ASME B31.3-2012

(Revision of ASME B31.3-2010)

Process Piping

ASME Code for Pressure Piping, B31

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

Three Park Avenue • New York, NY • 10016 USA

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The next edition of this Code is scheduled for publication in 2014. This Code will become effective 6 months after the Date of Issuance.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Code. Interpretations, Code Cases, and errata are published on the ASME Web site under the Committee Pages at http://cstools.asme.org/ as they are issued. Interpretations and Code Cases are also included with each edition.

Errata to codes and standards may be posted on the ASME Web site under the Committee Pages to provide corrections to incorrectly published items, or to correct typographical or grammatical errors in codes and standards. Such errata shall be used on the date posted.

The Committee Pages can be found at http://cstools.asme.org/. There is an option available to automatically receive an e-mail notification when errata are posted to a particular code or standard. This option can be found on the appropriate Committee Page after selecting "Errata" in the "Publication Information" section.

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

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FOREWORD

Responding to evident need and at the request of The American Society of Mechanical Engineers, the American Standards Association initiated Project B31 in March 1926, with ASME as sole administrative sponsor. The breadth of the field involved required that membership of the Sectional Committee be drawn from some 40 engineering societies, industries, government bureaus, institutes, and trade associations.

Initial publication in 1935 was as the American Tentative Standard Code for Pressure Piping. Revisions from 1942 through 1955 were published as American Standard Code for Pressure Piping, ASA B31.1. It was then decided to publish as separate documents the various industry Sections, beginning with ASA B31.8-1955, Gas Transmission and Distribution Piping Systems. The first Petroleum Refinery Piping Code Section was designated ASA B31.3-1959. ASA B31.3 revisions were published in 1962 and 1966.

In 1967–1969, the American Standards Association became first the United States of America Standards Institute, then the American National Standards Institute. The Sectional Committee became American National Standards Committee B31 and the Code was renamed the American National Standard Code for Pressure Piping. The next B31.3 revision was designated ANSI B31.3-1973. Addenda were published through 1975.

A draft Code Section for Chemical Plant Piping, prepared by Section Committee B31.6, was ready for approval in 1974. It was decided, rather than have two closely related Code Sections, to merge the Section Committees and develop a joint Code Section, titled Chemical Plant and Petroleum Refinery Piping. The first edition was published as ANSI B31.3-1976.

In this Code, responsibility for piping design was conceptually integrated with that for the overall processing facility, with safeguarding recognized as an effective safety measure. Three categories of Fluid Service were identified, with a separate Chapter for Category M Fluid Service. Coverage for nonmetallic piping was introduced. New concepts were better defined in five Addenda, the fourth of which added Appendix M, a graphic aid to selection of the proper Fluid Service category.

The Standards Committee was reorganized in 1978 as a Committee operating under ASME procedures with ANSI accreditation. It is now the ASME Code for Pressure Piping, B31 Committee. Section committee structure remains essentially unchanged.

The second edition of Chemical Plant and Petroleum Refinery Piping was compiled from the 1976 Edition and its five Addenda, with nonmetal requirements editorially relocated to a separate Chapter. Its new designation was ANSI/ASME B31.3-1980.

Section Committee B31.10 had a draft Code for Cryogenic Piping ready for approval in 1981. Again, it was decided to merge the two Section Committees and develop a more inclusive Code with the same title. The work of consolidation was partially completed in the ANSI/ASME B31.3-1984 Edition.

Significant changes were made in Addenda to the 1984 Edition: integration of cryogenic requirements was completed; a new stand-alone Chapter on high-pressure piping was added; and coverage of fabrication, inspection, testing, and allowable stresses was reorganized. The new Edition was redesignated as ASME/ANSI B31.3-1987 Edition.

Addenda to subsequent Editions, published at three-year intervals, have been primarily to keep the Code up-to-date. New Appendices have been added, however, on requirements for bellows expansion joints, estimating service life, submittal of Inquiries, aluminum flanges, and quality control in the 1990, 1993, 1999, and 2002 Editions, all designated as ASME B31.3.

