items will carry the ASME Single Certification Mark.

STATEMENT OF POLICY ON THE USE OF ASME MARKING TO IDENTIFY MANUFACTURED ITEMS

The ASME Boiler and Pressure Vessel Code provides rules for the construction of boilers, pressure vessels, and nuclear components. This includes requirements for materials, design, fabrication, examination, inspection, and stamping. Items constructed in accordance with all of the applicable rules of the Code are identified with the ASME Single Certification Mark described in the governing Section of the Code.

Markings such as "ASME," "ASME Standard," or any other marking including "ASME" or the ASME Single Certification Mark shall not be used on any item that is not constructed in accordance with all of the applicable requirements of the Code.

Items shall not be described on ASME Data Report Forms nor on similar forms referring to ASME that tend to imply that all Code requirements have been met when, in fact, they have not been. Data Report Forms covering items not fully complying with ASME requirements should not refer to ASME or they should clearly identify all exceptions to the ASME requirements.

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ASME codes and standards are developed and maintained by committees with the intent to represent the consensus of concerned interests. Users of ASME codes and standards may correspond with the committees to propose revisions or cases, report errata, or request interpretations. Correspondence for this Section of the ASME Boiler and Pressure Vessel Code (BPVC) should be sent to the staff secretary noted on the Section's committee web page, accessible at https://go.asme.org/CSCommittees.

NOTE: See ASME BPVC Section II, Part D for guidelines on requesting approval of new materials. See Section II, Part C for guidelines on requesting approval of new welding and brazing materials ("consumables").

Revisions and Errata

The committee processes revisions to this Code on a continuous basis to incorporate changes that appear necessary or desirable as demonstrated by the experience gained from the application of the Code. Approved revisions will be published in the next edition of the Code.

In addition, the committee may post errata and Special Notices at http://go.asme.org/BPVCerrata. Errata and Special Notices become effective on the date posted. Users can register on the committee web page to receive email notifications of posted errata and Special Notices.

This Code is always open for comment, and the committee welcomes proposals for revisions. Such proposals should be as specific as possible, citing the paragraph number, the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent background information and supporting documentation.

Cases

(a) The most common applications for cases are

(1) to permit early implementation of a revision based on an urgent need

(2) to provide alternative requirements

(3) to allow users to gain experience with alternative or potential additional requirements prior to incorporation directly into the Code

(4) to permit use of a new material or process

(b) Users are cautioned that not all jurisdictions or owners automatically accept cases. Cases are not to be considered as approving, recommending, certifying, or endorsing any proprietary or specific design, or as limiting in any way the freedom of manufacturers, constructors, or owners to choose any method of design or any form of construction that conforms to the Code.

(c) The committee will consider proposed cases concerning the following topics only:

(1) equipment to be marked with the ASME Single Certification Mark, or

(2) equipment to be constructed as a repair/replacement activity under the requirements of Section XI

(d) A proposed case shall be written as a question and reply in the same format as existing cases. The proposal shall also include the following information:

(1) a statement of need and background information

(2) the urgency of the case (e.g., the case concerns a project that is underway or imminent)

(3) the Code Section and the paragraph, figure, or table number to which the proposed case applies

(4) the editions of the Code to which the proposed case applies

(e) A case is effective for use when the public review process has been completed and it is approved by the cognizant supervisory board. Cases that have been approved will appear in the next edition or supplement of the Code Cases books, "Boilers and Pressure Vessels" or "Nuclear Components." Each Code Cases book is updated with seven Supplements.

Supplements will be sent or made available automatically to the purchasers of the Code Cases books until the next edition of the Code. Annulments of Code Cases become effective six months after the first announcement of the annulment in a Code Case Supplement or Edition of the appropriate Code Case book. The status of any case is available at http://go.asme.org/BPVCCDatabase. An index of the complete list of Boiler and Pressure Vessel Code Cases and Nuclear Code Cases is available at http://go.asme.org/BPVCC.

Interpretations

(a) Interpretations clarify existing Code requirements and are written as a question and reply. Interpretations do not introduce new requirements. If a revision to resolve conflicting or incorrect wording is required to support the interpretation, the committee will issue an intent interpretation in parallel with a revision to the Code.

(b) Upon request, the committee will render an interpretation of any requirement of the Code. An interpretation can be rendered only in response to a request submitted through the online Inquiry Submittal Form at http://go.asme.org/InterpretationRequest. Upon submitting the form, the inquirer will receive an automatic email confirming receipt.

(c) ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Code requirements. If, based on the information submitted, it is the opinion of the committee that the inquirer should seek assistance, the request will be returned with the recommendation that such assistance be obtained. Inquirers may track the status of their requests at http://go.asme.org/Interpretations.

(d) 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.

(e) Interpretations are published in the ASME Interpretations Database at http://go.asme.org/Interpretations as they are issued.

Committee Meetings

The ASME BPVC committees regularly hold meetings that are open to the public. Persons wishing to attend any meeting should contact the secretary of the applicable committee. Information on future committee meetings can be found at http://go.asme.org/BCW.

SUMMARY OF CHANGES

Changes listed below are identified on the pages by a margin note, **(25)**, placed next to the affected area.

Page	*Location*	*Change*
xviii	List of Sections	Title of Section XI, Division 1 revised
xix	Foreword	Third, fourth, seventh, tenth, and eleventh paragraphs editorially revised
xxii	Personnel	Updated
3	TG-140	First and third paragraphs revised
7	TG-310	First sentence revised
8	TG-330	Revised
9	TG-420	Last sentence revised
16	TM-130.2	Subparagraph (b) revised
16	TM-140.1	Subparagraphs (a)(3)(-b), (e), and (f) revised
17	Table TM-130.2-1	Under "Bolting," SA-194 deleted
20	Table TM-130.2-2	Revised
29	Table TM-130.2-5	Revised
32	Table TM-130.2-7	Revised
34	TM-140.2	First sentence revised
39	Figure TM-220.1	Revised
59	TD-130	Subparagraph (a) revised
63	TD-300.2	In subpara. (b), equation revised
64	TD-310.2	Revised in its entirety
68	Table TD-310.2-3	Added
65	TD-310.3	Revised in its entirety
68	Table TD-310.3-1	Added
70	TD-400.4	Revised
104	TW-130.4	First paragraph revised
105	Table TW-130.4	Type No. "(12)" corrected by errata to "(1)"
124	TF-110.2	In subpara. (a), last paragraph revised
128	TF-200	Subparagraph (f) revised
128	TF-210	Subparagraph (e) revised
128	TF-210.1	Subparagraphs (b) and (i)(2) revised
131	TF-220.7	Subparagraph (a) revised
143	TF-710	Subparagraph (f)(1) revised
155	TE-110.2	Subparagraph (a)(2) revised
157	TE-230.1	Subparagraph (b)(3)(-c) revised
166	TT-300	Subparagraph (e) revised
171	TOP-120	Subparagraph (a) revised
175	TS-100	Subparagraphs (c) and (g) revised
175	Figure TS-100	Revised
176	TS-100.1	Added and subsequent paragraphs redesignated
177	TS-110	Revised in its entirety
177	TS-130	Revised in its entirety
178	TS-200.7	Revised
180	TS-310	Subparagraph (c) revised
189	1-1.2	Definition of *dump body* added
192	1-1.4	Redesignated as 1-1.4.1 and 1-1.4.2 added
200	1-1.5	Subparagraph (c) added
217	1-4.4	First sentence added and subpara. (d) revised

Page	*Location*	*Change*
221	1-4.7	Revised in its entirety
226	3-1.5	First sentence revised
229	3-1.8	Revised in its entirety
236	I-1	Second paragraph revised
237	I-11	Second sentence revised
237	I-16	Subparagraph (d) revised
239	III-2	Definition of *Material Test Report* revised
249	V-2	Revised
251	VI-2	Revised
260	X-2	Subparagraphs (c)(1) and (c)(2) revised
269	XV-4	Subparagraph (c)(10) revised
283	XX-5	Subparagraph (d) revised
287	XX-6	Paragraph following eq. (6) revised
307	Table C-1	Instruction/description for (54) revised
310	Form T-1A	"Certificate of Shop Inspection" revised
311	Form T-1B	"Certificate of Shop Inspection" revised
312	Form T-1C	"Certificate of Shop Inspection" revised
313	Form T-2A	"Certificate of Shop Inspection" revised
314	Form T-2B	"Certificate of Shop Inspection" revised
315	Form T-2C	"Certificate of Shop Inspection" revised
321	E-2	Subparagraph (b) revised
323	E-4	Subparagraph (a) revised and subpara. (a)(3) added
326	E-6	Subparagraph (o) revised
328	E-9	Subparagraph (e) deleted
329	E-12	Added
337	H-5.3	Subparagraph (c) revised

CROSS-REFERENCING IN THE ASME BPVC

Paragraphs within the ASME BPVC may include subparagraph breakdowns, i.e., nested lists. The following is a guide to the designation and cross-referencing of subparagraph breakdowns:

(a) Hierarchy of Subparagraph Breakdowns

(1) First-level breakdowns are designated as (a), (b), (c), etc.

(2) Second-level breakdowns are designated as (1), (2), (3), etc.

(3) Third-level breakdowns are designated as (-a), (-b), (-c), etc.

(4) Fourth-level breakdowns are designated as (-1), (-2), (-3), etc.

(5) Fifth-level breakdowns are designated as (+a), (+b), (+c), etc.

(6) Sixth-level breakdowns are designated as (+1), (+2), etc.

(b) Cross-References to Subparagraph Breakdowns. Cross-references within an alphanumerically designated paragraph (e.g., PG-1, UIG-56.1, NCD-3223) do not include the alphanumerical designator of that paragraph. The cross-references to subparagraph breakdowns follow the hierarchy of the designators under which the breakdown appears. The following examples show the format:

(1) If X.1(c)(1)(-a) is referenced in X.1(c)(1), it will be referenced as (-a).

(2) If X.1(c)(1)(-a) is referenced in X.1(c)(2), it will be referenced as (1)(-a).

(3) If X.1(c)(1)(-a) is referenced in X.1(e)(1), it will be referenced as (c)(1)(-a).

(4) If X.1(c)(1)(-a) is referenced in X.2(c)(2), it will be referenced as X.1(c)(1)(-a).

