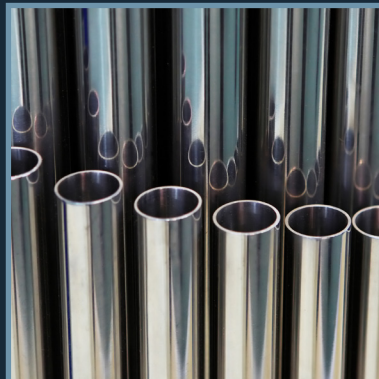
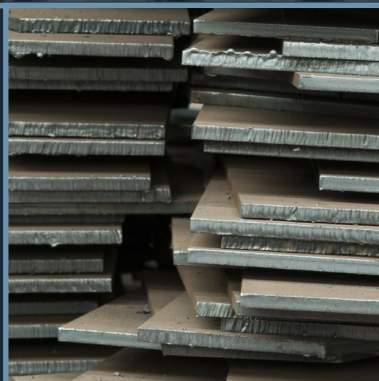




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Handbook of Comparative World Steel Standards

5th Edition
John E. Bringas, Editor



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John E. Bringas, Editor

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Preface

This is the book I never wanted to write but always wanted to own. As a metallurgical engineer and long-time user of steel standards, author of the four CASTI Metals Data Books, and as a member of ASTM, ISO, and SAE steel standard committees, I knew all too well the many pitfalls and challenges of writing such a handbook. There were many steel standards from around the world that were new to me and that created many surprises, including the Chinese GB steel standards, which were translated into English by the metallurgical engineers of CASTI Publishing, Inc.

Comparing steel standards is not an exact science, so the biggest challenge in preparing such a book was deciding on the “rules of comparison.” Of the similar books on the market today, none explain in detail why one steel is comparable to another. They simply appear together in a list of steels. I kept a daily diary to help construct a workable set of comparison rules that I could share with other users to assist them in understanding how and why one steel is comparable to another.

When writing the first edition of this book (DS67A), these rules changed from chapter to chapter while the book was being written. It was not until the last chapter and the appendix were completed that I was able to finalize the rules of comparison. In the end, a complete review of the book was performed, resulting in the reorganization of some chapters and the fine-tuning of others. There were too many occasions when I thought the book was finished, only to have to change, add, or delete a rule that made yet another review of the book necessary.

My writing of this fifth edition (DS67D) was greatly assisted by using the ASTM Passport to Steel database. Without it, the handbook would be much smaller. The addition of data from Chinese GB and ASME steel standards has significantly improved this edition. With the use of the ASTM Passport to Steel database, many new comparable steels were also added to this edition.

I hope you enjoy using this handbook as much as I have. Tie a chain to it and anchor it to your desk because once others see it, you may never see the book again.

I am interested in your comments and suggestions for improving this handbook and encourage you to send your feedback directly to ASTM.

John E. Bringas, P.Eng.
President and Metallurgical Engineer
CASTI Publishing, Inc.

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Several colleagues from ASTM, Society of Automotive Engineers (SAE), and International Standards Organization (ISO) committees were contacted for their input during the progress of this handbook, including ASTM committee members Ralph Davison, Frank Christensen, and John Mahaney; Günter Briefs and Baoshi Liu from the ISO; and Mel Head of the SAE. They added valuable insights into the history and technical aspects of the standards data found in this handbook.

The ASTM publishing staff, most notably John Pace, David Von Glahn, Kathy Dernoga, and Monica Siperko, were very supportive of my requests to obtain access to the hundreds of standards needed to write this handbook. Their patience and confidence in my ability to complete the work is appreciated. Thank you all.

The author also acknowledges the dedicated assistance of the Codes and Standards Training Institute (CASTI) staff who assisted in the research, entered data, and who updated the book with care and diligence.

A special thanks is extended to Information Handling Service (IHS) Engineering Products for permitting the use of their Engineering Resource Center (ERC).

One person could not have produced this handbook. It took a dedicated team of professionals. These acknowledgments cannot adequately express the author's sincere appreciation and gratitude for everyone's assistance. Without it, this handbook would never have been completed.

Getting Started With This Book

The intent of this handbook is to allow the user to identify comparable steels that are found in standards from around the world and then to evaluate each complete standard on its own merit to ensure that the selected steel is suited for the intended application. This handbook is not designed to be the sole source of information for selecting a comparative steel and is not intended to be used as a replacement for steel standards. This handbook is one tool in the process of comparing steel standards from around the world.

Comparing steel standards is not an exact science, and there is no foolproof method. When you begin to use this handbook, you will quickly discover that there is no such thing as “equivalent” steel standards. The user must also be aware that not all steels have comparative counterparts. Before proceeding directly to the contents of this handbook, it is strongly recommended that you read [Chapter 1](#), which includes a detailed explanation of the “rules of comparison” used in this handbook.

Because there was often insufficient space on one page to place both the chemical composition and mechanical properties tables, they were split into two separate tables. To assist the user in keeping track of which comparison criteria were used for a given steel, each table within a chapter was sequentially numbered and appended with either the letter A or B. Table numbers ending in the letter A designate that the table was the main criterion used for comparison; whereas table numbers ending with the letter B were “mirrored” from the A table.

Each group of steel data in the tables is separated by two types of horizontal lines: black and gray. Black lines separate groups of steels that are more closely comparable to each other; whereas gray lines separate steel data within a comparative group.

Caution: The pages of this handbook are formatted to keep comparative groups together as much as possible. However, when a group of comparative steels extends to more than one page, a note is placed at the bottom of the page to indicate that the comparative group continues on the following page (i.e., “NOTE: This section continues on the next page”).

Appendix 2 and Appendix 4 include lists of withdrawn and replaced standards that should always be checked when trying to find comparable steels. This handbook, unlike many others, includes the year-date of each standard, which is critical when trying to identify the status of a standard.

Chapter

1

INTRODUCTION TO COMPARING WORLD STEEL STANDARDS

Myth and Methodology When Comparing Steel Standards

When comparing steel standards from different national and international standard development organizations (SDOs), there is no such thing as *equivalent* steel standards. At best, one may be able to group *comparable* steel standards together based on some defined set of rules, which has been done in this handbook. For example, ASTM A516/A516M Grade 70 is *comparable* to JIS G3118 symbol SGV 480 and to EN 10028-2 steel name P295GH, based on chemical compositions, mechanical properties, and application. Yet they are not *equivalent* because there are differences in all three standards. Comparing steel standards is not an exact science and cannot be made into a mathematical equation where two sides of an equation are equal to one another because there will always be differences among standards.

These differences may be significant to one user but not significant to another. Therefore, this handbook uses the term *comparative* to denote similar standards that have been compared to each other. Comparative is a relative word that is inevitably dependent upon the requirements of the end user, the one who is ultimately responsible for selecting the appropriate steel for a specific application.

There are some steel standards that are shared by multiple SDOs. For example, EN ISO 4957–Tool Steels is a standard that is shared within the European Committee for Standardization (CEN) and the International Standards Organization (ISO) systems. Consequently, the data are equivalent in both systems, but there is only one standard.

There are also different standards that share the same grades of steel. For example, ASTM A485 and ISO 683-17 share seven identical bearing steel grade chemical compositions, yet there are differences in grain size, hardenability, microstructure, hardness, inspection, testing, and in other details of both standards. As a result, the seven bearing steels within these two standards are not equivalent, but they are comparable.

Comparative and Closest Match

There is also a difference between *comparative* and *closest match* when evaluating steel standards. While gathering the data for this handbook, it was difficult to decide whether to include data on a

technically comparative basis or on a closest match basis as both have their merits and limitations. (See 70 % rule in EN 10020 on page 6 for a more detailed discussion.)

A technically comparative group of steels can assist the user with making a material selection based on technical merit. However, this may severely limit the number of steels that would be comparable. On the other hand, displaying the closest match data will usually increase the number of comparative steels for the user to consider but at the risk of widening the technical comparison criteria. Likewise, a strict technical comparison will provide more accurate results, but a closest match comparison will provide more data to assist the user in searching for similar steels.

There are many instances in the handbook where it would be a disservice to the reader not to include the closest match steels because there would be no comparisons otherwise. Because this broadens the technical comparison criteria, the user is warned that the data herein cannot substitute for education, experience, and sound engineering judgment after evaluating all of the specifications within each comparable standard.

In the end, there are no definitive rules that can be formulated to distinguish between *comparative* steels and *closest match* steels. Consequently, at the editor's discretion, both types of comparisons are used in this handbook. Table 1.1 is one example of the comparison process, with respect to technically comparative steels and closest match steels.

Table 1.1 lists the chemical compositions of four grades of cast alloy chromium-nickel-molybdenum (Cr-Ni-Mo) steels. If a strict technical comparison was made based on their chemical composition, none of these alloys would be comparable because their chemical compositions would differ; although there are similarities in their carbon (C), Cr, Mo, and Ni contents.

Table 1.2 shows how these four steels were divided into two separate comparative groups based on the differing Cr and Mo contents. The thin black line in Table 1.2 is the separator between the two comparative groups.

Displaying the two groups side by side also assists the user in seeing the differences and similarities among these four cast alloy steels.

Table 1.1 List of Chemical Compositions of Cr-Ni-Mo Alloy Cast Steels Before Comparison

Specification	Designation	Steel No.	UNS No.	Weight, % max, Unless Otherwise Specified*								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A958/ A958M-14	SC 4330	---	J23259	0.28– 0.33	0.60– 0.90	0.30– 0.60	0.035	0.040	0.70– 0.90	1.65– 2.00	0.20– 0.30	—
JIS G5111:1991	SCNCrM 2	---	---	0.25– 0.35	0.90– 1.50	0.30– 0.60	0.040	0.040	0.30– 0.90	1.60– 2.00	0.15– 0.35	—
EN 10293:2015	G32NiCrMo8-5-4	1.6570	---	0.28– 0.35	0.60– 1.00	0.60	0.020	0.015	1.00– 1.40	1.60– 2.10	0.30– 0.50	V 0.05 Cu 0.30
ISO 14737:2003	Grade G32NiCrMo8-5-4	---	---	0.28– 0.35	0.60– 1.00	0.60	0.020	0.015	1.00– 1.40	1.60– 2.10	0.30– 0.50	V 0.05 Cu 0.30

Table 1.2 List of Chemical Compositions of Cr-Ni-Mo Cast Alloy Steels After Comparison

Specification	Designation	Steel No.	UNS No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A958/A958M-14	SC 4330	---	J23259	0.28–0.33	0.60–0.90	0.30–0.60	0.035	0.040	0.70–0.90	1.65–2.00	0.20–0.30	---
JIS G5111:1991	SCNCrM 2	---	---	0.25–0.35	0.90–1.50	0.30–0.60	0.040	0.040	0.30–0.90	1.60–2.00	0.15–0.35	---
EN 10293:2015	G32NiCrMo8-5-4	1.6570	---	0.28–0.35	0.60–1.00	0.60	0.020	0.015	1.00–1.40	1.60–2.10	0.30–0.50	V 0.05 Cu 0.30
ISO 14737:2003	Grade G32NiCrMo8-5-4	---	---	0.28–0.35	0.60–1.00	0.60	0.020	0.015	1.00–1.40	1.60–2.10	0.30–0.50	V 0.05 Cu 0.30

A classic closest match example is shown in Table 1.3, where the four grades within EN 10085 are different; on this basis, they may not belong to this comparative group. However, the Cr-Al-Mo alloys in this group typically are used as nitriding steels, and the EN 10085 steels are the closest match for this group. Excluding them would be a disservice to the user because they belong to the same application family, and its inclusion in this group will direct the user to other similar nitriding alloys.

There are many opportunities to make technical errors that may lead to inappropriate steel comparisons. For example, there are many technical decisions to make when comparing stainless steels because finding identical chemical compositions within standards from different countries is not common. Table 1.4 shows a list of comparative Cr-Ni-Mo wrought austenitic stainless steels from the United States, Europe, China, Japan, and other international locations. Note the differences in the silicon (Si), Cr, Ni, and

nitrogen (N). The U.S., Chinese, and Japanese chemical compositions are more closely matched, whereas the European and international (ISO) standards are identical. These differences may affect the corrosion resistance performance in many applications, such that the user must be very careful when selecting a comparative steel based solely on data in this handbook.