In a program to clarify the application of all Sections of the Code for Pressure Piping, changes were made in the Introduction and Scope statements of the 1996 Edition, and its title was changed to Process Piping.

Under direction of ASME Codes and Standards management, metric units of measurement are being emphasized. With certain exceptions, SI metric units were listed first in the 1996 Edition and were designated as the standard. Instructions for conversion are given where metric data are not available. U.S. customary units also are given. By agreement, either system may be used.

In this Edition of the Code, SI metric units are given first, with U.S. Customary units in parentheses. Appendices H and X, the table in Appendix K, and Tables C-1, C-3, and C-6 in Appendix C are exceptions. A portion of the allowable design values in Appendix A are given in both SI metric and U.S. Customary units. Except for Appendix A, values in metric units are to be regarded as the standard, unless otherwise agreed between the contracting parties. In Appendix A, the U.S. Customary units are to be regarded as the standard. Instructions are given in those tables for converting tabular data in U.S. Customary units to appropriate SI metric units.

Interpretations, Code Cases, and errata to the B31.3 Code on Process Piping are published on the following ASME web page: *http://cstools.asme.org/csconnect/CommitteePages.cfm?Committee=N10020400.*

ASME B31.3-2012 was approved by the American National National Standards Institute on May 9, 2012.

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Code for Pressure Piping

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INTRODUCTION

The ASME B31 Code for Pressure Piping consists of a number of individually published Sections, each an American National Standard, under the direction of ASME Committee B31, Code for Pressure Piping.

Rules for each Section reflect the kinds of piping installations considered during its development, as follows:

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

B31.3 Process Piping: piping typically found in petroleum refineries; chemical, pharmaceutical, textile, paper, semiconductor, and cryogenic plants; and related processing plants and terminals

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

B31.5 Refrigeration Piping: piping for refrigerants and secondary coolants

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

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

B31.11[1] Slurry Transportation Piping Systems: piping transporting aqueous slurries between facilities, plants, and terminals, and within terminals and pumping and regulating stations.

B31.12 Hydrogen Piping and Pipelines: piping in gaseous and liquid hydrogen service and pipelines in gaseous hydrogen service

This is the B31.3 Process Piping Code Section. Hereafter, in this Introduction and in the text of this Code Section B31.3, where the word *Code* is used without specific identification, it means this Code Section.

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

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

– ANSI Z223.1 National Fuel Gas Code: piping for fuel gas from the point of delivery to the connection of each fuel utilization device

– NFPA Fire Protection Standards: fire protection systems using water, carbon dioxide, halon, foam, dry chemicals, and wet chemicals

– NFPA 99 Health Care Facilities: medical and laboratory gas systems

– building and plumbing codes, as applicable, for potable hot and cold water, and for sewer and drain systems

[1] Incorporated into B31.4-2012.

The Code sets forth engineering requirements deemed necessary for safe design and construction of pressure piping. While safety is the basic consideration, this factor alone will not necessarily govern the final specifications for any piping installation. The designer is cautioned that the Code is not a design handbook; it does not eliminate the need for the designer or for competent engineering judgment.

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

This Code Section includes the following:

(a) references to acceptable material specifications and component standards, including dimensional requirements and pressure–temperature ratings

(b) requirements for design of components and assemblies, including piping supports

(c) requirements and data for evaluation and limitation of stresses, reactions, and movements associated with pressure, temperature changes, and other forces

(d) guidance and limitations on the selection and application of materials, components, and joining methods

(e) requirements for the fabrication, assembly, and erection of piping

(f) requirements for examination, inspection, and testing of piping

ASME Committee B31 is organized and operates under procedures of The American Society of Mechanical Engineers that have been accredited by the American National Standards Institute. The Committee is a continuing one, and keeps all Code Sections current with new developments in materials, construction, and industrial practice. New editions are published at intervals of two years.