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PART TG
GENERAL REQUIREMENTS

ARTICLE TG-1
SCOPE AND JURISDICTION

TG-100 INTRODUCTION

TG-100.1 INTENT

The rules of this Section constitute requirements for construction and continued service of pressure vessels for the transportation of dangerous goods via highway, rail, air, or water. *Construction* is an all-inclusive term comprising materials, design, fabrication, examination, inspection, testing, certification, and over-pressure protection. *Continued service* is an all-inclusive term referring to inspection, testing, repair, alteration, and recertification of a transport tank that has been in service. The term *pressure vessel* refers to the pressure boundary defined by the geometric scope of this Section and includes, but is not limited to, the shell, heads, and openings. The term *tank* refers to the pressure vessel, appurtenances, and additional components that are covered by the Modal Appendices (see TG-210.1).

The general requirements given in Part TG shall be met for all vessels within the scope of this Section. In addition, all the applicable requirements of Modal Appendices, which address unique service conditions of the vessel, shall be met.

TG-100.2 APPLICABILITY

(a) The rules of this Section apply specifically to pressure vessels intended for transporting dangerous goods (see Mandatory Appendix III) with design pressures appropriate for the transportation mode and volumes greater than 450 L (120 gal).

(b) Pressures normally incident to transportation, including loading and unloading operations, are to be considered.

(c) This Section does not contain rules to cover all details of design and construction, and those aspects that are not addressed shall not be considered prohibited. Where complete details are not given, the Manufacturer, subject to the acceptance of the Inspector, shall provide details of design and construction that will be as safe as those provided by the rules of this Section. In the case of Class 3 vessels, the Design Certifying Engineer shall perform this function. (For definition of *Inspector*, see TG-410.)

TG-100.3 LAWS OR REGULATIONS

The laws or regulations issued by the competent authority covering the construction and continued service of pressure vessels intended for transporting dangerous goods shall be reviewed to determine if the requirements are more restrictive than the rules of this Section. Applicable laws and regulations may contain additional requirements for pressure vessels used in the transportation of dangerous goods, which are not addressed in this Section, such as Code of Federal Regulation, Title 49, Parts 100 through 185, Transportation.

TG-110 SCOPE

TG-110.1 GEOMETRIC SCOPE OF THE PRESSURE VESSEL

(a) The geometric scope of this Section shall, as a minimum, include the pressure-containing parts of pressure vessels up to and including the following:

(1) the first threaded joint for threaded connections.

(2) the face of the first flange for flanged connections.

(3) the first sealing surface for proprietary connections or fittings for which rules are not provided in this Section.

(4) the welding end connection for the first circumferential joint for welded connections to attached piping, valves, and instruments, etc.

(5) the welding pad for attachment of any external nonpressure attachments such as shipping frames and handling points. Parts welded to these pads need not comply with (b).

(6) pressure-retaining permanent covers and closures, including seals, bolting, and other mechanical retainers at openings.

(b) Where nonpressure parts are directly welded to the pressure-retaining surface of a pressure vessel, this scope shall include the material, design, fabrication, and testing requirements established for nonpressure attachments by the applicable paragraphs of this Section.

(c) Items in addition to the *pressure vessel* transform the vessel into a *tank*. These items are addressed in the applicable Modal Appendix.

TG-110.2 PHYSICAL SCOPE OF THE PRESSURE VESSEL

(a) Internal pressure shall be in the range from full vacuum to 138 bar (2,000 psig).

(b) The temperature range shall be from −269°C to 343°C (−452°F to 650°F).

(c) Thickness of shells and heads shall not exceed 38 mm (1½ in.).

TG-120 VESSEL CLASSIFICATIONS

TG-120.1 CLASSIFICATIONS OUTSIDE THE SCOPE OF THIS SECTION

The following classes of pressure-containing equipment are not within the scope of this Section:

(a) those items that are within the scope of other Sections of the Code

(b) pressure-containing equipment that is an integral part or component of a rotating or reciprocating mechanical device mounted in a common setting with the vessel, where the primary design considerations and/or design stresses are derived from the functional requirements of the device

(c) piping, valves, and other components beyond the geometric scope described in TG-110.1 for the loading, transport, and unloading of the vessel contents

(d) cylinders and multiple element gas containers and the attachment of same to trailers, commonly referred to as “tube trailers”

TG-120.2 STAMPING OF VESSELS WITHIN THE SCOPE OF THIS SECTION

(a) Any vessel that meets all applicable requirements of this Section may be stamped with the Certification Mark with T Designator.

(b) Vessels manufactured and stamped under this Section are not precluded from using parts stamped to Section VIII, Division 1, as long as all requirements of Section XII are met, except for marking and reporting. (See TM-110.10.)

TG-120.3 VESSEL CLASS

For the purposes of obtaining Certificates of Authorization, Inspections, and Stamping, vessels that meet all applicable requirements of this Section shall be designated as meeting one of three Classes. Vessel Class is defined in the applicable Modal Appendix. It is determined by the hazard class of the dangerous goods, pressure and mode of transport, as required by the competent authority (see, e.g., Code of Federal Regulations, Title 49, Part 173, Subpart F). Additional requirements are provided in TG-430.

TG-130 DOCUMENTS REFERENCED BY THIS SECTION

TG-130.1 NORMATIVE REFERENCES

The latest edition of the following documents shall be used, unless a specific edition is listed below. Items in compliance with one of the Product Standards listed in Table TG-130 are acceptable for use in construction, unless specifically prohibited elsewhere in this Section.

ANSI/NB-23. National Board Inspection Code. National Board of Boiler and Pressure Vessel Inspectors.

ASME Boiler and Pressure Vessel Code, Section VIII. Rules for Construction of Pressure Vessels — Division 1. The American Society of Mechanical Engineers.

ASME Boiler and Pressure Vessel Code, Section VIII. Rules for Construction of Pressure Vessels — Division 2, Alternative Rules (for fatigue analysis only). The American Society of Mechanical Engineers.

ASME CA-1. Conformity Assessment Requirements. The American Society of Mechanical Engineers.

ASME QAI-1. Qualifications for Authorized Inspection. The American Society of Mechanical Engineers.

ASNT ACCP 1997, Rev. 3. ASNT Central Certification Program (for Nondestructive Testing Personnel). American Society for Nondestructive Testing.

ASNT CP-189-2006. ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel. American Society for Nondestructive Testing.

ASNT Recommended Practice No. SNT-TC-1A–2006. Guidelines for Personnel Qualification and Certification in Nondestructive Testing. American Society for Nondestructive Testing.

Code of Federal Regulations, Title 49, Parts 100 through 185, Transportation. U.S. Government Publishing Office.

ISO 1496-3:1995. Series 1 freight containers — Specification and testing — Part 3: Tank containers for liquids, gases and pressurized dry bulk. International Organization for Standardization.

ISO 21010:2017. Cryogenic vessels — Gas/materials compatibility. International Organization for Standardization.

ISO 21013-3:2016. Cryogenic vessels — Pressure relief accessories for cryogenic service — Part 3: Sizing and capacity determination. International Organization for Standardization.

Table TG-130
Product Standards Referenced by This Section

Title	Number	Year
Unified Inch Screw Threads (UN and UNR Thread Form)	ASME B1.1	2018
Pipe Threads, General Purpose (Inch)	ASME B1.20.1	2018
Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250	ASME B16.1	2015
Pipe Flanges and Flanged Fittings: NPS ½ Through NPS 24 Metric/Inch Standard	ASME B16.5	2017
Factory-Made Wrought Buttwelding Fittings	ASME B16.9	2018
Forged Fittings, Socket-Welding and Threaded	ASME B16.11	2016
Cast Copper Alloy Threaded Fittings: Classes 125 and 250	ASME B16.15	2018
Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral Wound, and Jacketed	ASME B16.20	2017
Cast Copper Alloy Pipe Flanges and Flanged Fittings and Valves: Classes 150, 300, 600, 900, 1500, and 2500	ASME B16.24	2016
Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300	ASME B16.42	2016
Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard	ASME B16.47	2017
Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts	ASME B18.2.2	2015
Welded and Seamless Wrought Steel Pipe	ASME B36.10M	2018

ISO 21014:2019. Cryogenic vessels — Cryogenic insulation performance. International Organization for Standardization.

TG-130.2 INFORMATIVE REFERENCES

ADR 2003. European Agreement Concerning the International Carriage of Dangerous Goods by Road. United Nations Economic Commission for Europe.

API RP-579. Fitness for Service. American Petroleum Institute.

ASME B31.3–2018. Process Piping. The American Society of Mechanical Engineers.

ASME B31.12–2019. Hydrogen Piping and Pipelines. The American Society of Mechanical Engineers.

ASME PCC-2–2018. Repair of Pressure Equipment and Piping. The American Society of Mechanical Engineers.

ASTM E399. Standard Test Method for Plane-Strain Fracture Toughness of Metallic Materials. ASTM International.

ASTM E1820. Standard Test Method for Measurement of Fracture Toughness. ASTM International.

CGA G-4.1. Cleaning Equipment for Oxygen Service. Compressed Gas Association.

CGA S-1.2. Pressure Relief Device Standards, Part 2: Cargo and Portable Tanks for Compressed Gases. Compressed Gas Association.

IMDG Code 2018. International Maritime Dangerous Goods Code (including Amendment 31-02). International Maritime Organization.

RID 2003. Carriage of Dangerous Goods. Intergovernmental Organisation for International Carriage by Rail.

United Nations Recommendations on the Transport of Dangerous Goods — Model Regulations. United Nations Publications.

UL-969. Marking and Labeling Systems. Underwriters Laboratories, Inc.

TG-140 UNITS OF MEASUREMENT (25)

Either U.S. Customary, SI, or any local customary units may be used to demonstrate compliance with all requirements of this Section (e.g., materials, design, fabrication, examination, inspection, testing, certification, and overpressure protection).

In general, it is expected that a single system of units shall be used for all aspects of design except where unfeasible or impractical. When components are manufactured at different locations where local customary units are different than those used for the general design, the local units may be used for the design and documentation of that component. Similarly, for proprietary components or those uniquely associated with a system of units different than that used for the general design, the alternate units may be used for the design and documentation of that component.

For any single equation, all variables shall be expressed in a single system of units. Calculations using any material data published in Section XII or Section II, Part D shall be carried out in one system of standard units listed in Mandatory Appendix XII. When separate equations are provided for U.S. Customary and SI units, those equations must be executed using variables in the units associated with the specific equation. Data expressed in other units shall be converted to U.S. Customary or SI units for use in these equations. The result obtained from execution of these equations may be converted to other units.