In summary, if strict technical comparison is made to this type of data, few relationships among the various grades of steel would be established, and the comparison would serve no purpose. By widening the technical comparison criteria to find the closest match steels, the user must understand that these steels are not equivalent and cannot be indiscriminately substituted without first reviewing the complete current standards and securing competent technical advice prior to any decision making.

To find a balance for comparison of steels by product form, use (application), mechanical properties, chemical compositions,

Table 1.3 Chromium-Molybdenum-Aluminum (Cr-Mo-Al) Steels for Nitriding

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A355-89 (2012)	A	K24065	---	0.38–0.43	0.50–0.70	0.15–0.35	0.035	0.040	1.40–1.80	---	0.30–0.40	Al 0.95–1.30
EN 10085:2001	32CrAlMo7-10	---	1.8505	0.28–0.35	0.40–0.70	0.40	0.025	0.035	1.50–1.80	---	0.20–0.40	Al 0.80–1.20
	34CrAlMo5-10	---	1.8507	0.30–0.37	0.40–0.70	0.40	0.025	0.035	1.00–1.30	---	0.15–0.25	Al 0.80–1.20
	34CrAlNi7-10	---	1.8550	0.30–0.37	0.40–0.70	0.40	0.025	0.035	1.50–1.80	0.85–1.15	0.15–0.25	Al 0.80–1.20
	41CrAlMo7-10	---	1.8509	0.38–0.45	0.40–0.70	0.40	0.025	0.035	1.50–1.80	---	0.20–0.35	Al 0.80–1.20
GB/T 3077-1999	Grade 38CrMoAl	---	---	0.35–0.42	0.30–0.60	0.20–0.45	0.035	0.035	1.35–1.65	0.30	0.15–0.25	Al 0.70–1.10; Cu 0.30
GB/T 3078-94	Grade 38CrMoAlA	---	---	0.35–0.42	0.30–0.60	0.20–0.45	0.025	0.025	1.35–1.65	0.30	0.15–0.25	Al 0.70–1.10; Cu 0.25
ISO 683-10:1987	41 CrAlMo 7 4	---	---	0.38–0.45	0.50–0.80	0.50	0.030	0.035	1.50–1.80	---	0.25–0.40	Al 0.8–1.20
JIS G4053:2008	Symbol SACM 645	---	---	0.40–0.50	0.60	0.15–0.50	0.030	0.030	1.30–1.70	0.25	0.15–0.30	Al 0.70–1.20; Cu 0.30

Table 1.4 List of Comparative Cr-Ni-Mo Wrought Austenitic Stainless Steels

Specification	Designation	UNS	Steel	Weight, %, max, Unless Otherwise Specified								
		No.	No.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 317L	S31703	---	0.030	2.00	0.75	0.045	0.030	18.0–20.0	11.0–15.0	3.0–4.0	N 0.10
ASTM A240/A240M-15a	Type 317L	S31703	---	0.030	2.00	0.75	0.045	0.030	18.0–20.0	11.0–15.0	3.0–4.0	N 0.10
EN 10028-7:2007	X2CrNiMo18-15-4	---	1.4438	0.030	2.00	1.00	0.045	0.015	17.5–19.5	13.0–16.0	3.0–4.0	N 0.10
EN 10088-2:2014	X2CrNiMo18-15-4	---	1.4438	0.030	2.00	1.00	0.045	0.015	17.5–19.5	13.0–16.0	3.0–4.0	N 0.10
GB 4237-92	Grade 00Cr19Ni13Mo3	---	---	0.030	2.00	1.00	0.035	0.030	18.00–20.00	11.00–15.00	3.00–4.00	---
GB 4239-91	Grade 00Cr19Ni13Mo3	---	---	0.030	2.00	1.00	0.035	0.030	18.00–20.00	11.00–15.00	3.00–4.00	---
ISO 9328-7:2004	Grade X2CrNiMo18-15-4	---	---	0.030	2.00	1.00	0.045	0.015	17.5–19.5	13.0–16.0	3.00–4.0	N 0.11
JIS G 4304:2012	Symbol SUS317L	---	---	0.030	2.00	1.00	0.045	0.030	18.00–20.00	11.00–15.00	3.00–4.00	---
JIS G 4305:2012	Symbol SUS317L	---	---	0.030	2.00	1.00	0.045	0.030	18.00–20.00	11.00–15.00	3.00–4.00	---
SAE J405 JUN98	Type 317L	S31703	---	0.030	2.00	0.75	0.045	0.030	18.00–20.00	11.00–15.00	3.00–4.00	N 0.10

related manufacturing processes (including heat treatment), and so forth, a methodology had to be put in place and rules had to be established. However, as much as methodology and rules were essential in preparing this handbook, there were many instances where they would not cover every variable and circumstance. Therefore, difficult comparison decisions—such as those described previously—had to be made. There were literally hundreds, if not more than a thousand, such decisions made in this handbook. In these cases, the closest match comparison decisions were made at the discretion of the editor.

Organization

Two of the main variables in selecting a specific grade of steel are its intended application (use) and product form, which usually narrows the selection to a family of steels. Therefore, the remaining data chapters in this handbook were organized by product form and use, as follows.

Chapter No.	Title
2.	Carbon and Alloy Steels for General Use
3.	Structural Steel Plates
4.	Pressure Vessel Steel Plates
5.	Steel Tubes and Pipes
6.	Steel Forgings
7.	Steel Castings

8. Wrought Stainless Steels
9. Steels for Special Use

Although this list of chapter titles, at first glance, looks rather straightforward, there were difficult decisions regarding the steel comparisons within each chapter. For example, ASTM has 9 definitions for *pipe* and 22 definitions for *tube*, depending on the standard's subject matter and application (see *ASTM Dictionary of Engineering Science & Technology*, 10th edition). In contrast, ISO 2604, Steel Products for Pressure Purposes—Quality Requirements—Part II: Wrought Seamless Tubes, notes that “The word *tube* is synonymous with *pipe*.”

Each standard is typically listed only in one chapter, but there are exceptions. For example, ASTM A240/A240M–15a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications, appears in more than one chapter due to its dual role for pressure vessel and general applications (i.e., Chapter 4—Pressure Vessel Steel Plates and Chapter 8—Wrought Stainless Steels). Similarly, the Japanese Industrial Standards (JIS) and Chinese (Guojia Biaozhun, or GB) stainless steel flat product standards were also included in Chapters 4 and 8.

Definitions of Steel Terms

It is common to find terminology standards for steels within most but not all standard development organizations (SDOs). These

standards are very useful when working with steel standards, particularly when interpreting specific terms. Table 1.5 contains a list of steel terminology standards.

It is important to note that these standards differ in the terms used to describe the different types of steel. The user of comparative steel standards data must take into account that each national SDO has their own set of terms and definitions for steels and related products and, in some cases, may have multiple definitions. For example, three different definitions for carbon steel can be found in ASTM standards A941-13b, A902-14, and F1789-14a.

A summary of the chemical element limits for ASTM A941-13b alloy steel and EN 10020:2000 non-alloy steel is shown in Table 1.6. Although the limits seem to be the same, it is important to note the 70 % rule in EN 10020, Paragraph 3.1.2, which states:

Where for elements other than manganese a maximum value only is specified in the product standard or specification for the ladle analysis, a value of 70 % of this maximum value shall be taken for classification as set out in tables 1 and 2. For manganese see note *a* of table 1.

In some cases, this 70 % rule resulted in several steels being non-comparable. For example, EN 10028-3:2009, Flat Products Made of Steels for Pressure Purposes—Part 3: Weldable Fine Grain Steels, Normalized, contains steels with a nickel content of 0.50 % maximum (i.e., there is no minimum nickel requirement). Using the 70 % rule, this would define these steels to contain 0.35 % Ni, which is over the 0.30 % maximum limit for non-alloy steels (carbon steels), thereby making them alloy steels and thus becoming noncomparable with non-alloy steels.

ASTM A941-13b and EN 10020:2000 share the same definition for stainless steel, as follows.

Stainless steel—a steel that conforms to a specification that requires, by mass percent, a minimum chromium content of 10.5 or more, and a maximum carbon content of less than 1.20.

In this handbook, steels have been divided into three main categories:

1. Carbon Steels (Non-Alloy Steels)
2. Alloy Steels
3. Stainless Steels

Table 1.5 List of Steel Terminology Standards

ASTM A941-13b	Standard Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys
ASTM A644-14	Standard Terminology Relating to Iron Castings
ASTM A751-14a	Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
ASTM A902-15	Standard Terminology Relating to Metallic Coated Steel Products
EN 10020:2000	Definition and Classification of Grades of Steel
EN 10027-1:2005	Designation systems for steels—Part 1: Steel names
EN 10052:1993	Vocabulary of Heat Treatment Terms for Ferrous Products
EN 10079:2007	Definition of Steel Products
EN 10169-1:2003	Continuously Organic Coated (Coil Coated) Steel Flat Products—Part 1: General Information (Definitions, Materials, Tolerances, Test Methods)
EN 10266:2003	Steel tubes, fittings and structural hollow sections—Symbols and definitions of terms for use in product standards
GB/T 13304-1991	Steels—Classification
GB/T 15574-1995	Steel products classification and definitions
GB/T 15575-1995	Steel products standard designation
GB/T 341-1989	Steel wire—Classification and vocabulary
JIS G 0201:2000	Glossary of terms used in iron and steel (Heat treatment)
JIS G 0202:2013	Glossary of terms used in iron and steel (Testing)
JIS G 0203:2009	Glossary of terms used in iron and steel (Products and quality)
ISO 6929:1987	Steel products—Definitions and classification
ISO 2532:1974	Steel wire ropes—Vocabulary
ISO 3252:2000	Powder metallurgy—Vocabulary
ISO 4885:1996	Ferrous products—heat treatments—Vocabulary
ISO 8954-1:1990	Ferroalloys—Vocabulary—Part 1: Materials
ISO 8954-2:1990	Ferroalloys—Vocabulary—Part 2: Sampling and sample preparation
ISO 8954-3:1990	Ferroalloys—Vocabulary—Part 3 Sieve analysis
ISO 17893:2004	Steel wire ropes—Vocabulary, designation, and classification

Table 1.6 Limits for EN 10020:2000 and ASTM A941-13b Between Carbon Steels/Non-Alloy Steel and Alloy Steels (% by mass)

Symbol	Name	EN 10020:2000b	ASTM A941-13b
Al	Aluminum	0.30	0.30
B	Boron	0.0008	0.0008
Bi	Bismuth	0.10	---
Co	Cobalt	0.30	0.30
Cr	Chromium	0.30	0.30
Cu	Copper	0.40	0.40
La	Lanthanides	0.10	---
Mn	Manganese	1.65b	1.65
Mo	Molybdenum	0.08	0.08
Nb	Niobium	0.06	0.06
Ni	Nickel	0.30	0.30
Pb	Lead	0.40	0.40
Se	Selenium	0.10	---
Si	Silicon	0.60	0.60
Te	Tellurium	0.10	---
Ti	Titanium	0.05	0.05
V	Vanadium	0.10	0.10
W	Tungsten	0.30	0.30
Zr	Zirconium	0.05	0.05
	Other (except C, P, S, N)	0.10	0.10

^aAlloy steel when equal to or greater than the limit.

^bWhere manganese is specified only as a maximum, the limit value is 1.80 % and the 70 % rule does not apply (see 3.1.2 of EN 10020:2000).

ASTM A941-13b and EN 10020:2000 were used as guidelines in developing these categories. Where practical, these steel categories were further divided into subcategories based on their product form, intended application, service requirement, or other similar criteria.

Cautionary Note

Many standard specifications include cautionary paragraphs that warn users about their responsibilities (e.g., see Paragraph 1.5 from ASTM A53/A53M-12, quoted here). Accordingly, it is the user's responsibility when comparing steel standards to perform an engineering review of each standard to ensure that it is suitable for their intended application.