Code users will note that paragraphs in the Code are not necessarily numbered consecutively. Such discontinuities result from following a common outline, insofar as practical, for all Code Sections. In this way, corresponding material is correspondingly numbered in most Code Sections, thus facilitating reference by those who have occasion to use more than one Section.

It is intended that this edition of Code Section B31.3 not be retroactive. Unless agreement is specifically made between contracting parties to use another issue, or the regulatory body having jurisdiction imposes the use of another issue, the latest edition issued at least 6 mo prior to the original contract date for the first phase of activity covering a piping installation shall be the governing document for all design, materials, fabrication, erection, examination, and testing for the piping until the completion of the work and initial operation.

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

The B31 Committee has established an orderly procedure to consider requests for interpretation and revision of Code requirements. To receive consideration, such request must be in writing and must give full particulars in accordance with Appendix Z.

The approved reply to an inquiry will be sent directly to the inquirer. In addition, the question and reply will be published as part of an Interpretation supplement.

A Case is the prescribed form of reply when study indicates that the Code wording needs clarification, or when the reply modifies existing requirements of the Code or grants permission to use new materials or alternative constructions. The Case will be published as part of a Case supplement.

Code Cases remain available for use until annulled by the ASME B31 Standards Committee.

A request for revision of the Code will be placed on the Committee's agenda. Further information or active participation on the part of the proponent may be requested during consideration of a proposed revision.

Materials ordinarily are listed in the stress tables only when sufficient usage in piping within the scope of the Code has been shown. Requests for listing shall include evidence of satisfactory usage and specific data to permit establishment of allowable stresses, maximum and minimum temperature limits, and other restrictions. Additional criteria can be found in the guidelines for addition of new materials in the ASME Boiler and Pressure Vessel Code, Section II. (To develop usage and gain experience, unlisted materials may be used in accordance with para. 323.1.2.)

ASME B31.3-2012
SUMMARY OF CHANGES

Following approval by the B31 Committee and ASME, and after public review, ASME B31.3-2012 was approved by the American National Standards Institute on May 9, 2012.

Changes given below are identified on the pages by a margin note, **(12),** placed next to the affected area.

Page	*Location*	*Change*
xix, xx	Introduction	Ninth-to-last and third-to-last paragraphs revised
1–7	300	(1) Subparagraph (b)(1) revised (2) Subparagraph (d) revised (3) Subparagraph (e) deleted (4) Subparagraph (f) redesignated as (e) and new subparagraph (f) added
	300.2	(1) Definition of *autogenous weld* added (2) Under *fluid service*, definitions of *Category D Fluid Service*, *Elevated Temperature Fluid Service*, and *Normal Fluid Service* revised, and all definitions alphabetized (3) Definition of *orbital welding* revised (4) Under *pipe,* definition of *spiral welded pipe* revised (5) Definition of *room temperature* added
9	Table 300.4	Entry for Appendix N added
10	301.1	Subparagraph (a) revised
12	302.2.2	Revised
13, 14	302.3.2	In subparagraph (d), last paragraph revised
15–20	Table 302.3.3C	General Note revised
	302.3.4	Subparagraph (a) revised
	302.3.5	Subparagraphs (d) and (e) revised
	Table 302.3.4	(1) Entries in fourth column revised (2) Last row revised
	302.5	Paragraph 302.4.1 redesignated as 302.5 and revised
	303	Revised
	Table 302.3.5	(1) General Note (b) and Notes (1), (2), and (9) revised (2) General Note (e) added
22	304.3.2	Subparagraphs (a) and (b) revised
29	304.7.2	First paragraph revised