Production, measurement and test equipment, drawings, welding procedure specifications, welding procedure and performance qualifications, and other

fabrication documents may be in U.S. Customary, SI, or local customary units in accordance with the fabricator's practice. When values shown in calculations and analysis, fabrication documents or measurement and test equipment are in different units, any conversions necessary for verification of Code compliance, and to ensure that dimensional consistency is maintained, shall be in accordance with the following:

(a) Conversion factors shall be accurate to at least four significant figures.

(b) The results of conversions of units shall be expressed to a minimum of three significant figures.

Conversion of units, using the precision specified above shall be performed to ensure that dimensional consistency is maintained. Conversion factors between U.S. Customary and SI units may be found in the Nonmandatory Appendix G. Whenever local customary units are used, the Manufacturer shall provide the source of the conversion factors that shall be subject to verification and acceptance by the Authorized Inspector or Certified Individual.

Material that has been manufactured and certified to either the U.S. Customary or SI material specification (e.g., SA-516 or SA-516M) may be used regardless of the unit system used in design. Standard fittings (e.g., flanges, elbows, etc.) that have been certified to either U.S. Customary or SI units may be used regardless of the units system used in design.

All entries on a Manufacturer's Data Report and data for Code-required nameplate marking shall be in units consistent with the fabrication drawings for the component using U.S. Customary, SI, or local customary units. It is acceptable to show alternate units parenthetically. Users of this Code are cautioned that the competent authority at the receiving location should be contacted to ensure the units are acceptable.

It has been customary for transport tanks to express pressure in bars (1 bar = 14.5 psi). The bar is not a standard SI unit, but its use is encouraged where appropriate.

The User may specify a duplicate nameplate (per Article TS-1) and duplicate certified documents translated into the language and units of measurement appropriate for the modal service application.

TG-150 EQUATIONS

The equations in this Section may be used with any consistent set of units. When constants in the equations depend on units, the equations for both sets of units are provided. Either SI units or U.S. Customary units may be used for compliance with this Section, but one system shall be used consistently throughout for all phases of construction.

TG-160 TOLERANCES

The Code does 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.

ARTICLE TG-2
ORGANIZATION OF SECTION XII

TG-200 PARTS

This Section is divided into ten parts.

(a) Part TG contains general requirements.

(b) Part TM contains the material requirements.

(c) Part TD contains the design requirements.

(d) Part TW contains the requirements for welded construction.

(e) Part TF contains the fabrication requirements.

(f) Part TE contains requirements for nondestructive examination.

(g) Part TT contains the testing requirements.

(h) Part TOP contains rules for overpressure protection.

(i) Part TS contains the stamping and certification requirements. It also provides requirements for Manufacturer's Data Reports and other records.

(j) Part TP contains the requirements for continued service, repair, and alterations.

TG-210 APPENDICES

TG-210.1 MODAL APPENDICES

The Modal Appendices contain rules for vessels used in specific transport modes and service applications. The Modal Appendices take precedence over the requirements of other parts of this Section.

TG-210.2 MANDATORY APPENDICES

The Mandatory Appendices contain specific rules that are not covered elsewhere in this Section. Their requirements are mandatory when applicable.

TG-210.3 NONMANDATORY APPENDICES

The Nonmandatory Appendices provide information and suggested good practices. The information provided is not mandatory; however, if a nonmandatory appendix is used, it shall be used in its entirety, to the extent applicable.

TG-220 ARTICLES AND PARAGRAPHS

TG-220.1 ARTICLES

The main divisions of the Parts of this Section are designated as Articles. These are given numbers and titles such as Article TG-1, Scope and Jurisdiction.

TG-220.2 PARAGRAPHS AND SUBPARAGRAPHS

The Articles are divided into paragraphs and subparagraphs, which are given three-digit numbers, the first of which corresponds to the Article number. Each such paragraph or subparagraph number is prefixed with letters that, with the first digit (hundreds), indicate the Part and Article of this Section in which it is found, such as TD-140, which is a subparagraph of TD-100 in Article TD-1 of Part TD.

(a) Major subdivisions of paragraphs, or subparagraphs, are indicated by the basic paragraph number, followed by a decimal point and one or two digits. Each of these subdivisions is titled.

(b) Minor subdivisions of paragraphs are designated (a), (b), etc.

(c) Where further subdivisions are needed, they are designated by numbers in parentheses [e.g., TG-230.2 (b)(1)].

TG-220.3 TABLES, CHARTS, AND FIGURES

Tables, charts, and figures providing relevant illustrations or supporting information for text passages have been designated with numbers corresponding to the paragraph they illustrate or support. Multiple tables, charts, and figures referenced by the same paragraph shall be designated with the paragraph number with a hyphen, and sufficient additional numbers reflecting the order of reference.

TG-230 REFERENCES

When a Part, Article, or paragraph is referenced in this Section, the reference shall be taken to include all subdivisions under that Part, Article, or paragraph (including all subparagraphs) and any tables, charts, or figures referenced by that paragraph.

TG-240 TERMS AND DEFINITIONS

Terms and definitions used in this Section are defined where they first appear or are of primary interest. Some of these terms and definitions are also included in Mandatory Appendix III.

ARTICLE TG-3
RESPONSIBILITIES AND DUTIES

TG-300 GENERAL

The Owner, Manufacturer, and Inspector involved in the construction of vessels and vessel parts to the rules of this Section and the Party responsible for continued service have definite responsibilities and duties in meeting the requirements of this Section. The responsibilities and duties set forth in the following paragraphs relate only to compliance with the rules of this Section, and are not to be construed as involving contractual relations or legal liabilities. Whenever *Owner* appears in this document, it may be considered to apply also to an Agent or User acting in the Owner's behalf. When the Owner is not identified before the vessel is manufactured, the responsibilities assigned to the Owner in TG-310 apply to the Manufacturer.

(25) TG-310 OWNER'S RESPONSIBILITY

It is the responsibility of the Owner or the Owner's designated agent to provide the Manufacturer with the necessary information regarding modal application and service conditions, including the hazardous material to be transported, design pressure and temperatures, design loads, corrosion allowance, and other pertinent information needed to determine the design and construction requirements of the vessel.

TG-310.1 USER'S RESPONSIBILITIES

In addition to the responsibilities agreed upon between the Owner and the User, the User is responsible for meeting the requirements for continued service; see Part TP.

TG-320 MANUFACTURER'S RESPONSIBILITY

The Manufacturer has the responsibility of ensuring that the quality control, the detailed examinations and tests required by this Section are performed. The Manufacturer shall perform duties as specified by the rules of this Section.

Some, but not all, of these duties that are defined elsewhere within the applicable rules of this Section are summarized as follows:

(a) Prepare a Quality Control System and obtain the Certificate of Authorization in accordance with CA-1 authorizing the construction and stamping of a specific class of vessel.

(b) Prepare or obtain the drawings and design calculations for the vessel or part.

(c) Provide for identification for all materials used in the fabrication of the vessel or part.

(d) Obtain any Partial Data Reports (see TS-310) and attach to the vessel data report.

(e) Provide access for the Inspector.

(f) Examine all materials before fabrication to make certain they meet the required thickness, to detect defects, to make certain the materials are permitted by this Section, and to ensure that the traceability to the material identification has been maintained.

(g) Document any impact tests and any tests in addition to those in the material specification.

(h) Obtain concurrence of the Inspector, prior to any repair.

(i) Examine the shell and head sections to confirm they have been properly formed to the specified shapes within the permissible tolerances.

(j) Qualify the welding procedures before they are used in fabrication.

(k) Qualify welders and welding operators.

(l) Examine all parts, prior to joining, to make sure they have been properly fitted for welding and that the surfaces to be joined have been cleaned and the alignment tolerances are maintained.

(m) Examine parts as fabrication progresses, for material marking, for detection of flaws, and to ensure that dimensional tolerances are maintained.

(n) Provide controls to ensure that all required heat treatments are performed.

(o) Record all nondestructive examinations performed on the vessel or vessel parts. This shall include retaining the radiographic film.

(p) Perform the required hydrostatic or pneumatic test and maintain a record of such test.

(q) Apply the required stamping and or nameplate to the vessel and make certain that it is applied to the proper vessel.

(r) Prepare the required Manufacturer's Data Report and have it certified by the Inspector.

(s) Provide for retention of Manufacturer's Data Reports.

TG-320.1 STRUCTURAL AND PRESSURE-RETAINING INTEGRITY

The Manufacturer is responsible for the structural and pressure-retaining integrity of the vessel or vessel part and for compliance with the requirements specified by the Owner and the rules of this Section.

TG-320.2 CODE COMPLIANCE

(a) The Manufacturer has the responsibility to comply with all the applicable requirements of this Section and, through proper certification, to ensure that any work performed by others also complies with all the requirements of this Section.

(b) The Manufacturer shall certify compliance with these requirements by the completion of the appropriate Manufacturer's Data Report, as prescribed in Article TS-3.

(25) ## TG-330 INSPECTOR'S DUTIES

It is the duty of the Inspector to verify that the inspections and tests specified by the rules of this Section are performed, ensuring that materials are in accordance with the requirements of the material specifications, that the construction is in accordance with the Manufacturer's design calculations and drawings, and that the requirements of this Section are met. This includes monitoring the Manufacturer's Quality Control System to ensure that the proper controls for materials, design, drawings, and fabrication are properly implemented. The Inspector shall certify the above to be true to the best of the Inspector's knowledge by signing the Manufacturer's Data Report. The Inspector does not have the duty of determining the completeness or correctness of the design calculations; however, the Inspector does have the duty of establishing that the Manufacturer of the completed vessel has prepared design calculations that address the requirements of this Section.