The following precautionary caveat pertains only to the test method portion, Sections 7, 8, 9, 13, 14, and 15 of this specification: This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this

standard to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.

Questions Regarding the Rules of Comparison

When comparing two or more steel standards, the following questions must be asked:

1. Should mechanical properties or chemical composition be the main criteria? If mechanical properties are compared, which property should be the first criteria for comparison, that is, yield strength, tensile strength, elongation, impact strength, hardness, and so on? Once having selected a primary criterion, say tensile strength, should there be a secondary criterion for ranking the comparative steels within this group, for example, yield strength, hardness, and so on? When mechanical properties or chemical compositions vary with section thickness for a given steel grade, which section thickness data should be selected as the criteria for comparison? When two steels have the same minimum tensile strength values but have different yield strength values, are they no longer similar?
2. Should comparisons be based on the data's minimum values, maximum values, or average values of their minimum/maximum ranges? Should alloy steels and stainless steels be compared based on their mechanical properties when they generally are selected for use based on their alloying elements' abilities to provide satisfactory service in their intended applications?
3. Is it reasonable to compare steels based only on their chemical compositions, regardless of their product form? That is, should forging steels be compared to steel plates or tubes because they have similar chemical compositions, and is this type of comparative data useful in engineering practice?

Noncomparable Steels

It is fundamental to understand that not all steels have comparative counterparts. Knowing that a steel is noncomparable can be just as important as knowing that there are comparative steels. Otherwise, valuable time could be wasted searching for something that does not exist.

Criteria for Comparing Steels

The two major criteria for comparing steels in this type of handbook are mechanical properties and chemical compositions. For each given standard steel grade, there is typically only one chemical composition, which makes it ideal as a comparison criterion. However, there are several mechanical properties that can be used to compare standard steel grades and, to be consistent throughout a handbook of this type, only one property can be chosen. The decision was to use a steel's tensile strength as the second comparison criterion.

Having settled on chemical composition and tensile strength as the two main comparison criteria, the next step was to decide

when to apply one or the other, or both. Because carbon steels typically are selected based on mechanical properties, it was decided that tensile strength would be the first criterion used for comparing carbon steels. Likewise, because alloy steels and stainless steels generally are selected based on their chemistry, it was decided that chemical composition would be used to compare them. An exception to this methodology is made for the structural steels data in [Chapter 3](#), where the tensile strength was used as the main comparison criterion for carbon and alloy steels. This exception was made because structural steels generally are selected based on their mechanical properties. Also in this same chapter, high-strength, low-alloy steels are treated as a subcategory to alloy steels, although ASTM A941 defines them separately.

Because there was insufficient space on a page to place both the chemical composition and mechanical properties tables, they were split into two separate tables. To assist the user in keeping track of the comparison criteria used for a given steel, each table within a chapter was sequentially numbered and appended with the letter A or B. Table numbers ending in the letter A designate that it was the main criterion used for comparison, whereas table numbers ending with the letter B were “mirrored” from the A tables. In this manner, the user must first consider the data in the A table, and then see how well the data in the B table match the steels that are being compared.

This is not a foolproof methodology of comparison. For example, ASTM A958 Grade SC 4330 has one chemical composition but has 13 different strength classes based on heat treatment (see [Chapter 7](#)). So just because two steel grades have comparative chemical compositions does not mean that they are comparable in mechanical properties and vice versa. Using data found in this handbook is only one step in finding suitable comparable steel for the intended application.

With this basic methodology in place, the following is a list of the comparison rules that were established to produce this handbook.

List of Comparison Rules

1. The first criterion of order for carbon (non-alloy) steels is based on tensile strength, followed by yield strength; that is, if two steels have the same tensile strength, then they are placed in ascending order by yield strength, and if yield strength is not required, it is placed at the top of the order.
2. Typically, comparative groups are made for every 50 MPa (50 N/mm² or 7.25 ksi) in tensile strength (that is, a black line divides comparative groups every 50 Mpa [50 N/mm² or 7.25 ksi]). When an abundance of data is available, this limit may be reduced to improve the comparison accuracy.
3. Mechanical property subcategories, such as steels with impact testing below -20°C (-4°F), are used to further narrow the comparison process.
4. If a carbon steel's tensile strength varies with section thickness, the tensile strength of the lowest section thickness will be used as the governing comparison factor. There is no technical reason for choosing the lowest section thickness; it is just that one had to be chosen.
5. If a carbon steel standard does not contain mechanical properties, such as those found in [Chapter 2](#), Carbon and Alloy Steels for General Use, then the steels will be compared based on their carbon content.
6. The major criterion for alloy steel and stainless steel comparisons is chemical composition. Once these steels are placed in a comparative group by chemical composition, they are then arranged in ascending order within these groups by their tensile strength. Where possible, subcategories of alloy and stainless steel groups are made to further narrow the comparison process.
7. Chemical compositions listed are the heat analysis requirements in the standards (also called ladle or cast analysis). Product analyses are not listed.
8. The chemical composition and mechanical properties data for the same steel grades are typically not listed on the same page due to space limitations. Consequently, as a means of keeping the data consistent between these two sets of tables, each table is numbered, and each table number ends with either the letter A or B.
9. Each set of steel data in the tables is divided by two types of horizontal lines: black and gray. Black lines separate groups of steels that are more closely comparable to each other, whereas gray lines separate steel data within a comparative group. This does not mean that steels outside of these groups cannot be compared because these horizontal lines are dependent upon all of the comparison rules in this list and can be subjective at times. **Caution:** Do not confuse the thinner dividing black line within a table with the thicker black rule that borders the table. To assist in this regard, the pages were formatted to keep comparative groups together as much as practicable. However, when a group of comparative steels appears on more than one page, a note is placed at the bottom of the page to indicate that the comparative group continues on the following page (“Note: This group continues on the next page”). Likewise, when a specification within a group of comparative steels cannot fit onto just one page, a note is placed at the bottom of the page to indicate that the specification within the comparative group continues on the following page (“Note: This specification continues on the next page within the same group”).
10. Steel data in standards are not always mandatory. Some data are listed as typical values or informative values or are found in supplementary requirements. This type of data is still very useful and has been included in this handbook whenever possible. This type of data is identified with an explanatory note that appears in the list of standards at the beginning of the related chapter.
11. Some standards included multiple requirements for impact testing, such as differing test temperatures or requirements for sub-size specimens.

12. Where space permitted, as much data as possible were included. However, there are occasions when the phrase “see standard for impact test data” was used to indicate that more data could be found in the standard.
13. The phrase “see standard for impact test data” was also used when the standard did not specify a test temperature but did specify an absorbed energy value.
14. Impact testing values listed in the tables are typically for full-size specimens and for the minimum average result at the testing temperature but do not include the minimum individual test piece requirement, if any.
15. For the purpose of this handbook, phrases found in standards such as “may be applied if necessary” or “may be applied by agreement between the purchaser and supplier” or “the manufacturer may find it necessary to” or “when specified” or “may be added if necessary” are not a part of the comparison process.
16. Data from footnotes in the chemical composition and mechanical properties tables of steel standards were considered during the comparison process but were not always reported in the handbook due to lack of space in the tables or because they represented technical issues that were too complex to be represented in a tabular format. In these cases, the note “see standard” was used.
17. The same heat treatment terms used in each standard are listed at the beginning of each chapter. Abbreviations in the tables were made based on the terms used in the standards. A concerted effort was made to make the abbreviations consistent from chapter to chapter, although there are exceptions because each heat treatment abbreviation must be referred to in the list of heat treatment terms at the beginning of each chapter. There are many instances when the heat treatment requirements within a standard became very cumbersome to include in a small cell within a table. Consequently, the phrase “see standard” is used to direct the user to the standard to read all of the heat treatment details involved.
18. A determined effort was made to enter the data in this handbook in a manner identical to that listed in the related standard, including the use of niobium (Nb) or columbium (Cb). It should be noted that even within the same SDO, data were not always entered in the same manner from standard to standard; for example, TP304 versus TP 304, where a space between the letter P and the number 3 is listed in the data.

Brief Introduction to Steel Standards and Designation Systems

In the world of standardization, metals were at the forefront at the turn of the twentieth century. In 1895, the International Association for Testing Materials (IATM) held their first conference in Zurich and the standardization of metals began. The IATM encouraged members to form national chapters and, on June 16, 1898, 70 IATM members met in Philadelphia to form the American section of the

International Association for Testing Materials, which in 1898 became the American Society for Testing Materials (ASTM).

By reviewing some examples of the more prominent metals’ designation systems, a direction is offered to assist those who use metal standards as a part of their work or study. This section is not all-inclusive. The amount of information on this topic could easily make up a complete book.

ASTM Designation System

ASTM’s designation system for metals consists of a letter (A for ferrous materials) followed by an arbitrary sequentially assigned number. These designations often apply to specific products; for example, A822 is applicable to seamless cold-drawn carbon steel tubing for hydraulic system service. Metric ASTM standards have a suffix letter M.

Examples of the ASTM ferrous metal designation system, describing its use of specification numbers and letters, are as follows:

ASTM A334/A334M-04a (2010), Grade 1—Pressure Vessel Plates, Alloy Steel and High-Strength Low-Alloy Steel, Quenched-and-Tempered:

- A describes a ferrous metal but does not subclassify it as cast iron, carbon steel, alloy steel, tool steel, or stainless steel.
- 334 is a sequential number without any relationship to the metal’s properties.
- M indicates that the standard A334M is written in rationalized SI units (the “M” comes from the word “metric”); hence, together A334/A334M includes both inch-pound and SI units.
- 04 indicates the year of adoption or last revision and a letter *a* following the year indicates the second revision of the standard in 2004.
- (2010), a number in parentheses, indicates the year of last reapproval.
- Grade 1 indicates the type of steel.

In the steel industry, the terms *grade*, *type*, and *class* generally are defined as follows. *Grade* is used to describe chemical composition; *type* is used to define deoxidation practice; and *class* is used to indicate other characteristics such as strength level or surface finish. However, within ASTM standards, these terms were adapted for use to identify a particular metal within a metal standard and are used without any “strict” definition but essentially mean the same thing, although some loose rules do exist, as follows.

ASTM A106/A106M-14 Grade A, Grade B, Grade C—Seamless Carbon Steel Pipe for High-Temperature Service:

- Typically an increase in alphabet (such as the letters A, B, C) results in higher tensile or yield strength steels and, if it is an unalloyed carbon steel, an increase in carbon content.
- In this case: Grade A: 0.25 % C (max.), 48 ksi tensile strength (min.); Grade B: 0.30 % C (max.), 60 ksi tensile strength (min.); Grade C: 0.35 % C (max.), 70 ksi tensile strength (min.)

ASTM A276/A276M-15, Type 304, 316, 410—Stainless Steel Bars and Shapes:

- Types 304, 316, 410, and others are based on the SAE designation system for stainless steels (see SAE and former American Iron and Steel Institute [AISI] description that follows).

Another use of ASTM grade designators is found in pipe, tube, and forging products, where the first letter “P” refers to pipe, “T” refers to tube, “TP” may refer to tube or pipe, and “F” refers to forging. Examples are found in the following ASTM specifications:

- ASTM A335/A335M-15, Grade P22, Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
- ASTM A213/A213M-15a, Grade T22, Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
- ASTM A312/A312M-15, Grade TP304, Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
- ASTM A336/A336M-10a, Grade F91, Alloy Steel Forgings for Pressure and High-Temperature Parts

ASTM Referenced Standards and Supplementary Requirements

ASTM standards contain a “referenced documents” section, which lists other ASTM standards that are referenced in the text and that either become a part of the original standard or its supplementary requirements. Supplementary requirements are listed at the end of the ASTM standards and do not apply unless specified in the purchase order—that is, they are optional.

SAE Designation System and Related AISI Designation System

For many years, certain grades of carbon and alloy steels have been designated by a four-digit AISI/SAE numbering system that identified the grades according to standard chemical compositions. Because the AISI does not write material specifications, the relationship between AISI and grade designations has been discontinued. Beginning with the 1995 edition of the Iron and Steel Society (ISS) Strip Steel Manual, the four-digit designations are referred to solely as SAE designations.