Page	*Location*	*Change*
30	305.2.4	Revised
34	311.2.3	Revised
37	319.2.3	Subparagraph (c) deleted
38, 39	319.3.6	Revised
	319.4.4	Revised
46	323.2	Revised
49	Fig. 323.2.2A	Note (3) revised
56	326.1.2	Cross-reference revised
57, 58	Table 326.1	(1) Under Metallic Fittings, Valves, and Flanges, ASME B16.50 and MSS SP-78 added (2) Under Miscellaneous, MSS SP-73 deleted
59	328	Revised
	328.1	Revised
	328.2	Revised in its entirety
65	330.1	Revised
	330.1.1	Revised
66	Table 330.1.1	Revised in its entirety
67	331.1.1	Subparagraph (e) revised
68, 69	Table 331.1.1	First column head and Note (1) revised
71	333	Revised in its entirety
73	340.4	Subparagraph (b) revised
74	341.3.4	Subparagraph (a) revised
	341.4.1	Subparagraph (b)(1) revised
77	Table 341.3.2	Note (3) revised
79	341.4.4	First paragraph and subparagraph (b)(1) revised
80	344.1.3	Footnote 2 revised
82	345.1	Subparagraphs (c)(1) and (c)(2) revised
84	345.5.1	Revised
	345.7.3	Revised
	345.8	Revised
	345.9.1	Subparagraph (a) revised
91	A314.2.1	Revised
97, 98	Table A326.1	(1) ASTM F2389 added in two places (2) ASTM D2104 deleted
99	A328.2.5	Subparagraphs (a)(1) and (a)(2) revised

Page	*Location*	*Change*
117	K302.3.2	Previous footnote 1 deleted and remaining footnotes renumbered
	K302.3.3	In subparagraph (c), cross-reference revised
	K302.3.4	Revised
118	K302.5	Paragraph K302.4.1 redesignated as K302.5 and revised
122	K305.1.1	Revised
	K306.1.1	Revised
126	K323.2	Revised
130	K326	Revised in its entirety
131	K328.2.1	Subparagraph (h) deleted
137	K344.6.2	Revised
139	K346.2	Subparagraphs (d) and (g) revised
142	U328	Revised
	U328.2.1	Subparagraph (h) added
	U341.4.1	Revised in its entirety
144	U344.8.1	First paragraph revised
	U344.8.2	Revised
148–150	Specification Index for Appendix A	ASTM A213, A1010, A1053, and B371 added
151, 152	Notes for Tables A-1, A-1A, A-1B, A-1M, A-2, and A-2M	(1) Title revised (2) General Notes (a) through (c) revised (3) Notes (5) and (35) revised
155	Table A-1	UNS Nos. added
156, 158	Table A-1	Seventh column heading revised and all S-Nos. replaced by P-Nos.
160	Table A-1	(1) Seventh column heading revised and all S-Nos. replaced by P-Nos. (2) Under Carbon Steel, Pipes (Structural Grade), in Material column, A570 replaced by A1011 in six rows
162, 163	Table A-1	(1) Under Plates, Bars, Shapes, and Sheets (Structural), in Spec. No. column, A570 replaced by A1011 in six rows (2) Under Castings, A352 Grade LCC added
164, 166, 168, 170	Table A-1	Under Low and Intermediate Alloy Steel, UNS Nos. added
172, 173	Table A-1	Under Stainless Steel, Pipes and Tubes, A213 Grades TP304L and TP316L added