The Inspector shall make other inspections as in the Inspector's judgment are necessary to verify that all vessels to be stamped with the Certification Mark have been designed and constructed in accordance with the requirements of this Section. Some, but not all, of the required inspections and verifications that are defined elsewhere within the applicable rules of this Section are summarized as follows:

(a) verifying that the Manufacturer has a valid Certificate of Authorization and is working to a Quality Control System

(b) verifying that the applicable design calculations are available

(c) verifying that the materials used in the construction of the vessel comply with the requirements of this Section

(d) verifying that all welding procedures have been qualified

(e) verifying that all welders, welding operators have been qualified

(f) verifying that the heat treatments, including PWHT, have been performed

(g) verifying that material imperfections repaired by welding were repaired properly

(h) verifying that weld defects were acceptably repaired

(i) verifying that required nondestructive examinations, impact tests, and other tests have been performed and that results are acceptable

(j) making a visual inspection of the vessel to confirm that there are no surface defects or deviations from Code-required dimensions

(k) performing internal and external inspections and witnessing the hydrostatic or pneumatic tests

(l) verifying that the required marking is provided and that proper nameplate has been attached to the vessel

(m) signing the Certificate of Inspection on the Manufacturer's Data Report and Certificate of Conformance Form that serves as the acceptance document for the vessel when, to the best of the Inspector's knowledge and belief, the vessel is in compliance with all provisions of this Section

ARTICLE TG-4
GENERAL RULES FOR INSPECTION

TG-400 GENERAL REQUIREMENTS FOR INSPECTION AND EXAMINATION

The inspection and examination of vessels to be stamped with the Certification Mark shall conform to the general requirements for inspection and examination in this Article, and to the specific requirements for inspection and examination given in the applicable Parts and Modal Appendices of this Section.

TG-410 THE INSPECTOR

All references to Inspectors throughout this Section mean the Inspector or Certified Individual, as defined in this paragraph, responsible for verification of the inspection and testing of pressure vessels or parts thereof. All Inspections required by this Section shall be performed by the type of Inspector identified in TG-430 for the specific Class of vessel to be constructed or repaired.

ASME Qualified Inspection Organization (QIO): an organization that is qualified by ASME to criteria specified in the appropriate code or standard to provide designated oversight through the use of Qualified Inspectors (QI); not an Authorized Inspection Agency and not an entity authorized by ASME to use its marks.

Authorized Inspector (AI): an Inspector regularly employed by an ASME-accredited Authorized Inspection Agency (AIA), who has been qualified to ASME developed criteria, to perform inspections under the rules of any jurisdiction that has adopted the ASME Code.

The Authorized Inspector shall not be in the employ of the Manufacturer. The AIA and supervisor's duties and qualifications and AI qualifications are as required in the latest edition and addenda of ASME QAI-1, Qualifications for Authorized Inspection.

Certified Individual (CI): an individual employee of the Certificate Holder who is authorized by ASME under a Certificate of Authorization to apply the ASME Certification Mark on items that are in compliance with the governing standard, and who may serve as the Certificate Holder's authorized representative responsible for signing data reports or certificates of conformance.

The CI shall be qualified and certified by the Certificate Holder to criteria specified in the governing standard. The qualification and certification are subject to evaluation by ASME Designees. The CI is neither an AI nor a Qualified Inspector providing inspections as an employee of a Qualified Inspection Organization. The quality management system shall establish measures to designate, train, qualify, and certify an individual(s) to perform the duties of a CI.

Qualifications shall include as a minimum:

(a) knowledge of the requirements of this Section of the Code for application of the Certification Mark with the appropriate Designator

(b) knowledge of the Manufacturer's Quality System Program

(c) training commensurate with the scope, complexity, or special nature of the activities to which oversight is to be provided

(d) a record, maintained, and certified by the Manufacturer, containing objective evidence of the qualifications of the CI and training provided

The CI's qualifications and duties are as required in the latest edition and addenda of ASME QAI-1, Qualifications for Authorized Inspection. The CI shall be qualified in accordance with ASME CA-1.

Qualified Inspector (QI): an inspector regularly employed by an ASME Qualified Inspection Organization (QIO) who has been qualified to ASME-developed criteria by a written examination, to perform inspections under the rules of any jurisdiction that has adopted the ASME Code. The QI shall not be in the employ of the Manufacturer.

The QIO's and supervisor's duties and qualifications and the QI's qualifications are as required in the latest edition and addenda of ASME QAI-1, Qualifications for Authorized Inspection.

TG-420 ACCESS FOR THE INSPECTOR (25)

The Manufacturer of the pressure vessel or part thereof shall arrange for the Inspector to have free access to such parts of all plants as are concerned with the supply or manufacture of materials for the vessel or part, when so requested. The Inspector shall be permitted free access at all times while work on the vessel is being performed to all parts of the Manufacturer's shop that concern the construction of the vessel during the period of its assembly and testing. The Manufacturer shall keep the Inspector informed of the progress of

the work and shall notify the Inspector reasonably in advance when the vessel or materials will be ready for any required tests or inspections.

TG-430 THE MANUFACTURER

(a) Manufacturers of Class 1 vessels constructed in accordance with the rules of this Section shall have in force, at all times, a valid inspection contract or agreement with an accredited Authorized Inspection Agency, employing Authorized Inspectors as defined in this Article.

(b) Manufacturers of Class 2 vessels constructed in accordance with the rules of this Section shall have in force, at all times, a valid inspection contract or agreement with an accredited QIO, employing Qualified Inspectors as defined in this Article.

(c) Manufacturers of Class 3 vessels constructed in accordance with the rules of this Section shall employ a Certified Individual as defined in this Article.

(d) Vessel Classes are designated in the applicable Modal Appendix.

(e) Authorized Inspection Agencies may provide inspection services for Manufacturers of Class 2 and Class 3 vessels. Qualified Inspection Organizations may provide inspection services for Manufacturers of Class 3 vessels.

TG-440 CONTINUED SERVICE

(a) Personnel performing inspections during the course of repair, alteration, or continued service of these pressure vessels shall meet the requirements of TG-430.

(b) Users may perform continued service inspections and tests if no rerating, repairs, or alterations requiring welding are performed, except see TG-100.3.

(c) Users may perform continued service inspections, including repairs and alterations, if the User possesses a valid Owner/User Certificate of Authorization issued by The National Board of Boiler and Pressure Vessel Inspectors or the equivalent recognized by the competent authority, and the Inspectors possess a National Board Owner/User commission or the equivalent recognized by the competent authority and are in the employ of the Owner/User.

PART TM
MATERIAL REQUIREMENTS

ARTICLE TM-1
MATERIAL REQUIREMENTS

TM-100 GENERAL

The requirements of Part TM are applicable to all pressure parts in pressure vessels and attachments to pressure parts, except as permitted by the applicable Modal Appendix, and shall be used in conjunction with the specific requirements given elsewhere in this Section that pertain to the method of fabrication, the material used, and the commodities being transported. See the applicable Modal Appendix for materials for other parts of transport tanks.

TM-110 GENERAL REQUIREMENTS FOR ALL PRODUCTS

(a) Material subject to stress due to pressure, and attachments that are essential to structural integrity of the pressure vessel when welded to pressure-retaining components, shall conform to one of the specifications given in Tables TM-130.2-1 through TM-130.2-7 and listed in Section II, Parts A and B, except as otherwise permitted in TM-110.5, TM-110.10, TM-120, and TM-130.1. Material may be identified as meeting more than one material specification or grade, provided the material meets all requirements of the identified material specification(s) or grade(s).

(b) Except as limited by TM-180.2, material for nonpressure parts, such as baffles, extended heat transfer surfaces, insulation supports, and minor attachments[1] (such as clips, locating lugs, nameplates) need not conform to the specifications for the material to which they are attached or to a material specification permitted in this Section; but if attached to the vessel by welding, it shall be of weldable quality. The allowable stress values for material not identified in accordance with Tables TM-130.2-1 through TM-130.2-7 shall not exceed 80% of the maximum allowable stress value permitted for similar material in Tables TM-130.2-1 through TM-130.2-7.

(c) Materials other than those allowed by this Section may not be used, unless data thereon are submitted to and approved by the Boiler and Pressure Vessel Committee in accordance with Section II, Part D, Mandatory Appendix 5.

(d) Materials outside the limits of size and/or thickness listed in the title or scope clause of the specifications listed in Tables TM-130.2-1 through TM-130.2-7, and permitted elsewhere in this Section, may be used if the material is in compliance with the other requirements of the specification and no size or thickness limitation is given in the stress tables. In those specifications in which chemical composition or mechanical properties vary with size or thickness, materials outside the range shall be required to conform to the composition and mechanical properties shown for the nearest specified range.

(e) All material used for construction of vessels and appurtenances must be suitable for the modal application and conditions specified by the User (see TG-310) and shall comply with the additional requirements in the applicable Modal Appendices.

TM-110.1 PLATES

Plates used in the construction of vessels shall conform to one of the specifications in Tables TM-130.2-1 through TM-130.2-7 for which allowable stress values are given in Section II, Part D, except as otherwise provided in TM-110(a) through TM-110(e), TM-110.10, TM-120, and TM-130.1.

TM-110.2 FORGINGS

Forged material may be used in vessel construction, provided the material has been worked sufficiently to remove the coarse ingot structure. Specifications for acceptable forging materials are given in Tables TM-130.2-1 through TM-130.2-7 and maximum allowable stress values in Section II, Part D.

TM-110.3 CASTINGS

Cast material may be used in the construction of vessels and vessel parts. Specifications for acceptable casting materials are listed in Tables TM-130.2-1 through TM-130.2-7 and the maximum allowable stress values in Section II, Part D. Castings shall comply with the additional requirements in TM-190. The allowable stress values shall be multiplied by the applicable casting quality factor given in TM-190.

TM-110.4 PIPE AND TUBES

Pipe and tubes of seamless or welded construction conforming to one of the specifications given in Tables TM-130.2-1 through TM-130.2-7 may be used for shells and other parts of transport tanks. Allowable stress values for the materials used in pipe and tubes are given in Section II, Part D.

TM-110.5 WELDING MATERIALS

Welding materials shall comply with the requirements of this Section, Section IX, and the applicable qualified welding procedure specification. When the welding materials comply with one of the specifications in Section II, Part C, the marking or tagging of the material, containers, or packages as required by the applicable Section II specification may be accepted for identification in lieu of a Material Test Report or a Certificate of Compliance. When the welding materials do not comply with one of the specifications of Section II, the marking or tagging shall be identifiable with the welding materials set forth in the welding procedure specification and may be accepted in lieu of a Material Test Report or a Certificate of Compliance.

TM-110.6 BOLTS AND STUDS

(a) Bolts and studs may be used for the attachment of removable parts. Permissible specifications are listed in Tables TM-130.2-1 through TM-130.2-7. Nuts and bolts shall conform to the requirements of TM-110.6 and the additional rules in TM-150.1, TM-150.5, or TM-160.1, as applicable. The allowable stresses for bolting materials are given in Section II, Part D, Subpart 1, Table 3.