The SAE system uses a basic four-digit system to designate the chemical composition of carbon and alloy steels. Throughout the system, the last two digits give the carbon content in hundredths of a percent. Carbon steels are designated 10XX. For example, a carbon steel containing 0.45 % carbon is designated 1045 in this system.

Resulfurized carbon steels are designated within the series 11XX, resulfurized and rephosphorized carbon steels within 12XX, and steels having manganese contents between 0.9 % and 1.5 % but no other alloying elements are designated 15XX. Composition ranges for manganese and silicon and maximum percentages for sulfur and phosphorus are also specified.

For alloy steels, the first two digits of the SAE system describe the major alloying elements present in the material, the first digit giving the alloy group. For example the 43XX series of steels contain 1.65–2.00 % Ni, 0.50–0.80 % Cr, and 0.20–0.30 % Mo, along with composition ranges for manganese and silicon and the maximums for sulfur and phosphorus.

Additional letters added between the second and third digits include “B” when boron is added (between 0.0005 % and 0.003 %) for enhanced hardenability and “L” when lead is added (between 0.15 % and 0.35 %) for enhanced machinability. The prefix “M” is used to designate merchant quality steel (the least restrictive quality descriptor for hot-rolled steel bars used in noncritical parts of structures and machinery). The prefix “E” (electric-furnace steel) and the suffix “H” (hardenability requirements) are mainly

Table 1.7 Types and Identifying Elements in Standard SAE Carbon and Alloy Steels

Carbon Steels	Description
10XX	Non-resulfurized, 1.00 manganese maximum
11XX	Resulfurized
12XX	Rephosphorized and resulfurized
15XX	Non-resulfurized, over 1.00 manganese maximum
Alloy Steels	Description
13XX	1.75 manganese
40XX	0.20 or 0.25 molybdenum or 0.25 molybdenum and 0.042 sulfur
41XX	0.50, 0.80, or 0.95 chromium and 0.12, 0.20, or 0.30 molybdenum
43XX	1.83 nickel, 0.50 to 0.80 chromium, and 0.25 molybdenum
46XX	0.85 or 1.83 nickel and 0.20 or 0.25 molybdenum
47XX	1.05 nickel, 0.45 chromium, 0.20 or 0.35 molybdenum
48XX	3.50 nickel and 0.25 molybdenum
51XX	0.80, 0.88, 0.93, 0.95, or 1.00 chromium
51XXX	1.03 chromium
52XXX	1.45 chromium
61XX	0.60 or 0.95 chromium and 0.13 or 0.15 vanadium minimum
86XX	0.55 nickel, 0.50 chromium, and 0.20 molybdenum
87XX	0.55 nickel, 0.50 chromium, and 0.25 molybdenum
88XX	0.55 nickel, 0.50 chromium, and 0.35 molybdenum
92XX	2.00 silicon or 1.40 silicon and 0.70 chromium
50BXX	0.28 or 0.50 chromium
51BXX	0.80 chromium
81BXX	0.30 nickel, 0.45 chromium, and 0.12 molybdenum
94BXX	0.45 nickel, 0.40 chromium, and 0.12 molybdenum

applicable to alloy steels. The full series of classification groups is shown in Table 1.7.

UNS Designation System

The Unified Numbering System (UNS) is an alphanumeric designation system consisting of a letter followed by five numbers. This system represents only the chemical composition for an individual metal or alloy and is not a metal standard or specification. For the most part, existing systems such as the SAE designations were incorporated into the UNS so that some familiarity was given to the system where possible.

For example, the UNS prefix letter for carbon and alloy steels is “G,” and the first four digits are the SAE designation; for example, SAE 1040 is UNS G10400. The intermediate letters “B” and “L” of the SAE system are replaced by making the fifth digit of the UNS designation 1 and 4, respectively, while the prefix letter “E” for electric furnace steels is designated in the UNS system by making the fifth digit “6.” The SAE steels, which have a hardenability requirement indicated by the suffix letter “H,” are designated by the Hxxxxx series in the UNS system. Carbon and alloy steels not referred to in the SAE system are categorized under the prefix letter “K.”

Where possible, the first letter in the system denotes the metal group; for instance, “S” designates stainless steels. Of the five digits of the UNS designation for stainless steels, the first three are the SAE alloy classification; for example, S304XX. The final two digits are equivalent to the various modifications represented by suffix letters in the SAE system as given in the list of suffixes in Table 1.7. The UNS designations for ferrous metals and alloys are described in Table 1.8.

Canadian Standards Association (CSA)

The Canadian Standards Association (CSA) has established metal standards for structural steels (CSA G40.20/40.21), pipeline steels (CSA Z245.1), corrugated steel pipe (G401), wire

products (CSA G4, G12, G30.x, G279.2, G387), sprayed metal coatings (G189), and welding consumables (CSA W48.x).

Most CSA material standards use SI units, although some are available in both SI and Imperial units (for example, CSA G40.20/G40.21-04). When a CSA standard designation is followed by the letter “M,” it uses SI units, and if the letter “M” is not present, it may use both units or use only Imperial units. The type of measurement units adopted in CSA standards are specific industry driven, with some industries moving faster toward the exclusive use of SI units than others, and thus the reason for these differences.

As far as practicable, rationalization with relevant ISO standards has been achieved in CSA G4, Steel Wire Rope for General Purpose and for Mine Hoisting and for Mine Haulage. Similarly, the 2005 edition of CSA Z245.1, Steel Line Pipe, references requirements for ISO 1027:1998 (E) on radiographic image indicators for nondestructive testing: principles and identification, as well as ISO 5579:1998 on nondestructive testing—radiographic examination of metallic materials by X- and gamma rays—basic rules.

Introduction to European (EN) Standard Steel Designation System

The Comité Européen de Normalisation (CEN, the European Committee for Standardization) was founded in 1961 by the national standards bodies in the European Economic Community and European Free Trade Association (EFTA) countries. The CEN is a system of formal processes to produce standards, shared principally among:

- Thirty national members and the representative expertise they assemble from each country; these members vote for and implement European Standards (EN).
- Seven associate members and four affiliates.
- The CEN Management Centre, Brussels.

The CEN works closely with the European Committee for Electrotechnical Standardization (CENELEC), the European

Table 1.8 UNS Designations for Ferrous Metals and Alloys

UNS Descriptor	Ferrous Metals
Dxxxxx	Specified mechanical properties of steels
Fxxxxx	Cast irons
Gxxxxx	SAE and former AISI carbon and alloy steels (except tool steels)
Hxxxxx	AISI H-steels
Jxxxxx	Cast steels
Kxxxxx	Miscellaneous steels and ferrous alloys
Sxxxxx	Heat and corrosion-resistant (stainless) steels
Txxxxx	Tool steels
UNS Descriptor	Welding Filler Metals
Wxxxxx	Welding filler metals, covered and tubular electrodes classified by weld deposit composition

Telecommunications Standards Institute (ETSI), and the ISO. It also has close liaisons with European trade and professional organizations.

The principal task of CEN is to prepare and issue European standards (EN), defined as a set of technical specifications established and approved in collaboration with the parties concerned in the various member countries of CEN. They are established on the principle of consensus and are adopted by the votes of weighted majority. Adopted standards must be implemented in their entirety as national standards by each member country regardless of the way in which the national member voted, and any conflicting national standards must be withdrawn.

The identification of European standards in each member country begins with the reference letters of the country's national standards body—for example, BS for the British Standards Institution (BSI) in the United Kingdom; DIN for the German Institute for Standardization (Deutsches Institut für Normung); NF for the French national organization for standardization (Association Française de Normalisation, or AFNOR). It is followed by the initials EN and a sequential number of up to five digits. For example, BS EN 10025, DIN EN 10025, or NF EN 10025 are all the same EN standard, which is available in English, French, and German.

An EN standard may contain one document, or it may be made up of several parts. For example, EN 10028 Parts 1 through 7, where each part specifies a particular characteristic of the steel product, may not include the word *part* in the designation but rather it is replaced with a hyphen (e.g., EN 10028-1, etc.), meaning Part 1. The prefix “pr” preceding the EN designation identifies the document as a draft standard that has not yet been approved, (e.g., prEN 10088-1, etc.).

EN 10027 Standard Designation System for Steels

The CEN designation system for steels is standardized in EN 10027, which is published in two parts:

- Part 1—Steel Names
- Part 2—Numerical System

The steel name is a combination of letters and numbers as described by EN 10027-1. Within this system, steel names are classified into two groups. The system is similar in some respects to, but is not identical with, that outlined in an ISO technical report (ISO TS 4949:2003—Steel names based on letter symbols).

Steel Names

Steel Names Group 1, within EN 10027-1, refers to steels that are designated according to their application and mechanical or physical properties. These have names that are comprised of one or more letters related to the application, followed by a number related to properties. For example, the name for structural steels begins with

the letter S, line pipe steels begin with the letter L, rail steels begin with the letter R, and steels for pressure purposes begin with the letter P, such as EN 10028-3 Steel Name P275NH.

Steel Names Group 2 is used for steels that are designated according to their chemical composition and are further divided into four subgroups, depending on alloy content. Examples of these Group 2 steel names are:

- EN 10222-2 Steel Name 13CrMo4-5
- EN 10250-4 Steel Name X2CrNi18-9

Numerical System

EN 10027-2 describes the system used for assigning steel numbers, which are complementary to the steel names described earlier. These consist of a fixed set of digits and hence are more suitable than the name for data processing purposes. The steel numbers are in the form 1.XXXX, where the “1” refers to steel. The first two digits following the “1” represent the steel group number. Examples of steel numbers are as follows:

- EN 10222-2 Steel Name 13CrMo4-5, Steel Number 1.7335
- EN 10250-4 Steel Name X2CrNi18-9, Steel Number 1.4307

Former National Standards Superseded by CEN Standards

An increasing number of national European and UK standards are being withdrawn and superseded by EN standards. This transition, from old to new standards, has made it increasingly difficult to compare the superseded national standards with current standards from other nations outside of Europe and the UK, let alone to compare them to the new EN standards. For example, if you are looking up a former national standard such as DIN 17441, it has been superseded by EN 10028-7:2007.

Superseded national standards may be replaced by more than one new EN standard, and some may have been partially replaced. So, a superseded national standard could be replaced by 2, 3, 4, or more new EN standards, or it may be only partially replaced by these new EN standards.