Page	*Location*	*Change*
174, 175	Table A-1	A213 Grade TP316 added
176, 177	Table A-1	(1) A213 Grade TP304 added (2) A1053 Grade 50 added (3) A790 and A789 S32003 added (4) For A789 and A790 S32750, stress value in Min. Temp. to 100°F column revised (5) Under Plates and Sheets, A1010 Grades 40 and 50 added
178, 179	Table A-1	Two A240 S32003 rows added
182, 183	Table A-1	Under Bar, A479 Grades 321, 321H, 347, 347H, and XM-19 added
186, 187	Table A-1	Under new body heading Copper and Copper Alloy, Rod, three B371 C69300 rows added
188, 189	Table A-1	(1) Under Nickel and Nickel Alloy, Pipes and Tubes, for B407 N08811, stress values for 1,550°F through 1,650°F revised (2) B619, B622, and B626 N06030 added
190, 191	Table A-1	(1) For B619 N10276, stress values for 850°F through 1,250°F added (2) For B622 N10276, stress values for 850°F and higher changed to boldface or regular type (3) B626 N10276 added (4) B619, B622, and B626 N06230 added
192, 193	Table A-1	(1) Under Plates and Sheets, B582 N06030 added (2) For B575 N10276, stress values for 850°F and higher changed to boldface or regular type (3) B435 N06230 added
194, 195	Table A-1	(1) Under Forgings and Fittings, B366 and B462 N06030 added (2) For B366 and B564 N10276, stress values for 500°F and higher changed to boldface or regular type (3) B564 and B366 N06230 added
196, 197	Table A-1	(1) Under Rod and Bar, B408 N08810, N08811, and N08800 relocated from pages for Pipes and Tubes (2) B581 N06030 added (3) B574 N10276 added (4) B572 N06230 added

Page	*Location*	*Change*
198, 199	Table A-1	(1) Under Titanium and Titanium Alloy, Pipes and Tubes, for B861 and B862 R50250, Notes, Min. Yield Strength, and stress values revised (2) For B861 and B862 R50400, R52400, and R50550, Notes revised
200–205	Table A-1	(1) Sixth column heading revised and all S-Nos. replaced by P-Nos. (2) UNS Nos. added (3) Under Aluminum Alloy, stress values revised (4) Under Plates and Sheets, for last B209 A95456, Temper revised (5) Under Forgings and Fittings, for three B247 A95083 rows, Min. Tensile Strength revised
206–331	Table A-1M	Added
333	Table A-1B	(1) Under Carbon Steel, for API 5L, second row added (2) For fourth API 5L row, A134, and A139, Description revised (3) For first A381 row, Appendix A Notes revised
336–345	Table A-2	Revised in its entirety
346–361	Table A-2M	Added
363	Specification Index for Appendix B	(1) ASTM D2104 deleted (2) ASTM F2389 added
365, 366	Table B-1	(1) All six ASTM D2104 rows deleted (2) ASTM F2389 added
378	Table C-5	(1) For polyethylene, all previous entries deleted and PE2606 through PE4710 added (2) Polypropylene PP0210B44002 and PP0210G07G11030 added
380, 381	Table C-6	Under Copper and Copper Alloys, second Material entry revised
383	Table C-8	(1) Previous PE entries deleted (2) PE2606 through PE4710 added
387	Table D300	Note (2) revised

Page	*Location*	*Change*
388–392	Appendix E	(1) ASTM A193, A194, A307, A320, A354, A370, A437, A453, A563, A675, A723, B21, B150, B160, B166, B187, B211, B366, B564, B574, B575, B619, B622, B626, B813, B828, E112, E114, E186, E272, E280, E310, and E446 updated (2) ASTM A213, A1010, A1011, A1053, B32, B371, B572, and F2389 added (3) ASTM A570 and D2104 deleted (4) ASME B16.50 and PCC-2 added (5) API 526, 594, 600, and 609 updated (6) API 570 added (7) All three ASNT standards updated (8) AWS A3.0, A5.11, and A5.22 updated (9) AWS A5.8, A5.31, and QC1 added (10) CDA Copper Tube Handbook deleted (11) CEN/TR 14549 added (12) CGA G-4.1 updated (13) ISO 15649 added (14) MSS SP-73 deleted (15) MSS SP-78 added (16) MSS SP-55 updated (17) PFI ES-48 added (18) In list of organizations, CDA deleted, and CEN and ISO added
398	F345.5	Added
	FA323.4	Revised
	FU315	Added
400–408	Appendix H	Revised in its entirety
409–418	Appendix J	Revised
423	Notes for Appendix K Table	General Note (a), Note (7), and Note (12) revised
424, 426, 428, 430, 432, 434	Table K-1	Third column heading revised and all S-Nos. replaced by P-Nos.
440	Fig. M300	Columns 4 and 5 revised
441	Appendix N	Added
459	V304	Values of W for girth weld corrected by errata to read 0.80 or 0.77 in six places and used to correct values for S_{L1}/W, S_{L2}/W, and S_{L3}/W to read 3.75, 3.90, and 4.81 in equations for S_1, S_2, and S_3, respectively