(b) Studs shall be threaded full length or shall be machined down to the root diameter of the thread in the unthreaded portion, provided that the threaded portions are at least $1\frac{1}{2}$ diameters in length. Studs greater than eight diameters in length may have an unthreaded portion that has the nominal diameter of the thread, provided the following requirements are met:

(1) the threaded portions shall be at least $1\frac{1}{2}$ diameters in length

(2) the stud shall be machined down to the root diameter of the thread for a minimum distance of 0.5 diameters adjacent to the threaded portion

(3) a suitable transition shall be provided between the root diameter and the unthreaded portion

(4) particular consideration shall be given to any dynamic loadings

TM-110.7 NUTS AND WASHERS

(a) Nuts shall conform to the requirements in the applicable paragraph elsewhere in this Code (see TM-150.1, TM-150.2, and TM-160.2). They shall engage the threads for the full depth of the nut.

(b) The use of washers is optional. When used, they shall be of wrought materials.

TM-110.8 RODS AND BARS

Rod and bar stock may be used in the vessel construction for pressure parts such as flange rings, stiffening rings, frames for reinforced openings, stays and staybolts, and similar parts. Rod and bar materials shall conform to the requirements for bars or bolting in the applicable section elsewhere in this Code (see TM-150.4).

TM-110.9 FERRITIC STEELS WITH TENSILE PROPERTIES ENHANCED BY HEAT TREATMENT

Except when specifically prohibited by Part TM (see TM-180.2 and TW-130.7), steels listed in Table TM-130.2-6 may be used for the entire vessel or for individual components that are joined to other Grades listed in that Table or to other steels conforming to the specifications in Table TM-130.2-1 or Table TM-130.2-2. The maximum allowable stress values for the materials listed in Table TM-130.2-6 are given in Section II, Part D.

TM-110.10 PREFABRICATED OR PREFORMED PRESSURE PARTS FURNISHED WITHOUT A CERTIFICATION MARK

(a) Prefabricated or preformed pressure parts for pressure vessels that are subject to stresses due to pressure and that are furnished by others instead of the Manufacturer of the completed vessel shall conform to all applicable requirements of this Section except as permitted in (b) through (e). When the prefabricated or preformed parts are furnished with a nameplate that contains product-identifying marks and the nameplate interferes with further fabrication or service, and where stamping on the material is prohibited, the Manufacturer of the completed vessel with the concurrence of the Authorized Inspector may remove the nameplate. The removal of the nameplate shall be noted in the "Remarks" section of the tank Manufacturer's Data Report. The nameplate shall be destroyed. The rules of (b) through (e) shall not be applied to welded shells or heads or to quick-actuating closures. Parts furnished under the provisions of (b), (c), and (d) need not be manufactured by a Certificate of Authorization Holder. However, the Manufacturer of the completed

vessel or Certification Mark-stamped part shall ensure that parts furnished under the provisions of (b), (c), (d), and (e) meet all of the applicable Code requirements such as TF-310.1(c), TF-410.4, TF-510.1, and TF-610.1. Prefabricated or preformed pressure parts may be supplied as follows:

(1) cast, forged, rolled or die-formed nonstandard pressure parts

(2) cast, forged, rolled or die-formed standard pressure parts that comply with an ASME product standard, welded or nonwelded

(3) cast, forged, rolled or die-formed standard pressure parts that comply with a standard other than an ASME product standard, welded or nonwelded

(b) Cast, Forged, Rolled, or Die-Formed Nonstandard Pressure Parts. Pressure parts such as shells, heads, removable doors, and pipe coils that are wholly formed by casting, forging, rolling, or die forming may be supplied basically as materials. All such parts shall be made of materials permitted under this Section, and the Manufacturer of the part shall furnish identification in accordance with TM-140.2. Such parts shall be marked with the name or trademark of the parts manufacturer and with such other markings to identify the particular parts with accompanying material identification. The Manufacturer of the completed tank shall be satisfied that the part is suitable for the design conditions specified for the completed tank in accordance with the rules of this Section.

(c) Cast, Forged, Rolled, or Die-Formed Standard Pressure Parts That Comply with an ASME Product Standard, Welded or Nonwelded

(1) These are pressure parts that comply with an ASME product standard accepted by reference in TG-130. The ASME product standard establishes the basis for the pressure–temperature rating and marking unless modified in TM-110.5.

(2) Flanges and flanged fittings may be used at the pressure–temperature ratings specified in the appropriate standard listed in this Section.

(3) Materials for standard pressure parts shall be as follows:

(-a) as permitted by this Section

(-b) as specifically listed in the ASME product standard (see TG-130)

(4) When welding is performed, it shall meet the following:

(-a) the requirements of Article TF-2

(-b) the welding requirements of SA-234

(5) Pressure parts, such as welded standard pipe fittings, welding caps, and flanges that are fabricated by one of the welding processes recognized by this Section do not require inspection, identification in accordance with TM-140.1(a) or TM-140.1(b), or Partial Data Reports, provided the requirements in (c) are met.

(6) If postweld heat treatment is required by the rules of this Section, it may be performed either in the location of the parts manufacturer or in the location of the Manufacturer of the tank to be marked with the Certification Mark.

(7) If radiography or other volumetric examination is required by the rules of this Section, it may be performed at one of the following locations:

(-a) Manufacturer of the completed tank

(-b) pressure parts manufacturer

(-c) examination provider

(8) Parts made to an ASME product standard shall be marked as required by the ASME product standard.

(9) The Manufacturer of the completed tank shall have the following responsibilities when using standard pressure parts that comply with an ASME product standard:

(-a) Ensure that all standard pressure parts comply with the applicable rules of this Section.

(-b) Ensure that all standard pressure parts are suitable for the design conditions of the completed tank.

(10) The Manufacturer shall fulfill these responsibilities by obtaining, when necessary, documentation as follows, provide for retention of this documentation, and have such documentation available for examination by the Inspector when requested. The documentation shall contain at a minimum:

(-a) material used

(-b) pressure–temperature rating of the part

(-c) basis for establishing the pressure–temperature rating

(d) Cast, Forged, Rolled, or Die-Formed Standard Pressure Parts That Comply With a Standard Other Than an ASME Product Standard, Welded or Nonwelded

(1) Standard pressure parts that are welded or nonwelded and comply with a manufacturer's proprietary standard or a standard other than an ASME product standard may be supplied by:

(-a) a Certificate of Authorization Holder

(-b) a pressure parts manufacturer

(2) Parts of small size falling within this category for which it is impossible to obtain identified material or which may be stocked and for which identification in accordance with TM-140.2 cannot be obtained and are not customarily furnished, may be used for parts as described in (b).

(3) Materials for these parts shall be as permitted by this Section only.

(4) When welding is performed, it shall meet the requirements of Article TF-2.

(5) Pressure parts, such as welded standard pipe fittings, welding caps, and flanges that are fabricated by one of the welding processes recognized by this Section do not require inspection, identification in accordance with TM-140.1 or Partial Data Reports, provided the requirements of TM-140.1(a) or TM-140.1(b) are met.

(6) If postweld heat treatment is required by the rules of this Section, it may be performed at the location of the parts manufacturer, the Manufacturer of the completed tank, or a heat-treatment facility.

(7) If radiography or other volumetric examination is required by the rules of this Section, it may be performed at one of the following locations:

(-a) Manufacturer of the completed tank

(-b) parts Manufacturer

(-c) pressure parts manufacturer

(-d) the examination provider

(8) Marking for these parts shall be as follows:

(-a) with the name or trademark of the Certificate Holder or the pressure part manufacturer and any other markings as required by the proprietary standard or other standard used for the pressure part

(-b) with a permanent or temporary marking that will identify the part with the Certificate Holder or the pressure parts manufacturer's written documentation of the particular items, and which defines the pressure–temperature rating of the part

(9) The Manufacturer of the completed tanks shall have the following responsibilities when using standard pressure parts:

(-a) Ensure that all standard pressure parts comply with applicable rules of this Section

(-b) Ensure that all standard pressure parts are suitable for the design conditions of the completed tank.

(-c) When volumetric examination is required by the rules of this Section, obtain the completed radiographs, properly identified, with a radiographic inspection report, and any other applicable volumetric examination report.

(10) The Manufacturer of the completed tank shall fulfill these responsibilities by one of the following methods:

(-a) Obtain when necessary, documentation as provided below, provide for retention of this documentation, and have such documentation available for examination by the Inspector when requested.

(-b) Perform an analysis of the pressure part in accordance with the rules of this Division. See also TG-100.2(c). This analysis shall be included in the documentation and shall be made available for examination by the Inspector when requested.

(11) The documentation shall contain at a minimum:

(-a) material used

(-b) pressure–temperature rating of the part

(-c) basis for establishing the pressure–temperature rating

(-d) written certification by the pressure parts manufacturer that all welding complies with Code requirements

(e) The Code recognizes that a Certificate of Authorization Holder may fabricate parts in accordance with (d), and that are marked in accordance with (d)(8). In lieu of the requirement in (d)(4), the Certificate of Authorization Holder may subcontract to an individual or organization not holding an ASME Certificate of Authorization standard pressure parts that are fabricated to a standard other than an ASME product standard provided all the following conditions are met:

(1) The activities to be performed by the subcontractor are included within the Certificate Holder's Quality Control System.

(2) The Certificate Holder's Quality Control System provides for the following activities associated with subcontracting of welding operations, and these provisions shall be acceptable to the Manufacturer's Authorized Inspection Agency.

(-a) welding processes permitted by this Section that are permitted to be subcontracted

(-b) welding operations

(-c) Authorized Inspection activities

(-d) placement of the Certificate of Authorization Holder's marking in accordance with (d)(8)

(3) The Certificate Holder's Quality Control System provides for the requirements of TG-420 to be met at the subcontractor's facility.

(4) The Certificate Holder shall be responsible for reviewing and accepting the Quality Control Systems of the subcontractor.

(5) The Certificate Holder shall ensure that the subcontractor uses written procedures and welding operations that have been qualified as required by this Section.

(6) The Certificate Holder shall ensure that the subcontractor uses personnel that have been qualified as required by this Section.

(7) The Certificate Holder and the subcontractor shall describe in their Quality Control Systems the operational control of procedure and personnel qualifications of the subcontracted welding operations.

(8) The Certificate Holder shall be responsible for controlling the quality and ensuring that all materials and parts that are welded by subcontractors and submitted to the Inspector for acceptance conform to all applicable requirements of this Section.