Indexes in this Handbook

One of the easiest ways of using this handbook is to refer to one of the four indexes. If a user is looking for a comparable steel, then the information can be found in at least one of the indexes, which are built around the steel designation systems described previously, namely:

- Steel Grade/Name Index
- UNS Number Index
- Steel Number Index
- Specification Designation Index

Chapter

2

***CARBON AND ALLOY STEELS
FOR GENERAL USE***

ASME Standard

ASME SA-29/SA-29M	Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for

ASTM Standards

ASTM A29/A29M-12e1	General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
ASTM A322-13	Steel Bars, Alloy, Standard Grades
ASTM A355-89 (2012)	Steel Bars, Alloys, for Nitriding
ASTM A576-90b (2012)	Steel Bars, Carbon, Hot-Wrought, Special Quality

EN Standards

EN 10083-2:2006	Steels for quenching and tempering – Part 2: Technical delivery conditions for non alloy steels
EN 10083-3:2006 C1:2008	Steels for quenching and tempering – Part 3: Technical delivery conditions for alloy steels
EN 10084:2008	Case hardening steels – Technical delivery conditions
EN 10085:2001	Nitriding steels – Technical delivery conditions
EN 10250-2:1999 C1:2000	Open die steel forgings for general engineering purposes – Part 2: Non-alloy quality and special steels
EN 10263-3:2001 C1:2001	Steel rod, bars and wire for cold heading and cold extrusion – Part 3: Technical delivery conditions for case hardening steels
EN 10263-4:2001 C2:2003	Steel rod, bars and wire for cold heading and cold extrusion – Part 4: Technical delivery conditions for steels for quenching and tempering
EN 10269:2013	Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties

ISO Standards

ISO 683-1:1987	Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels – Part 1: Direct-Hardening Unalloyed and Low-Alloyed Wrought Steel in Form of Different Black Products
ISO 683-10:1987	Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels – Part 10: Wrought Nitriding Steels
ISO 683-11:1987	Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels – Part 11: Wrought Case-Hardening Steels

EN ISO Standards

EN ISO 16120-2:2011	Non-alloy steel wire rod for conversion to wire – Part 2: Specific requirements for general-purpose wire rod
EN ISO 16120-4:2011	Non-alloy steel wire rod for conversion to wire – Part 4: Specific requirements for wire rod for special applications

GB Standards

GB/T 699-1999	Quality Carbon Structural Steels
GB 715-89	Hot-Rolled Round Carbon Steel Bars for Standard Parts
GB/T 3077-1999	Alloy Structure Steels
GB/T 3078-94	Technical Requirements for Quality Structural Steel Cold Drawn Bars
GB 5216-85	Technical Requirements for Structural Steel with Specified Hardenability Bands
GB 13791-92	Cold Drawn Special Shaped Steel Bar

JIS Standards

JIS G 4051:2009	Carbon steels for machine structural use
JIS G 4053:2008	Low-alloyed steels for machine structural use
JIS G 7105:2000	Heat-treatable steels, alloy steels and free-cutting steels – Part 18: Bright products of unalloyed and low alloy steels

SAE Standards

SAE J403 JUN14	Chemical Compositions of SAE Carbon Steels (Long Products Only)
SAE J404 JAN09	Chemical Compositions of SAE Alloy Steels (Hot Rolled and Cold Finished Bars Only)

2.1 Chemical Composition of Carbon Steels for General Use

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1005	G10050	---	0.06	0.35	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1005	G10050	---	0.06	0.35	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C4D	---	1.0300	0.06	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Al 0.01; Cu 0.30
EN ISO 16120-4:2011	C3D2	---	1.1110	0.05	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
SAE J403 JUN14	Grade 1005	G10050	---	0.06	0.35	---	0.040	0.050	---	---	---	---
ASME SA-29/SA-29M	Grade 1006	G10060	---	0.08	0.25-0.40	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1006	G10060	---	0.08	0.25-0.40	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C7D	---	1.0313	0.05-0.09	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Al 0.01; Cu 0.30
EN ISO 16120-4:2011	C5D2	---	1.1111	0.07	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
SAE J403 JUN14	Grade 1006	G10060	---	0.08	0.25-0.40	---	0.040	0.050	---	---	---	---
ASME SA-29/SA-29M	Grade 1008	G10080	---	0.10	0.30-0.50	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1008	G10080	---	0.10	0.30-0.50	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1008	G10080	---	0.10	0.30-0.50	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C9D	---	1.0304	0.10	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Al 0.01; Cu 0.30
EN ISO 16120-4:2011	C8D2	---	1.1113	0.06-0.10	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB/T 699-1999	Grade 08	---	---	0.05-0.11	0.35-0.65	0.17-0.37	---	---	0.10	0.30	---	Cu 0.25
	Grade 08F	---	---	0.05-0.11	0.25-0.50	0.03	---	---	0.10	0.30	---	Cu 0.25
SAE J403 JUN14	Grade 1008	G10080	---	0.10	0.30-0.50	---	0.040	0.050	---	---	---	---
ASME SA-29/SA-29M	Grade 1010	G10100	---	0.08-0.13	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1010	G10100	---	0.08-0.13	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1010	G10100	---	0.08-0.13	0.30-0.60	---	0.040	0.050	---	---	---	---
EN 10084:2008	C10E	---	1.1121	0.07-0.13	0.30-0.60	0.40	0.035	0.035	---	---	---	---
	C10R	---	1.1207	0.07-0.13	0.30-0.60	0.40	0.035	0.020-0.040	---	---	---	---
EN ISO 16120-2:2011	C10D	---	1.0310	0.08-0.13	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Al 0.01; Cu 0.30
EN ISO 16120-4:2011	C10D2	---	1.1114	0.08-0.12	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB 13791-92	Grade 10	---	---	0.07-0.13	0.35-0.65	0.17-0.37	---	---	0.15	0.30	---	Cu 0.25
GB/T 3078-94	Grade 10	---	---	0.07-0.13	0.35-0.65	0.17-0.37	---	---	0.15	0.30	---	Cu 0.25
	Grade 10F	---	---	0.07-0.13	0.50	0.03	0.035	0.035	---	---	---	---
GB/T 699-1999	Grade 10	---	---	0.07-0.13	0.35-0.65	0.17-0.37	---	---	0.15	0.30	---	Cu 0.25
	Grade 10F	---	---	0.07-0.13	0.25-0.50	0.07	---	---	0.15	0.30	---	Cu 0.25
ISO 683-11:1987	Type C 10	---	---	0.07-0.13	0.30-0.60	0.15-0.40	0.035	0.035	---	---	---	---
JIS G 4051:2009	Symbol S10C	---	---	0.08-0.13	0.30-0.60	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
	Symbol S09CK	---	---	0.07-0.12	0.30-0.60	0.10-0.35	0.025	0.025	0.20	0.20	---	Cu 0.25; (Ni+Cr) 0.30
SAE J403 JUN14	Grade 1010	G10100	---	0.08-0.13	0.30-0.60	---	0.040	0.050	---	---	---	---

2.1 Chemical Composition of Carbon Steels for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1012	G10120	---	0.10-0.15	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1012	G10120	---	0.10-0.15	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1012	G10120	---	0.10-0.15	0.30-0.60	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C12D	---	1.0311	0.10-0.15	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Al 0.01; Cu 0.30
EN ISO 16120-4:2011	C12D2	---	1.1124	0.10-0.15	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB 715-89	Grade BL2	---	---	0.09-0.15	0.25-0.55	0.07	0.040	0.040	---	---	---	---
JIS G 4051:2009	Symbol S12C	---	---	0.10-0.15	0.30-0.60	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
SAE J403 JUN14	Grade 1012	G10120	---	0.10-0.15	0.30-0.60	---	0.040	0.050	---	---	---	---
ASME SA-29/SA-29M	Grade 1015	G10150	---	0.13-0.18	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1016	G10160	---	0.13-0.18	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1015	G10150	---	0.13-0.18	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1016	G10160	---	0.13-0.18	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1015	G10150	---	0.13-0.18	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1016	G10160	---	0.13-0.18	0.60-0.90	---	0.040	0.050	---	---	---	---
EN 10084:2008	C15R	---	1.1140	0.12-0.18	0.30-0.60	0.40	0.035	0.020-0.040	---	---	---	---
	C15E	---	1.1141	0.12-0.18	0.30-0.60	0.40	0.035	0.035	---	---	---	---
	C16E	---	1.1148	0.12-0.18	0.60-0.90	0.40	0.035	0.035	---	---	---	---
	C16R	---	1.1208	0.12-0.18	0.60-0.90	0.40	0.035	0.020-0.040	---	---	---	---
EN ISO 16120-2:2011	C15D	---	1.0413	0.12-0.17	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Al 0.01; Cu 0.30
EN ISO 16120-4:2011	C15D2	---	1.1126	0.13-0.17	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB/T 699-1999	Grade 15	---	---	0.12-0.18	0.35-0.65	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 15F	---	---	0.12-0.18	0.25-0.50	0.07	---	---	0.25	0.30	---	Cu 0.25
	Grade 15Mn	---	---	0.12-0.18	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB/T 3078-94	Grade 15	---	---	0.12-0.18	0.35-0.65	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 15F	---	---	0.12-0.18	0.50	0.07	0.035	0.035	---	---	---	---
	Grade 15Mn	---	---	0.12-0.18	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB 13791-92	Grade 15	---	---	0.12-0.18	0.35-0.65	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
ISO 683-11:1987	Type C 16 M2	---	---	0.12-0.18	0.60-0.90	0.15-0.40	0.035	0.020-0.040	---	---	---	---
	Type C 16 E4	---	---	0.12-0.18	0.60-0.90	0.15-0.40	0.035	0.035	---	---	---	---
	Type C 15 M2	---	---	0.12-0.18	0.30-0.60	0.15-0.40	0.035	0.020-0.040	---	---	---	---
	Type C 15 E4	---	---	0.12-0.18	0.30-0.60	0.15-0.40	0.035	0.035	---	---	---	---
JIS G 4051:2009	Symbol S15C	---	---	0.13-0.18	0.30-0.60	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
	Symbol S15CK	---	---	0.13-0.18	0.30-0.60	0.15-0.35	0.025	0.025	0.20	0.20	---	Cu 0.25; (Ni+Cr) 0.30
SAE J403 JUN14	Grade 1015	G10150	---	0.13-0.18	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1016	G10160	---	0.13-0.18	0.60-0.90	---	0.040	0.050	---	---	---	---

2.1 Chemical Composition of Carbon Steels for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1017	G10170	---	0.15-0.20	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1018	G10180	---	0.15-0.20	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1019	G10190	---	0.15-0.20	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1017	G10170	---	0.15-0.20	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1018	G10180	---	0.15-0.20	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1019	G10190	---	0.15-0.20	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1017	G10170	---	0.15-0.20	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1018	G10180	---	0.15-0.20	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1019	G10190	---	0.15-0.20	0.70-1.00	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C18D	---	1.0416	0.15-0.20	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Al 0.01; Cu 0.30
EN ISO 16120-4:2011	C18D2	---	1.1129	0.16-0.20	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
JIS G 4051:2009	Symbol S17C	---	---	0.15-0.20	0.30-0.60	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
SAE J403 JUN14	Grade 1017	G10170	---	0.15-0.20	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1018	G10180	---	0.15-0.20	0.60-0.90	---	0.040	0.050	---	---	---	---
ASME SA-29/SA-29M	Grade 1020	G10200	---	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1021	G10210	---	0.18-0.23	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1022	G10220	---	0.18-0.23	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1020	G10200	---	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1021	G10210	---	0.18-0.23	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1022	G10220	---	0.18-0.23	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1020	G10200	---	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1021	G10210	---	0.18-0.23	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1022	G10220	---	0.18-0.23	0.70-1.00	---	0.040	0.050	---	---	---	---
EN 10083-2:2006	C22R	---	1.1149	0.17-0.24	0.40-0.70	0.40	0.030	0.020-0.040	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
	C22E	---	1.1151	0.17-0.24	0.40-0.70	0.40	0.030	0.035	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
EN 10250-2:1999 C1:2000	C22	---	1.0402	0.17-0.24	0.40-0.70	0.40	0.045	0.045	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
EN ISO 16120-2:2011	C20D	---	1.0414	0.18-0.23	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Al 0.01; Cu 0.30
EN ISO 16120-4:2011	C20D2	---	1.1137	0.18-0.23	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB/T 699-1999	Grade 20	---	---	0.17-0.23	0.35-0.65	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 20Mn	---	---	0.17-0.23	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB 715-89	Grade BL3	---	---	0.14-0.22	0.30-0.60	0.07	0.040	0.040	---	---	---	---
GB/T 3078-94	Grade 20	---	---	0.17-0.23	0.35-0.65	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 20F	---	---	0.17-0.24	0.50	0.07	0.035	0.035	---	---	---	---
	Grade 20Mn	---	---	0.17-0.23	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB 13791-92	Grade 20	---	---	0.17-0.23	0.35-0.65	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25