NOTES:
(1) The interpretations to ASME B31.3 issued between April 23, 2010 and September 27, 2011 follow the last page of this edition as a separate supplement, Interpretations Volume 23.
(2) After the interpretations, a separate supplement containing Cases 180, 181, and 185 follows.

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PROCESS PIPING

Chapter I
Scope and Definitions

(12) 300 GENERAL STATEMENTS

(a) Identification. This Process Piping Code is a Section of the American Society of Mechanical Engineers Code for Pressure Piping, ASME B31, an American National Standard. It is published as a separate document for convenience of Code users.

(b) Responsibilities

(1) Owner. The owner of a piping installation shall have overall responsibility for compliance with this Code, and for establishing the requirements for design, construction, examination, inspection, and testing that will govern the entire fluid handling or process installation of which the piping is a part. The owner is also responsible for designating piping in Category D, Category M, High Pressure, and High Purity Fluid Services, and for determining if a specific Quality System is to be employed. [See paras. 300(d)(4) through (7) and Appendix Q.]

(2) Designer. The designer is responsible to the owner for assurance that the engineering design of piping complies with the requirements of this Code and with any additional requirements established by the owner.

(3) Manufacturer, Fabricator, and Erector. The manufacturer, fabricator, and erector of piping are responsible for providing materials, components, and workmanship in compliance with the requirements of this Code and of the engineering design.

(4) Owner's Inspector. The owner's Inspector (see para. 340) is responsible to the owner for ensuring that the requirements of this Code for inspection, examination, and testing are met. If a Quality System is specified by the owner to be employed, the owner's Inspector is responsible for verifying that it is implemented.

(c) Intent of the Code

(1) It is the intent of this Code to set forth engineering requirements deemed necessary for safe design and construction of piping installations.

(2) This Code is not intended to apply to the operation, examination, inspection, testing, maintenance, or repair of piping that has been placed in service. The provisions of this Code may optionally be applied for those purposes, although other considerations may also be necessary.

(3) Engineering requirements of this Code, while considered necessary and adequate for safe design, generally employ a simplified approach to the subject. A designer capable of applying a more rigorous analysis shall have the latitude to do so; however, the approach must be documented in the engineering design and its validity accepted by the owner. The approach used shall provide details of design, construction, examination, inspection, and testing for the design conditions of para. 301, with calculations consistent with the design criteria of this Code.

(4) Piping elements should, insofar as practicable, conform to the specifications and standards listed in this Code. Piping elements neither specifically approved nor specifically prohibited by this Code may be used provided they are qualified for use as set forth in applicable Chapters of this Code.

(5) The engineering design shall specify any unusual requirements for a particular service. Where service requirements necessitate measures beyond those required by this Code, such measures shall be specified by the engineering design. Where so specified, the Code requires that they be accomplished.

(6) Compatibility of materials with the service and hazards from instability of contained fluids are not within the scope of this Code. See para. F323.

(d) Determining Code Requirements

(1) Code requirements for design and construction include fluid service requirements, which affect selection and application of materials, components, and joints. Fluid service requirements include prohibitions, limitations, and conditions, such as temperature limits or a requirement for safeguarding (see Appendix G). Code requirements for a piping system are the most restrictive of those that apply to any of its elements.

(2) For metallic piping not designated by the owner as Category M, High Pressure, or High Purity Fluid Service (see para. 300.2 and Appendix M), Code requirements are found in Chapters I through VI (the base Code) and fluid service requirements are found in