(9) The Certificate Holder shall describe in their Quality Control Systems the operational control for maintaining traceability of materials received from the subcontractor.

(10) The Certificate Holder shall receive approval for subcontracting from the Authorized Inspection Agency prior to commencing of activities.

TM-120 MATERIAL IDENTIFIED WITH OR PRODUCED TO A SPECIFICATION NOT PERMITTED BY THIS SECTION, AND MATERIAL NOT FULLY IDENTIFIED

(a) Identified Material With Complete Certification From the Material Manufacturer. Material identified with a specification not permitted by this Section and identified to a single production lot as required by a permitted specification may be accepted as satisfying the requirements of a specification permitted by this Section, provided the conditions set forth in (1) or (2) are satisfied.

(1) Recertification by an Organization Other Than the Vessel or Part Manufacturer. Not permitted

(2) Recertification by the Vessel or Part Manufacturer

(-a) Documentation is provided to the Certificate Holder demonstrating that all applicable requirements (including, but not limited to, melting method, melting practice, deoxidation, chemical analysis, mechanical properties, quality, and heat treatment) of the specification permitted by this Section, to which the material is to be recertified, have been met.

(-b) The material has marking, acceptable to the Inspector, for identification to the documentation.

(-c) When the conformance of the material with the permitted specification has been established, the material shall be marked as required by the permitted specification.

(b) Material Identified With a Specification Not Permitted by This Section and Identified to a Particular Production Lot as Required by a Specification Permitted by This Section but Which Cannot Be Qualified Under (a). Any material for which the documentation required in (a) is not available may be accepted as satisfying the requirements of the specification permitted by this Section, provided that the conditions set forth below are satisfied.

(1) Recertification by an Organization Other Than the Vessel or Part Manufacturer. Not permitted.

(2) Recertification by the Vessel or Part Manufacturer

(-a) When documentation demonstrating complete conformance to the chemical requirements is not available, chemical analyses are made on different pieces from the lot to establish a mean analysis that is to be accepted as representative of the lot. The pieces chosen for analysis shall be selected at random from the lot. The number of pieces selected shall be at least 10% of the number of pieces in the lot, but not less than three. For lots of three pieces or less, each piece shall be analyzed. Each individual analysis for an element shall conform to the limits for product analysis in the permitted specification, and the mean for each element shall conform to the heat analysis limits of that specification. Analyses need only be made for those elements required by the permitted specification (including its general specification); only those elements for which documentation is not available must be tested.

(-b) When documentation demonstrating complete conformance to the mechanical property requirements is not available, mechanical property tests are made in accordance with the requirements of the permitted specification, and the results of the tests conform to the specified requirements; only those properties for which documentation is not available must be tested.

(-c) When documentation demonstrating complete conformance to the heat treatment requirements is not available, the material is heat treated in accordance with those requirements, either prior to or during fabrication. (See also TM-140.2.)

(-d) All other applicable requirements (including, but not limited to, melting method, melting practice, deoxidation, chemical analysis, mechanical properties, grain size, and quality) of the specification permitted by this Section, to which the material is to be recertified, have been demonstrated to have been met.

(-e) The material has marking, acceptable to the Inspector, for identification to the documentation.

(-f) When the conformance of the material with the permitted specification has been established, the material has been marked as required by the permitted specification.

(c) Material Not Fully Identified. Material that cannot be qualified under the provisions of either (a) or (b), such as material not fully identified as required by the permitted specification or unidentified material, may be accepted as satisfying the requirements of a specification permitted by this Section, provided that the conditions set forth below are satisfied.

(1) Qualification by an Organization Other Than the Vessel or Part Manufacturer. Not permitted.

(2) Qualification by the Vessel or Part Manufacturer

(-a) Each piece is tested to show that it meets the chemical composition for product analysis and the mechanical property requirements of the permitted specification. Chemical analyses need only be made for those elements required by the permitted specification (including its general specification). When the direction of final rolling or major work (as required by the material specification) is not known, tension test specimens shall be taken in each appropriate direction from each sampling location designated in the permitted specification. The results of both tests shall conform to the minimum requirements of the specification, but the tensile strength of only one of the two specimens need conform to the maximum requirement.

(-b) The provisions of (b)(2)(-c), above shall be met.

(-c) All other applicable requirements (including, but not limited to, melting method, melting practice, deoxidation, chemical analysis, mechanical properties, grain

size, and quality) of the specification permitted by this Section, to which the material is to be recertified, have been demonstrated to have been met. If such verifiable evidence cannot be provided, recertification is not permitted.

(-d) When the identity of the material with the permitted specification has been established in accordance with (-a), (-b), and (-c) above, each piece (or bundle, etc., if permitted in the specification) shall be marked with a marking giving the permitted specification number and grade, type, or class, as applicable and a serial number identifying the particular lot of material. A suitable report, clearly marked as being a "Report on Tests of Nonidentified Material," shall be completed and certified by the tank or part Manufacturer. This report, when accepted by the Inspector, shall constitute authority to use the material in lieu of material procured to the requirements of the permitted specification.

TM-130 MATERIAL SPECIFICATIONS

TM-130.1 PRODUCT SPECIFICATION

When there is no material specification listed in Tables TM-130.2-1 through TM-130.2-7 covering a particular product of a grade, but there is an approved specification listed in Tables TM-130.2-1 through TM-130.2-7 covering some other product of that grade, the product for which there is no specification may be used, provided:

(a) the chemical and mechanical properties, heat treating requirements, and requirements for deoxidation, or grain size requirements conform to the approved specification listed in Tables TM-130.2-1 through TM-130.2-7. The stress values for that specification given in the tables referenced in TM-130.2 shall be used.

(b) the manufacturing procedures, tolerances, tests, and marking are in accordance with a specification listed in Tables TM-130.2-1 through TM-130.2-7 covering the same product form of a similar material.

(c) for the case of welded tubing made of plate, sheet, or strip, without the addition of filler metal, the appropriate stress values are multiplied by a factor of 0.85.

(d) the product is not pipe or tubing fabricated by fusion welding with the addition of filler metal unless it is fabricated in accordance with the rules of this Section as a pressure part.

(e) mill test reports reference the specifications used in producing the material and make reference to this paragraph.

(25) TM-130.2 APPROVED MATERIAL SPECIFICATIONS

(a) Approved material specifications are listed in the following Tables:

Table TM-130.2-1	Carbon and Low Alloy Steel
Table TM-130.2-2	High Alloy Steel

Table continued

Table TM-130.2-3	Aluminum and Aluminum Alloy Products
Table TM-130.2-4	Copper and Copper Alloys
Table TM-130.2-5	Nickel and High Nickel Alloys
Table TM-130.2-6	Ferritic Steels With Tensile Properties Enhanced by Heat Treatment
Table TM-130.2-7	Titanium and Titanium Alloys

(b) The maximum allowable tensile stress values for the materials listed in Tables TM-130.2-1 through TM-130.2-7 are the values given in Section II, Part D, for Section XII construction, except where otherwise specified or limited by Table TM-130.2-1, Note (1); Table TM-130.2-2, Notes (1) and (2); Table TM-130.2-5, Note (1); and Table TM-130.2-7.

TM-130.3 MATERIAL PROPERTIES

When the rules of this Section require the use of material physical properties, these properties shall be taken from the applicable tables in Section II, Part D, Subpart 2. If the applicable tables in Section II, Part D, Subpart 2 do not contain these properties for a permitted material or do not list them within the required temperature range, the Manufacturer may use other authoritative sources for the needed information. The Manufacturer's Data Report shall note under "Remarks" the property values obtained and their source.

NOTE: If material physical properties are not listed, the Manufacturer is encouraged to bring the information to the attention of the ASME Committee on Materials (BPVC Section II) so that the data can be added in Section II, Part D, Subpart 2.

TM-140 INSPECTION AND MARKING OF MATERIALS

TM-140.1 INSPECTION OF MATERIALS (25)

(a) Except as provided in TM-110(a) through TM-110(e), TM-110.10, TM-120, and TM-130.1, requirements for acceptance of materials furnished by the material Manufacturer or material supplier shall be in complete compliance with a material specification of Section II and the following requirements:

(1) For plates, the tank Manufacturer shall obtain the material test report or certificate of compliance as provided for in the material specification and the Inspector shall examine the Material Test Report or Certificate of Compliance and shall determine if it represents the material and meets the requirements of the material specification.

Table TM-130.2-1
Carbon and Low Alloy Steels

(25)

Specification Number	Type/Grade	ASME P-No.	Group No.
Plates, Sheet, and Strip			
SA-36	...	1	1
SA-203	A, B	9A	1
	D, E, F	9B	1
SA-204	A	3	1
	B, C	3	2
SA-225	C	10A	1
SA-283	C, D	1	1
SA-285	A, B, C	1	1
SA-299	A	1	2
	B	1	3
SA-302	A	3	2
	B, C, D	3	3
SA-387	2, Cl. 1	3	1
	2, Cl. 2	3	2
SA-414	A, B, C, D, E	1	1
	F, G	1	2
SA-455	...	1	2
SA-515	60, 65	1	1
	70	1	2
SA-516	55, 60, 65	1	1
	70	1	2
SA-537	Cl. 1	1	2
	Cl. 2 and 3	1	3
SA-572	42, 50	1	1
	55, 60	1	2
	65	1	3
SA-612	...	10C	1
SA-656	T3 50, T7 50	1	1
	T3 60, T7 60	1	2
	T3 70, T7 70	1	3
	T3 80, T7 80	1	4
SA-662	A, B	1	1
	C	1	2
SA-737	B	1	2
	C	1	3
SA-738	A	1	2
	B, C	1	3
SA-1008	CS-A and CS-B	1	1
SA-1011	HSLAS 45 Cl. 1 and 2	1	1
	HSLAS 50 Cl. 1 and 2	1	1
	HSLAS 60 Cl. 1 and 2	1	2
	SS 45, SS 50	1	1
SA/CSA-G40.21	38W	1	1
SA/EN 10028-2	P295GH	1	1
SA/EN 10028-3	P275NH	1	1
Forgings			
SA-266	1	1	1
	2, 4	1	2

Table TM-130.2-1
Carbon and Low Alloy Steels (Cont'd)