Note: This section continued on next page

2.1 Chemical Composition of Carbon Steels for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4051:2009	Symbol S20C	---	---	0.18-0.23	0.30-0.60	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
	Symbol S20CK	---	---	0.18-0.23	0.30-0.60	0.15-0.35	0.025	0.025	0.20	0.20	---	Cu 0.25; (Ni+Cr) 0.30
SAE J403 JUN14	Grade 1020	G10200	---	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1021	G10210	---	0.18-0.23	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1022	G10220	---	0.18-0.23	0.70-1.00	---	0.040	0.050	---	---	---	---
ASME SA-29/SA-29M	Grade 1023	G10230	---	0.20-0.25	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1023	G10230	---	0.20-0.25	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1023	G10230	---	0.20-0.25	0.30-0.60	---	0.040	0.050	---	---	---	---
JIS G 4051:2009	Symbol S22C	---	---	0.20-0.25	0.30-0.60	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
SAE J403 JUN14	Grade 1023	G10230	---	0.20-0.25	0.30-0.60	---	0.040	0.050	---	---	---	---
ASME SA-29/SA-29M	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1026	G10260	---	0.22-0.28	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1026	G10260	---	0.22-0.28	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1026	G10260	---	0.22-0.28	0.60-0.90	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C26D	---	1.0415	0.24-0.29	0.50-0.80	0.10-0.30	0.030	0.030	0.20	0.25	0.05	Al 0.01; Cu 0.30
EN ISO 16120-4:2011	C26D2	---	1.1139	0.24-0.29	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB 13791-92	Grade 25	---	---	0.22-0.29	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB/T 3078-94	Grade 25	---	---	0.22-0.29	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 25Mn	---	---	0.22-0.29	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB/T 699-1999	Grade 25	---	---	0.22-0.29	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 25Mn	---	---	0.22-0.29	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
ISO 683-1:1987	Grade C 25	---	---	0.22-0.29	0.40-0.70	0.10-0.40	0.045	0.045	---	---	---	---
	Grade C 25 E4	---	---	0.22-0.29	0.40-0.70	0.10-0.40	0.035	0.035	---	---	---	---
	Grade C 25 M2	---	---	0.22-0.29	0.40-0.70	0.10-0.40	0.035	0.020-0.040	---	---	---	---
JIS G 4051:2009	Symbol S25C	---	---	0.22-0.28	0.30-0.60	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
SAE J403 JUN14	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1026	G10260	---	0.22-0.28	0.60-0.90	---	0.040	0.050	---	---	---	---

2.1 Chemical Composition of Carbon Steels for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1029	G10290	---	0.25-0.31	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1029	G10290	---	0.25-0.31	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1029	G10290	---	0.25-0.31	0.60-0.90	---	0.040	0.050	---	---	---	---
JIS G 4051:2009	Symbol S28C	---	---	0.25-0.31	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu: 0.30; (Ni+Cr) 0.35
SAE J403 JUN14	Grade 1029	G10290	---	0.25-0.31	0.60-0.90	---	0.040	0.050	---	---	---	---
ASME SA-29/SA-29M	Grade 1030	G10300	---	0.28-0.34	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1030	G10300	---	0.28-0.34	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1030	G10300	---	0.28-0.34	0.60-0.90	---	0.040	0.050	---	---	---	---
GB 13791-92	Grade 30	---	---	0.27-0.34	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB/T 3078-94	Grade 30	---	---	0.27-0.34	0.60	0.20	0.035	0.035	---	---	---	---
	Grade 30Mn	---	---	0.27-0.34	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB/T 699-1999	Grade 30	---	---	0.27-0.34	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 30Mn	---	---	0.27-0.34	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
ISO 683-1:1987	Grade C 30	---	---	0.27-0.34	0.50-0.80	0.10-0.40	0.045	0.045	---	---	---	---
	Grade C 30 E4	---	---	0.27-0.34	0.50-0.80	0.10-0.40	0.035	0.035	---	---	---	---
	Grade C 30 M2	---	---	0.27-0.34	0.50-0.80	0.10-0.40	0.035	0.020-0.040	---	---	---	---
JIS G 4051:2009	Symbol S30C	---	---	0.27-0.33	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
SAE J403 JUN14	Grade 1030	G10300	---	0.28-0.34	0.60-0.90	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C32D	---	1.0530	0.30-0.35	0.50-0.80	0.10-0.30	0.030	0.030	0.20	0.25	0.05	Al 0.01; Cu 0.30
EN ISO 16120-4:2011	C32D2	---	1.1143	0.30-0.34	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
JIS G 4051:2009	Symbol S33C	---	---	0.30-0.36	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35

2.1 Chemical Composition of Carbon Steels for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1034	G10340	---	0.32-0.38	0.50-0.80	---	0.040	0.050	---	---	---	---
	Grade 1035	G10350	---	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1037	G10370	---	0.32-0.38	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1034	G10340	---	0.32-0.38	0.50-0.80	---	0.040	0.050	---	---	---	---
	Grade 1035	G10350	---	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1037	G10370	---	0.32-0.38	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1035	G10350	---	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1037	G10370	---	0.32-0.38	0.70-1.00	---	0.040	0.050	---	---	---	---
EN 10083-2:2006	C35R	---	1.1180	0.32-0.39	0.50-0.80	0.40	0.030	0.020-0.040	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
	C35E	---	1.1181	0.32-0.39	0.50-0.80	0.40	0.030	0.035	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
	C35	---	1.0501	0.32-0.39	0.50-0.80	0.40	0.045	0.045	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
EN ISO 16120-4:2011	C36D2	---	1.1145	0.34-0.38	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB/T 699-1999	Grade 35	---	---	0.32-0.39	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 35Mn	---	---	0.32-0.39	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB/T 3078-94	Grade 35	---	---	0.32-0.39	0.60	0.20	0.035	0.035	---	---	---	---
	Grade 35Mn	---	---	0.32-0.39	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB 13791-92	Grade 35	---	---	0.32-0.39	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
ISO 683-1:1987	Grade C 35	---	---	0.32-0.39	0.50-0.80	0.10-0.40	0.045	0.045	---	---	---	---
	Grade C 35 E4	---	---	0.32-0.39	0.50-0.80	0.10-0.40	0.035	0.035	---	---	---	---
	Grade C 35 M2	---	---	0.32-0.39	0.50-0.80	0.10-0.40	0.035	0.020-0.040	---	---	---	---
JIS G 4051:2009	Symbol S35C	---	---	0.32-0.38	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
SAE J403 JUN14	Grade 1035	G10350	---	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
ASME SA-29/SA-29M	Grade 1038	G10380	---	0.35-0.42	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1038	G10380	---	0.35-0.42	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1038	G10380	---	0.35-0.42	0.60-0.90	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C38D	---	1.0516	0.35-0.40	0.50-0.80	0.10-0.30	0.030	0.030	0.20	0.25	0.05	Al 0.01; Cu 0.30
EN ISO 16120-4:2011	C38D2	---	1.1150	0.36-0.40	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
JIS G 4051:2009	Symbol S38C	---	---	0.35-0.41	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
SAE J403 JUN14	Grade 1038	G10380	---	0.35-0.42	0.60-0.90	---	0.040	0.050	---	---	---	---

2.1 Chemical Composition of Carbon Steels for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1039	G10390	---	0.37-0.44	0.70-1.00	---	0.040	0.050	---	---	---	---
	Grade 1040	G10400	---	0.37-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1039	G10390	---	0.37-0.44	0.70-1.00	---	0.040	0.050	---	---	---	---
	Grade 1040	G10400	---	0.37-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1039	G10390	---	0.37-0.44	0.70-1.00	---	0.040	0.050	---	---	---	---
	Grade 1040	G10400	---	0.37-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
EN 10083-2:2006	C40E	---	1.1186	0.37-0.44	0.50-0.80	0.40	0.030	0.035	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
	C40R	---	1.1189	0.37-0.44	0.50-0.80	0.40	0.030	0.020-0.040	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
	C40	---	1.0511	0.37-0.44	0.50-0.80	0.40	0.045	0.045	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
EN ISO 16120-4:2011	C40D2	--	1.1153	0.38-0.42	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB 13791-92	Grade 40	---	---	0.37-0.44	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB/T 3078-94	Grade 40	---	---	0.37-0.44	0.60	0.20	0.035	0.035	---	---	---	---
	Grade 40Mn	---	---	0.37-0.44	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB/T 699-1999	Grade 40	---	---	0.37-0.44	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 40Mn	---	---	0.37-0.44	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
ISO 683-1:1987	Grade C 40	---	---	0.37-0.44	0.50-0.80	0.10-0.40	0.045	0.045	---	---	---	---
	Grade C 40 E4	---	---	0.37-0.44	0.50-0.80	0.10-0.40	0.035	0.035	---	---	---	---
	Grade C 40 M2	---	---	0.37-0.44	0.50-0.80	0.10-0.40	0.035	0.020-0.040	---	---	---	---
JIS G 4051:2009	Symbol S40C	---	---	0.37-0.43	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
SAE J403 JUN14	Grade 1039	G10390	---	0.37-0.44	0.70-1.00	---	0.040	0.050	---	---	---	---
	Grade 1040	G10400	---	0.37-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
ASME SA-29/SA-29M	Grade 1042	G10420	---	0.40-0.47	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1043	G10430	---	0.40-0.47	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1042	G10420	---	0.40-0.47	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1043	G10430	---	0.40-0.47	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1042	G10420	---	0.40-0.47	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1043	G10430	---	0.40-0.47	0.70-1.00	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C42D	---	1.0541	0.40-0.45	0.50-0.80	0.10-0.30	0.030	0.030	0.20	0.25	0.05	Al 0.01; Cu 0.30
EN ISO 16120-4:2011	C42D2	---	1.1154	0.40-0.44	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
JIS G 4051:2009	Symbol S43C	---	---	0.40-0.46	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
SAE J403 JUN14	Grade 1042	G10420	---	0.40-0.47	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1043	G10430	---	0.40-0.47	0.70-1.00	---	0.040	0.050	---	---	---	---

2.1 Chemical Composition of Carbon Steels for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1044	G10440	---	0.43-0.50	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1045	G10450	---	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1046	G10460	---	0.43-0.50	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1044	G10440	---	0.43-0.50	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1045	G10450	---	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1046	G10460	---	0.43-0.50	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1044	G10440	---	0.43-0.50	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1045	G10450	---	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1046	G10460	---	0.43-0.50	0.70-1.00	---	0.040	0.050	---	---	---	---
EN 10083-2:2006	C45E	---	1.1191	0.42-0.50	0.50-0.80	0.40	0.030	0.035	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
	C45R	---	1.1201	0.42-0.50	0.50-0.80	0.40	0.030	0.020-0.040	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
	C45	---	1.0503	0.42-0.50	0.50-0.80	0.40	0.045	0.045	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
EN ISO 16120-2:2011	C48D	---	1.0517	0.45-0.50	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
EN ISO 16120-4:2011	C46D2	---	1.1162	0.44-0.48	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
	C48D2	---	1.1164	0.46-0.50	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB 13791-92	Grade 45	---	---	0.42-0.50	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB/T 699-1999	Grade 45	---	---	0.42-0.50	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 45Mn	---	---	0.42-0.50	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB/T 3078-94	Grade 45	---	---	0.42-0.49	0.60	0.20	0.035	0.035	---	---	---	---
	Grade 45Mn	---	---	0.42-0.50	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
ISO 683-1:1987	Grade C 45	---	---	0.42-0.50	0.50-0.80	0.10-0.40	0.045	0.045	---	---	---	---
	Grade C 45 E4	---	---	0.42-0.50	0.50-0.80	0.10-0.40	0.035	0.035	---	---	---	---
	Grade C 45 M2	---	---	0.42-0.50	0.50-0.80	0.10-0.40	0.035	0.020-0.040	---	---	---	---
JIS G 4051:2009	Symbol S45C	---	---	0.42-0.48	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
	Symbol S48C	---	---	0.45-0.51	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
SAE J403 JUN14	Grade 1044	G10440	---	0.43-0.50	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1045	G10450	---	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1046	G10460	---	0.43-0.50	0.70-1.00	---	0.040	0.050	---	---	---	---