Specification Number	Type/Grade	ASME P-No.	Group No.
Forgings (Cont'd)			
SA-336	F1	3	2
SA-372	A	1	1
	B	1	2
	C, D	...	...
	E Cl. 65 and 70	...	...
	F Cl. 70, G Cl. 70	...	...
	H Cl. 70, J Cl. 65	...	...
	J Cl. 70 and 110, L	...	...
	M Cl. A and B	...	...
SA-508	1, 1A	1	2
	2 Cl. 1, 3 Cl. 1, 4N Cl. 3	3	3
SA-541	1, 1A	1	2
	2 Cl. 1, 3 Cl. 1	3	3
SA-765	I	1	1
	II	1	2
	III	9B	1
SA-836	...	1	1
Flanges, Fittings, and Valves			
SA-105	...	1	2
SA-181	Cl. 60	1	1
	Cl. 70	1	2
SA-182	F1, F2	3	2
	FR	9A	1
SA-234	WPB	1	1
	WPC	1	2
	WP1	3	1
SA-350	LF1	1	1
	LF2	1	2
	LF5 Cl. 1 and 2, LF9	9A	1
	LF3	9B	1
SA-420	WPL6	1	1
	WPL9	9A	1
	WPL3	9B	1
SA-727	...	1	1
Pipe			
SA-53	S Gr. A and B, E Gr. A and B	1	1
SA-106	A, B	1	1
	C	1	2
SA-135	A, B	1	1
SA-333	1, 6	1	1
	7, 9	9A	1
	3	9B	1
SA-335	P1, P2, P15	3	1
SA-369	FP1, FP2	3	1
SA-524	I, II	1	1
SA-587	...	1	1

Table TM-130.2-1
Carbon and Low Alloy Steels (Cont'd)

Specification Number	Type/Grade	ASME P-No.	Group No.
Tubes			
SA-178	A, C	1	1
SA-179	...	1	1
SA-192	...	1	1
SA-209	T1, T1a, T1b	3	1
SA-210	A-1	1	1
	C	1	2
SA-213	T2	3	1
	T17	10B	1
SA-214	...	1	1
SA-250	T1, T1a, T1b	3	1
SA-334	1, 6	1	1
	7, 9	9A	1
	3	9B	1
SA-556	A2, B2	1	1
	C2	1	2
SA-557	A2, B2	1	1
	C2	1	2
Castings			
SA-216	WCA	1	1
	WCB, WCC	1	2
SA-217	WC1	3	1
SA-352	LCB	1	1
	LC1	3	1
	LC2	9A	1
	LC3	9B	1
SA-487	1 Cl. A and B	10A	1
	2 Cl. A and B, 4 Cl. A	3	3
Bar			
SA-675	45, 50, 55, 60, 65	1	1
	70	1	2
Bolting			
SA-193	B5, B7, B7M, B16	...	...
SA-307	B	...	...
SA-320	L7, L7A, L7M, L43	...	...
SA-325	1	...	...
SA-354	BC, BD	...	...
SA-437	B4B, B4C	...	...
SA-449	...	...	...
SA-540	B21 Cl. 1, 2, 3 and 4	...	...
	B22 Cl. 3	...	...
	B23 Cl. 1, 2, 3, 4, and 5	...	...
	B24 Cl. 1, 2, 3, 4, and 5	...	...
	B24V	...	...
SA-574 (screws)	...	...	...
Nuts			
SA-540	B23, B24	...	...

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Table TM-130.2-2
High Alloy Steels

Specification Number	UNS No.	Type/Grade	ASME P-No.	Group No.
Plates, Sheet, and Strip				
SA-240	S41000	410	6	1
	S42900	429	6	2
	S40500	405	7	1
	S41008	410S	7	1
	S43000	430	7	2
	S44400	...	7	2
	S30200	302	8	1
	S30400	304	8	1
	S30403	304L	8	1
	S30451	304N	8	1
	S30453	304LN [Note (1)]	8	1
	S31600	316	8	1
	S31603	316L	8	1
	S31635	316Ti	8	1
	S31640	316Cb	8	1
	S31651	316N	8	1
	S31653	316LN [Note (2)]	8	1
	S31700	317	8	1
	S31703	317L	8	1
	S32100	321	8	1
	S34700	347	8	1
	S34800	348	8	1
	S38100	XM-15	8	1
	S30815	...	8	2
	S30908	309S	8	2
	S30940	309Cb	8	2
	S31008	310S	8	2
	S31040	310Cb	8	2
	S31050	310MoLN	8	2
	S20100	201-1, 201-2	8	3
	S20153	201LN	8	3
	S20400	204	8	3
	S20910	XM-19	8	3
	S24000	XM-29	8	3
	S31254	...	8	4
	S31725	...	8	4
	S31200	...	10H	1
	S31260	...	10H	1
	S31803	...	10H	1
	S32304	...	...	...
	S32550	...	10H	1
	S32900	329	10H	1
	S32950	...	10H	1
	S44626	XM-33	10I	1
	S44627	XM-27	10I	1
	S44635	25-4-4	10I	1
	S44700	29-4	10J	1
	S44660	26-3-3	10K	1

Table TM-130.2-2
High Alloy Steels (Cont'd)

Specification Number	UNS No.	Type/Grade	ASME P-No.	Group No.
Plates, Sheet, and Strip (Cont'd)				
	S44800	29-4-2	10K	1
	N08940	...	45	...
SA-666	S20100	201-1, 201-2	8	3
	S21904	XM-11	8	3
Forgings				
SA-965	S30400	F304	8	1
	S30403	F304L	8	1
	S30451	F304N	8	1
	S30453	304LN [Note (1)]	8	1
	S31600	F316	8	1
	S31603	F316L	8	1
	S31651	F316N	8	1
	S31653	316LN [Note (2)]	8	1
	S32100	F321	8	1
	S34700	F347	8	1
	S34800	F348	8	1
	S31000	F310	8	2
	S21904	FXM-11	8	3
Flanges, Fittings, and Valves				
SA-182	S41000	F6a Cl. 1	6	1
	S41000	F6a Cl. 2	6	3
	S30400	F304	8	1
	S30403	F304L	8	1
	S30453	304LN9	8	1
	S31600	F316	8	1
	S31603	F316L	8	1
	S31700	F317	8	1
	S31703	F317L	8	1
	S32100	F321	8	1
	S34700	F347	8	1
	S34800	F348	8	1
	S30815	F45	8	2
	S31000	F310	8	2
	S20910	FXM-19	8	3
	S21904	FXM-11	8	3
	S31254	F44	8	4
	S31803	F51	10H	1
	S44627	FXM-27Cb	10I	1
	N08940	...	45	...
SA-403	S30400	WP304	8	1
	S30403	WP304L	8	1
	S30451	WP304N	8	1
	S31600	WP316	8	1
	S31603	WP316L	8	1
	S31651	WP316N	8	1
	S31700	WP317	8	1

Table TM-130.2-2
High Alloy Steels (Cont'd)

Specification Number	UNS No.	Type/Grade	ASME P-No.	Group No.
Flanges, Fittings, and Valves (Cont'd)				
	S31703	WP317L	8	1
	S32100	WP321	8	1
	S34700	WP347	8	1
	S34800	WP348	8	1
	S30900	WP309	8	2
	S31000	WP310	8	2
	S20910	WPXM-19	8	3
SA-815	S31803	...	10H	1
Pipe				
SA-312	S30400	TP304	8	1
	S30403	TP304L	8	1
	S30451	TP304N	8	1
	S30453	304LN [Note (1)]	8	1
	S31600	TP316	8	1
	S31603	TP316L	8	1
	S31651	TP316N	8	1
	S31700	TP317	8	1
	S31703	TP317L	8	1
	S32100	TP321	8	1
	S34700	TP347	8	1
	S34800	TP348	8	1
	S38100	TPXM-15	8	1
	S30815	...	8	2
	S30908	TP309S	8	2
	S30940	TP309Cb	8	2
	S31008	TP310S	8	2
	S31040	TP310Cb	8	2
	S31050	TP310MoLN	8	2
	S20910	TPXM-19	8	3
	S21904	TPXM-11	8	3
	S24000	TPXM-29	8	3
	N08940	...	45	...
SA-358	S31254	...	8	4
	S31725	...	8	4
SA-376	S30400	TP304	8	1
	S30451	TP304N	8	1
	S30453	304LN [Note (1)]	8	1
	S31600	TP316	8	1
	S31651	TP316N	8	1
	S31653	316LN [Note (2)]	8	1
	S32100	TP321	8	1
	S34700	TP347	8	1
	S34800	TP348	8	1
	S31725	...	8	4
SA-409	S31725	...	8	4
SA-731	S44626	TPXM-33	10I	1
	S44627	TPXM-27	10I	1

Table TM-130.2-2
High Alloy Steels (Cont'd)

Specification Number	UNS No.	Type/Grade	ASME P-No.	Group No.
Pipe (Cont'd)				
SA-790	S31260	...	10H	1
	S31500	...	10H	1
	S31803	...	10H	1
	S32304	...	10H	1
	S32550	...	10H	1
	S32750	...	10H	1
	S32900	...	10H	1
	S32950	...	10H	1
SA-813	S30908	TP309S	8	2
	S30940	TP309Cb	8	2
	S31008	TP310S	8	2
	S31040	TP310Cb	8	2
SA-814	S30908	TP309S	8	2
	S30940	TP309Cb	8	2
	S31008	TP310S	8	2
	S31040	TP310Cb	8	2
Tubes				
SA-213	S30400	TP304	8	1
	S30403	TP304L	8	1
	S30451	TP304N	8	1
	S30453	304LN [Note (1)]	8	1
	S31600	TP316	8	1
	S31603	TP316L	8	1
	S31651	TP316N	8	1
	S32100	TP321	8	1
	S34700	TP347	8	1
	S34800	TP348	8	1
	S38100	TPXM-15	8	1
	S30815	...	8	2
	S30908	TP309S	8	2
	S30940	TP309Cb	8	2
	S31008	TP310S	8	2
	S31040	TP310Cb	8	2
	S31050	TP310MoLN	8	2
	S31725	...	8	4
SA-249	S30400	TP304	8	1
	S30403	TP304L	8	1
	S30451	TP304N	8	1
	S31600	TP316	8	1
	S31603	TP316L	8	1
	S31651	TP316N	8	1
	S31700	TP317	8	1
	S31703	TP317L	8	1
	S32100	TP321	8	1
	S34700	TP347	8	1
	S34800	TP348	8	1
	S38100	TPXM-15	8	1