2.1 Chemical Composition of Carbon Steels for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1049	G10490	---	0.46-0.53	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1050	G10500	---	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1053	G10530	---	0.48-0.55	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1049	G10490	---	0.46-0.53	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1050	G10500	---	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1053	G10530	---	0.48-0.55	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1049	G10490	---	0.46-0.53	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1050	G10500	---	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1053	G10530	---	0.48-0.55	0.70-1.00	---	0.040	0.050	---	---	---	---
EN 10083-2:2006	C50E	---	1.1206	0.47-0.55	0.60-0.90	0.40	0.030	0.035	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
	C50R	---	1.1241	0.47-0.55	0.60-0.90	0.40	0.030	0.020-0.040	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
EN ISO 16120-2:2011	C50D	---	1.0586	0.48-0.53	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
EN ISO 16120-4:2011	C50D2	---	1.1171	0.48-0.52	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB 13791-92	Grade 50	---	---	0.47-0.55	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 50Mn	---	---	0.48-0.56	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB/T 3078-94	Grade 50	---	---	0.47-0.55	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 50Mn	---	---	0.48-0.56	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB/T 699-1999	Grade 50	---	---	0.47-0.55	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 50Mn	---	---	0.48-0.56	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
ISO 683-1:1987	Grade C 50	---	---	0.47-0.55	0.60-0.90	0.10-0.40	0.045	0.045	---	---	---	---
	Grade C 50 E4	---	---	0.47-0.55	0.60-0.90	0.10-0.40	0.035	0.035	---	---	---	---
	Grade C 50 M2	---	---	0.47-0.55	0.60-0.90	0.10-0.40	0.035	0.020-0.040	---	---	---	---
JIS G 4051:2009	Symbol S50C	---	---	0.47-0.53	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
SAE J403 JUN14	Grade 1049	G10490	---	0.46-0.53	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1050	G10500	---	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1053	G10530	---	0.48-0.55	0.70-1.00	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C52D	---	1.0588	0.50-0.55	0.50	0.80	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
EN ISO 16120-4:2011	C52D2	---	1.1202	0.50-0.54	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
JIS G 4051:2009	Symbol S53C	---	---	0.50-0.56	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35

2.1 Chemical Composition of Carbon Steels for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1055	G10550	---	0.50-0.60	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1055	G10550	---	0.50-0.60	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1055	G10550	---	0.50-0.60	0.60-0.90	---	0.040	0.050	---	---	---	---
EN 10083-2:2006	C55E	---	1.1203	0.52-0.60	0.60-0.90	0.40	0.030	0.035	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
	C55R	---	1.1209	0.52-0.60	0.60-0.90	0.40	0.030	0.020-0.040	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
	C55	---	1.0535	0.52-0.60	0.60-0.90	0.40	0.045	0.045	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
EN ISO 16120-2:2011	C56D	---	1.0518	0.53-0.58	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
EN ISO 16120-4:2011	C56D2	---	1.1220	0.54-0.58	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB/T 3078-94	Grade 55	---	---	0.52-0.60	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB/T 699-1999	Grade 55	---	---	0.52-0.60	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
ISO 683-1:1987	Grade C 55	---	---	0.52-0.60	0.60-0.90	0.10-0.40	0.045	0.045	---	---	---	---
	Grade C 55 E4	---	---	0.52-0.60	0.60-0.90	0.10-0.40	0.035	0.035	---	---	---	---
	Grade C 55 M2	---	---	0.52-0.60	0.60-0.90	0.10-0.40	0.035	0.020-0.040	---	---	---	---
JIS G 4051:2009	Symbol S55C	---	---	0.52-0.58	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
SAE J403 JUN14	Grade 1055	G10550	---	0.50-0.60	0.60-0.90	---	0.040	0.050	---	---	---	---

2.1 Chemical Composition of Carbon Steels for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1059	G10590	---	0.55-0.65	0.50-0.80	---	0.040	0.050	---	---	---	---
	Grade 1060	G10600	---	0.55-0.65	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1059	G10590	---	0.55-0.65	0.50-0.80	---	0.040	0.050	---	---	---	---
	Grade 1060	G10600	---	0.55-0.65	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1060	G10600	---	0.55-0.65	0.60-0.90	---	0.040	0.050	---	---	---	---
EN 10083-2:2006	C60E	---	1.1221	0.57-0.65	0.60-0.90	0.40	0.030	0.035	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
	C60R	---	1.1223	0.57-0.65	0.60-0.90	0.40	0.030	0.020-0.040	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
	C60	---	1.0601	0.57-0.65	0.60-0.90	0.40	0.045	0.045	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
EN ISO 16120-2:2011	C58D	---	1.0609	0.55-0.60	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
	C60D	---	1.0610	0.58-0.63	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
EN ISO 16120-4:2011	C58D2	---	1.1212	0.56-0.60	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
	C60D2	---	1.1228	0.58-0.62	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB 13791-92	Grade 60	---	---	0.57-0.65	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB/T 3078-94	Grade 60	---	---	0.57-0.65	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 60Mn	---	---	0.57-0.65	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB/T 699-1999	Grade 60	---	---	0.57-0.65	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 60Mn	---	---	0.57-0.65	0.70-1.00	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
ISO 683-1:1987	Grade C 60	---	---	0.57-0.65	0.60-0.90	0.10-0.40	0.045	0.045	---	---	---	---
	Grade C 60 E4	---	---	0.57-0.65	0.60-0.90	0.10-0.40	0.035	0.035	---	---	---	---
	Grade C 60 M2	---	---	0.57-0.65	0.60-0.90	0.10-0.40	0.035	0.020-0.040	---	---	---	---
JIS G 4051:2009	Symbol S58C	---	---	0.55-0.61	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
SAE J403 JUN14	Grade 1060	G10600	---	0.55-0.65	0.60-0.90	---	0.040	0.050	---	---	---	---

2.1 Chemical Composition of Carbon Steels for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1064	G10640	---	0.60-0.70	0.50-0.80	---	0.040	0.050	---	---	---	---
	Grade 1065	G10650	---	0.60-0.70	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1064	G10640	---	0.60-0.70	0.50-0.80	---	0.040	0.050	---	---	---	---
	Grade 1065	G10650	---	0.60-0.70	0.60-0.90	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C62D	---	1.0611	0.60-0.65	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
	C66D	---	1.0612	0.63-0.68	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
	C68D	---	1.0613	0.65-0.70	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
EN ISO 16120-4:2011	C62D2	---	1.1222	0.60-0.64	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
	C68D2	---	1.1232	0.66-0.70	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
	C66D2	---	1.1236	0.64-0.68	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB/T 3078-94	Grade 65	---	---	0.62-0.70	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 65Mn	---	---	0.62-0.70	0.90-1.20	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
GB/T 699-1999	Grade 65	---	---	0.62-0.70	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 65Mn	---	---	0.62-0.70	0.90-1.20	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
SAE J403 JUN14	Grade 1065	G10650	---	0.60-0.70	0.60-0.90	---	0.040	0.050	---	---	---	---
ASME SA-29/SA-29M	Grade 1069	G10690	---	0.65-0.75	0.40-0.70	---	0.040	0.050	---	---	---	---
	Grade 1070	G10700	---	0.65-0.75	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1071	---	---	0.65-0.70	0.75-1.05	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1069	G10690	---	0.65-0.75	0.40-0.70	---	0.040	0.050	---	---	---	---
	Grade 1070	G10700	---	0.65-0.75	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1071	---	---	0.65-0.70	0.75-1.05	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1070	G10700	---	0.65-0.75	0.60-0.90	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C70D	---	1.0615	0.68-0.73	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
	C72D	---	1.0617	0.70-0.75	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
EN ISO 16120-4:2011	C72D2	---	1.1242	0.70-0.74	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
	C70D2	---	1.1251	0.68-0.72	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB/T 699-1999	Grade 70	---	---	0.67-0.75	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
	Grade 70Mn	---	---	0.67-0.75	0.90-1.20	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
SAE J403 JUN14	Grade 1070	G10700	---	0.65-0.75	0.60-0.90	---	0.040	0.050	---	---	---	---

2.1 Chemical Composition of Carbon Steels for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1074	G10740	---	0.70-0.80	0.50-0.80	---	0.040	0.050	---	---	---	---
	Grade 1075	G10750	---	0.70-0.80	0.40-0.70	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1074	G10740	---	0.70-0.80	0.50-0.80	---	0.040	0.050	---	---	---	---
	Grade 1075	G10750	---	0.70-0.80	0.40-0.70	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C76D	---	1.0614	0.73-0.78	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
	C78D	---	1.0620	0.75-0.80	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
EN ISO 16120-4:2011	C78D2	---	1.1252	0.76-0.80	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
	C76D2	---	1.1253	0.74-0.78	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB/T 699-1999	Grade 75	---	---	0.72-0.80	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
SAE J403 JUN14	Grade 1074	G10740	---	0.70-0.80	0.50-0.80	---	0.040	0.050	---	---	---	---
	Grade 1075	G10750	---	0.70-0.80	0.40-0.70	---	0.040	0.050	---	---	---	---
ASME SA-29/SA-29M	Grade 1078	G10780	---	0.72-0.85	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1078	G10780	---	0.72-0.85	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1078	G10780	---	0.72-0.85	0.30-0.60	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C80D	---	1.0622	0.78-0.83	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
	C82D	---	1.0626	0.80-0.85	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
EN ISO 16120-4:2011	C80D2	---	1.1255	0.78-0.82	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
	C82D2	---	1.1262	0.80-0.84	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB/T 699-1999	Grade 80	---	---	0.77-0.85	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
SAE J403 JUN14	Grade 1078	G10780	---	0.72-0.85	0.30-0.60	---	0.040	0.050	---	---	---	---
ASME SA-29/SA-29M	Grade 1080	G10800	---	0.75-0.88	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1080	G10800	---	0.75-0.88	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1080	G10800	---	0.75-0.88	0.60-0.90	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C86D	---	1.0616	0.83-0.88	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
EN ISO 16120-4:2011	C86D2	---	1.1265	0.84-0.88	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
SAE J403 JUN14	Grade 1080	G10800	---	0.75-0.88	0.60-0.90	---	0.040	0.050	---	---	---	---
ASME SA-29/SA-29M	Grade 1084	G10840	---	0.80-0.93	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1086	G10860	---	0.80-0.93	0.30-0.50	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1084	G10840	---	0.80-0.93	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1086	G10860	---	0.80-0.93	0.30-0.50	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1084	G10840	---	0.80-0.93	0.60-0.90	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C88D	---	1.0628	0.85-0.90	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
EN ISO 16120-4:2011	C88D2	---	1.0628	0.86-0.90	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
GB/T 699-1999	Grade 85	---	---	0.82-0.90	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
SAE J403 JUN14	Grade 1084	G10840	---	0.80-0.93	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1086	G10860	---	0.80-0.93	0.30-0.50	---	0.040	0.050	---	---	---	---

2.1 Chemical Composition of Carbon Steels for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1090	G10900	---	0.85-0.98	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1090	G10900	---	0.85-0.98	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1090	G10900	---	0.85-0.98	0.60-0.90	---	0.040	0.050	---	---	---	---
EN ISO 16120-2:2011	C92D	---	1.0618	0.90-0.95	0.50-0.80	0.10-0.30	0.030	0.030	0.15	0.20	0.05	Al 0.01; Cu 0.25; (Cu+Sn) 0.25
EN ISO 16120-4:2011	C92D2	---	1.1282	0.90-0.94	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
SAE J403 JUN14	Grade 1090	G10900	---	0.85-0.98	0.60-0.90	---	0.040	0.050	---	---	---	---
ASME SA-29/SA-29M	Grade 1095	G10950	---	0.90-1.03	0.30-0.50	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1095	G10950	---	0.90-1.03	0.30-0.50	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1095	G10950	---	0.90-1.03	0.30-0.50	---	0.040	0.050	---	---	---	---
EN ISO 16120-4:2011	C98D2	---	1.1283	0.96-1.00	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.03	Al 0.01; Cu 0.15; N 0.007; (Cu+Ni+Cr) 0.30; (Cu+Sn) 0.15
SAE J403 JUN14	Grade 1095	G10950	---	0.90-1.03	0.30-0.50	---	0.040	0.050	---	---	---	---