Table TM-130.2-2
High Alloy Steels (Cont'd)

Specification Number	UNS No.	Type/Grade	ASME P-No.	Group No.
Tubes (Cont'd)				
	S30815	...	8	2
	S30908	TP309S	8	2
	S30940	TP309Cb	8	2
	S31008	TP310S	8	2
	S31040	TP310Cb	8	2
	S31050	TP310MoLN	8	2
	S20910	TPXM-19	8	3
	S24000	TPXM-29	8	3
	S31254	...	8	4
	S31725	...	8	4
	N08940	...	45	...
SA-268	S41000	TP410	6	1
	S42900	TP429	6	2
	S40500	TP405	7	1
	S40800	...	7	1
	S40900	TP409	7	1
	S43000	TP430	7	2
	S43035	TP439	7	2
	S44400	...	7	2
	S44600	TP446-1	10I	1
	S44626	TPXM-33	10I	1
	S44627	TPXM-27	10I	1
	S44635	...	10I	1
	S44700	29-4	10J	1
	S44735	29-4C	10J	1
	S44660	26-3-3	10K	1
	S44800	29-4-2	10K	1
SA-688	S30400	TP304	8	1
	S30403	TP304L	8	1
	S30451	TP304N	8	1
	S31600	TP316	8	1
	S31603	TP316L	8	1
	S24000	TPXM-29	8	3
SA-789	S31260	...	10H	1
	S31500	...	10H	1
	S31803	...	10H	1
	S32304	...	10H	1
	S32550	...	10H	1
	S32750	...	10H	1
	S32900	...	10H	1
	S32950	...	10H	1
SA-803	S43035	TP439	7	2
	S44660	26-3-3	10K	1
Castings				
SA-217	J91150	CA15	6	3
SA-351	J92500	CF3, CF3A	8	1
	J92590	CF10	8	1

Table TM-130.2-2
High Alloy Steels (Cont'd)

Specification Number	UNS No.	Type/Grade	ASME P-No.	Group No.
Castings (Cont'd)				
	J92600	CF8, CF8A	8	1
	J92710	CF8C	8	1
	J92800	CF3M	8	1
	J92900	CF8M	8	1
	J93000	CG8M	8	1
	J93400	CH8	8	2
	J93402	CH20	8	2
	J94202	CK20	8	2
	J93790	CG6MMN	8	3
	J93254	CK3MCuN	8	4
	N08151	CT15C	45	...
SA-995	J93345	CE8MN	10H	1
Bar and Shapes				
SA-479	S41000	410	6	1
	S40500	405	7	1
	S43000	430	7	2
	S43035	439	7	2
	S30200	302	8	1
	S30400	304	8	1
	S30403	304L	8	1
	S30453	304LN [Note (1)]	8	1
	S31600	316	8	1
	S31603	316L	8	1
	S31653	316LN [Note (2)]	8	1
	S32100	321	8	1
	S34700	347	8	1
	S34800	348	8	1
	S30815	...	8	2
	S30908	309S	8	2
	S30940	309Cb	8	2
	S31008	310S	8	2
	S31040	310Cb	8	2
	S20910	XM-19	8	3
	S24000	XM-29	8	3
	S31725	...	8	4
	S32550	...	10H	1
	S44627	XM-27	10I	1
	S44700	29-4	10J	1
	S44800	29-4-2	10K	1
	N08904	904L	45	...
Bolting				
SA-193	S21800	B8S, B8SA	...	...
	S30400	B8 Cl. 1 and 2	...	...
	S30451	B8NA Cl. 1A	...	...
	S30500	B8P Cl. 1 and 2	...	...
	S31600	B8M Cl. 1 and 2, B8M2 Cl. 2	...	...

Table TM-130.2-2
High Alloy Steels (Cont'd)

Specification Number	UNS No.	Type/Grade	ASME P-No.	Group No.
Bolting (Cont'd)				
	S31651	B8MNA Cl. 1A	...	...
	S32100	B8T Cl. 1 and 2	...	...
	S34700	B8C Cl. 1 and 2	...	...
	S41000	B6	...	...
SA-320	S30323	B8F Cl. 1, B8FA Cl. 1A	...	...
	S30400	B8 Cl. 1 and Cl. 2, B8A Cl. 1A	...	...
	S31600	B8M Cl. 1 and 2, B8MA Cl. 1A	...	...
	S32100	B8T Cl. 1 and 2, B8TA Cl. 1A	...	...
	S34700	B8C Cl. 1 and 2, B8CA Cl. 1A	...	...
SA-453	S63198	651 Cl. A and B	...	...
	S66286	660 Cl. A and B	...	...
SA-479	S20910	XM-19	...	...
SA-564	S17400	630 H1100 and H1150 (not welded)	...	...
SA-705	S17400	630 H1100	...	...

NOTES:

(1) The maximum allowable design stress values given in Section II, Part D, Subpart 1, Table 1A, for solution annealed Type 304 stainless steel (Alloy UNS S30400) are applicable for solution annealed Type 304LN stainless steel (Alloy UNS S30453) for maximum design metal temperature not exceeding 38°C (100°F).

(2) The maximum allowable design stress values given in Section II, Part D, Subpart 1, Table 1A, for solution annealed Type 316 stainless steel (Alloy UNS S31600) are applicable for solution annealed Type 316LN stainless steel (Alloy UNS S31653) for maximum design metal temperature not exceeding 38°C (100°F).

Table TM-130.2-3
Aluminum and Aluminum Alloy Products

Specification Number	Alloy Designation/UNS No.	ASME P-No.
Plates, Sheet, and Strip		
SB-209	Alclad 3003, A91060, A91100, A93003	21
	Alclad 3004, A93004, A95052, A95154, A95254, A95454	22
	Alclad 6061, A96061	23
	A95083, A95086, A95456, A95652	25
SB-928	A95083, A95086, A95456	...
Forgings		
SB-247	A93003	21
	A96061	23
	A95083	25
	A92014	...
Pipe and Tubes		
SB-210	Alclad 3003, A91060, A93003	21
	A95052, A95154	22
	A96061, A96063	23
SB-234	Alclad 3003, A91060, A93003	21
	A95052, A95454	22
	A96061	23
SB-241	Alclad 3003, A91060, A91100, A93003	21
	A95052, A95454	22
	A96061, A96063	23
	A95083, A95086, A95456	25
Castings		
SB-26	A02040, A03560, A24430	...
SB-108	A02040, A03560	...
Rod, Bar, Wire, Shapes		
SB-211	A92014, A92024, A96061	23
SB-221	A91060, A91100, A93003	21
	A95154, A95454	22
	A96061, A96063	23
	A95083, A95086, A95456	25
	A92024	...
SB-308 (shapes)	A96061	23
Bolting		
SB-211	A92014, A92024, A96061	...

Table TM-130.2-4
Copper and Copper Alloys

Specification Number	Alloy Designation/UNS No.	ASME P-No.
Plates, Sheet, Strip, and Rolled Bars		
SB-96	C65500	33
SB-152	C10200, C10400, C10500, C10700, C11000, C12200, C12300	31
SB-169	C61400	35
SB-171	C36500, C44300, C44400, C44500, C46400, C46500	32
	C70600, C70620, C71500, C71520	34
	C61400, C63000	35
Forgings		
SB-283	C37700	...
	C64200	...
Pipe		
SB-42	C10200, C12000, C12200	31
SB-43	C23000	32
SB-315	C65500	33
SB-467	C70600, C70620	34
Tubes		
SB-75	C10200, C12000, C12200	31
SB-111	C10200, C12000, C12200, C14200, C19200	31
	C23000, C28000, C44300, C44400, C44500, C68700	32
	C70400, C70600, C70620, C71000, C71500, C71520, C72200	34
	C60800	35
SB-135	C23000	32
SB-315	C65500	33
SB-359	C70600, C70620	34
SB-395	C10200, C12000, C12200, C14200, C19200	31
	C23000, C44300, C44400, C44500, C68700	32
	C70600, C70620, C71000, C71500, C71520	34
	C60800	35
SB-466	C70600, C70620, C71000, C71500, C71520	34
SB-543	C12200, C19400	31
	C23000, C44300, C44400, C44500, C68700	32
	C70400, C70600, C70620, C71500, C71520	34
Castings		
SB-61	C92200	...
SB-62	C83600	...
SB-148	C95200, C95400	35
SB-271	C95200	35
SB-584	C92200, C93700, C97600	...
Rod, Bar, and Shapes		
SB-98	C65100, C65500, C66100	33
SB-150	C61400, C62300, C63000, C64200	35
SB-187	C10200, C11000	31
Bolting		
SB-98	C65100, C65500, C66100	33
SB-150	C61400, C62300, C63000, C64200	35
SB-187	C10200, C11000	31

Table TM-130.2-5
Nickel and Nickel Alloys

(25)

Specification Number	UNS No.	ASME P-No.
Plates, Sheet, and Strip		
SB-127	N04400	42
SB-162	N02200, N02201	41
SB-168	N06600, N06690	43
SB-333	N10001, N10665, N10675	44
SB-424	N08825	45
SB-434	N10003	44
SB-435	N06002, N06230	43
	R30556	45
SB-443	N06625	43
SB-463	N08020	45
SB-536	N08330	46
SB-575	N06022, N06059, N06455, N10276	44
SB-582	N06007, N06030, N06975, N06985	45
SB-599	N08700	45
SB-620	N08320	45
SB-625	N08925	45
SB-688	N08366, N08367	45
SB-709	N08028	45
Forgings		
SB-564	N04400	42
	N06022, N06059, N06230, N06600, N06625, N10276	43
	N10675	44
	N08367	45
SB-637	N07718, N07750	...
Flanges, Fittings, and Valves		
SB-366	N02200, N02201	41
	N04400	42
	N06002, N06022, N06230, N06059, N06455, N06600, N06625, N10276	43
	N10001, N10003, N10665, N10675	44
	N06007, N06030, N06985, N08020, N08825	45
	N08330	46
SB-462	N08020, N08367	45
Pipe and Tube		
SB-161	N02200, N02201	41
SB-163	N02200, N02201	41
	N04400	42
	N06600	43
	N08825	45
SB-165	N04400	42
SB-167	N06600, N06690	43
SB-423	N08825	45
SB-444	N06625	43
SB-464	N08020, N08024, N08026	45
SB-468	N08020, N08024, N08026	45
SB-516	N06600	43
SB-517	N06600	43