2.2 Chemical Composition of High Manganese Carbon Steels for General Use

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1522	G15220	---	0.18-0.24	1.10-1.40	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1522	G15220	---	0.18-0.24	1.10-1.40	---	0.040	0.050	---	---	---	---
	Grade 1524	G15240	---	0.19-0.25	1.35-1.65	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1522	G15220	---	0.18-0.24	1.10-1.40	---	0.040	0.050	---	---	---	---
	Grade 1524	G15240	---	0.19-0.25	1.35-1.65	---	0.040	0.050	---	---	---	---
GB/T 3077-1999	Grade 20Mn2	---	---	0.17-0.24	1.40-1.80	0.17-0.37	0.035	0.035	0.30	0.30	0.15	Cu 0.30
GB/T 3078-94	Grade 20Mn2	---	---	0.17-0.24	1.40-1.80	0.17-0.37	0.035	0.035	0.30	0.30	0.15	Cu 0.30
ISO 683-1:1987	Grade 22 Mn 6	---	---	0.19-0.26	1.30-1.65	0.10-0.40	0.035	0.035	---	---	---	---
JIS G 4053:2008	Symbol SMn420	---	---	0.17-0.23	1.20-1.50	0.15-0.35	0.030	0.030	0.35	0.25	---	Cu 0.30
	Symbol SMnC420	---	---	0.17-0.23	1.20-1.50	0.15-0.35	0.030	0.030	0.35-0.70	0.25	---	Cu 0.30
SAE J403 JUN14	Grade 1522	G15220	---	0.18-0.24	1.10-1.40	---	0.040	0.050	---	---	---	---
	Grade 1524	G15240	---	0.19-0.25	1.35-1.65	---	0.040	0.050	---	---	---	---
EN 10083-2:2006	28Mn6	---	1.1170	0.25-0.32	1.30-1.65	0.40	0.030	0.035	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
GB/T 3077-1999	Grade 30Mn2	---	---	0.27-0.34	1.40-1.80	0.17-0.37	0.035	0.035	0.30	0.30	0.15	Cu 0.30
ISO 683-1:1987	Grade 28 Mn 6	---	---	0.25-0.32	1.30-1.65	0.10-0.40	0.035	0.035	---	---	---	---
ASME SA-29/SA-29M	Grade 1536	G15360	---	0.30-0.37	1.20-1.50	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1536	G15360	---	0.30-0.37	1.20-1.50	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1536	G15360	---	0.30-0.37	1.20-1.50	---	0.040	0.050	---	---	---	---
GB/T 3077-1999	Grade 35Mn2	---	---	0.32-0.39	1.40-1.80	0.17-0.37	0.035	0.035	0.30	0.30	0.15	Cu 0.30
GB/T 3078-94	Grade 35Mn2	---	---	0.32-0.39	1.40-1.80	0.17-0.37	0.035	0.035	0.30	0.30	0.15	Cu 0.30
JIS G 4053:2008	Symbol SMn433	---	---	0.30-0.36	1.20-1.50	0.15-0.35	0.030	0.030	0.35	0.25	---	Cu 0.30
SAE J403 JUN14	Grade 1536	G15360	---	0.30-0.37	1.20-1.50	---	0.040	0.050	---	---	---	---

2.2 Chemical Composition of High Manganese Carbon Steels for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1541	G15410	---	0.36-0.44	1.35-1.65	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1541	G15410	---	0.36-0.44	1.35-1.65	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1541	G15410	---	0.36-0.44	1.35-1.65	---	0.040	0.050	---	---	---	---
GB/T 3077-1999	Grade 40Mn2	---	---	0.37-0.44	1.40-1.80	0.17-0.37	0.035	0.035	0.30	0.30	0.15	Cu 0.30
GB/T 3078-94	Grade 40Mn2	---	---	0.37-0.44	1.40-1.80	0.17-0.37	0.035	0.035	0.30	0.30	0.15	Cu 0.30
ISO 683-1:1987	Grade 36 Mn 6	---	---	0.33-0.40	1.30-1.65	0.10-0.40	0.035	0.035	---	---	---	---
JIS G 4053:2008	Symbol SMn438	---	---	0.35-0.41	1.35-1.65	0.15-0.35	0.030	0.030	0.35	0.25	---	Cu 0.30
SAE J403 JUN14	Grade 1541	G15410	---	0.36-0.44	1.35-1.65	---	0.040	0.050	---	---	---	---
ISO 683-1:1987	Grade 42 Mn 6	---	---	0.39-0.46	1.30-1.65	0.10-0.40	0.035	0.035	---	---	---	---
JIS G 4053:2008	Symbol SMn443	---	---	0.40-0.46	1.35-1.65	0.15-0.35	0.030	0.030	0.35	0.25	---	Cu 0.30
ASTM A29/A29M-12e1	Grade 1547	G15470	---	0.43-0.51	1.35-1.65	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1547	G15470	---	0.43-0.51	1.35-1.65	---	0.040	0.050	---	---	---	---
GB/T 3077-1999	Grade 45Mn2	---	---	0.42-0.49	1.40-1.80	0.17-0.37	0.035	0.035	0.30	0.30	0.15	Cu 0.30
GB/T 3078-94	Grade 45Mn2	---	---	0.42-0.49	1.40-1.80	0.17-0.37	0.035	0.035	0.30	0.30	0.15	Cu 0.30
SAE J403 JUN14	Grade 1547	G15470	---	0.43-0.51	1.35-1.65	---	0.040	0.050	---	---	---	---
ASTM A29/A29M-12e1	Grade 1552	G15520	---	0.47-0.55	1.20-1.50	---	0.040	0.050	---	---	---	---
ASTM A576-90b (2012)	Grade 1552	G15520	---	0.47-0.55	1.20-1.50	---	0.040	0.050	---	---	---	---
GB/T 3077-1999	Grade 50Mn2	---	---	0.47-0.55	1.40-1.80	0.17-0.37	0.035	0.035	0.30	0.30	0.15	Cu 0.30
GB/T 3078-94	Grade 50Mn2	---	---	0.47-0.55	1.40-1.80	0.17-0.37	0.035	0.035	0.30	0.30	0.15	Cu 0.30
SAE J403 JUN14	Grade 1552	G15520	---	0.47-0.55	1.20-1.50	---	0.040	0.050	---	---	---	---

2.3 Chemical Composition of Alloy Steels for General Use

2.3.1 Chromium (Cr) Steels

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10084:2008	17CrS3	---	1.7014	0.14-0.20	0.60-0.90	0.40	0.025	0.020-0.040	0.70-1.00	---	---	---
	17Cr3	---	1.7016	0.14-0.20	0.60-0.90	0.40	0.025	0.035	0.70-1.00	---	---	---
GB/T 3077-1999	Grade 15Cr	---	---	0.12-0.18	0.40-0.70	0.17-0.37	0.035	0.035	0.70-1.00	0.30	0.15	Cu 0.30
	Grade 15CrA	---	---	0.12-0.17	0.40-0.70	0.17-0.37	0.025	0.025	0.70-1.00	0.30	0.10	Cu 0.25
GB/T 3078-94	Grade 15CrA	---	---	0.12-0.17	0.40-0.70	0.17-0.37	0.025	0.025	0.70-1.00	0.30	0.10	Cu 0.25
JIS G 4053:2008	Symbol SCr415	---	---	0.13-0.18	0.60-0.90	0.15-0.35	0.030	0.030	0.90-1.20	0.25	---	Cu 0.30
ASME SA-29/SA-29M	Grade 5120	G51200	---	0.17-0.22	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	---	---	---
ASTM A29/A29M-12e1	Grade 5120	G51200	---	0.17-0.22	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	---	---	---
ASTM A322-13	Grade 5120	G51200	---	0.17-0.22	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	---	---	---
GB 13791-92	Grade 20Cr	---	---	0.18-0.24	0.50-0.80	0.17-0.37	0.035	0.035	0.70-1.00	0.30	0.15	Cu 0.30
GB 5216-85	Grade 20CrH	---	---	0.17-0.23	0.50-0.85	0.17-0.37	0.035	0.035	0.70-1.10	0.30	---	Cu 0.30
GB/T 3077-1999	Grade 20Cr	---	---	0.18-0.24	0.50-0.80	0.17-0.37	0.035	0.035	0.70-1.00	0.30	0.15	Cu 0.30
GB/T 3078-94	Grade 20Cr	---	---	0.18-0.24	0.50-0.80	0.17-0.37	0.035	0.035	0.70-1.00	0.30	0.15	Cu 0.30
ISO 683-11:1987	Type 20 CrS 4	---	---	0.17-0.23	0.60-0.90	0.15-0.40	0.035	0.020-0.040	0.90-1.20	---	---	---
	Type 20 Cr 4	---	---	0.17-0.23	0.60-0.90	0.15-0.40	0.035	0.035	0.90-1.20	---	---	---
JIS G 4053:2008	Symbol SCr420	---	---	0.18-0.23	0.60-0.90	0.15-0.35	0.030	0.030	0.90-1.20	0.25	---	Cu 0.30
SAE J404 JAN09	Grade 5120	G51200	---	0.17-0.22	0.70-0.90	0.15-0.35	0.030	0.040	0.70-0.90	0.25	0.06	Cu 0.35
ASME SA-29/SA-29M	Grade 5130	G51300	---	0.28-0.33	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	---	---	---
ASTM A29/A29M-12e1	Grade 5130	G51300	---	0.28-0.33	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	---	---	---
ASTM A322-13	Grade 5130	G51300	---	0.28-0.33	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	---	---	---
EN 10084:2008	28Cr4	---	1.7030	0.24-0.31	0.60-0.90	0.40	0.025	0.035	0.90-1.20	---	---	---
	28CrS4	---	1.7036	0.24-0.31	0.60-0.90	0.40	0.025	0.020-0.040	0.90-1.20	---	---	---
GB/T 3077-1999	Grade 30Cr	---	---	0.27-0.34	0.50-0.80	0.17-0.37	0.035	0.035	0.80-1.10	0.30	0.15	Cu 0.30
GB/T 3078-94	Grade 30Cr	---	---	0.27-0.34	0.50-0.80	0.17-0.37	0.035	0.035	0.80-1.10	0.30	0.15	Cu 0.30
JIS G 4053:2008	Symbol SCr430	---	---	0.28-0.33	0.60-0.90	0.15-0.35	0.030	0.030	0.90-1.20	0.25	---	Cu 0.30
SAE J404 JAN09	Grade 5130	G51300	---	0.28-0.33	0.70-0.90	0.15-0.35	0.030	0.040	0.80-1.10	0.25	0.06	Cu 0.35

2.3 Chemical Composition of Alloy Steels for General Use (Continued)

2.3.1 Chromium (Cr) Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 5132	G51320	---	0.30-0.35	0.60-0.80	0.15-0.35	0.035	0.040	0.75-1.00	---	---	---
ASTM A29/A29M-12e1	Grade 5132	G51320	---	0.30-0.35	0.60-0.80	0.15-0.35	0.035	0.040	0.75-1.00	---	---	---
ASTM A322-13	Grade 5132	G51320	---	0.30-0.35	0.60-0.80	0.15-0.35	0.035	0.040	0.75-1.00	---	---	---
EN 10083-3:2006 C1:2008	34Cr4	---	1.7033	0.30-0.37	0.60-0.90	0.40	0.025	0.035	0.90-1.20	---	---	---
	34CrS4	---	1.7037	0.30-0.37	0.60-0.90	0.40	0.025	0.020-0.040	0.90-1.20	---	---	---
ISO 683-1:1987	Grade 34 Cr 4	---	---	0.30-0.37	0.60-0.90	0.10-0.40	0.035	0.035	0.90-1.20	---	---	---
	Grade 34 CrS 4	---	---	0.30-0.37	0.60-0.90	0.10-0.40	0.035	0.020-0.040	0.90-1.20	---	---	---
SAE J404 JAN09	Grade 5132	G51320	---	0.30-0.35	0.60-0.80	0.15-0.35	0.030	0.040	0.75-1.00	0.25	0.06	Cu 0.35
ASME SA-29/SA-29M	Grade 5135	G51350	---	0.33-0.38	0.60-0.80	0.15-0.35	0.035	0.040	0.80-1.05	---	---	---
ASTM A29/A29M-12e1	Grade 5135	G51350	---	0.33-0.38	0.60-0.80	0.15-0.35	0.035	0.040	0.80-1.05	---	---	---
ASTM A322-13	Grade 5135	G51350	---	0.33-0.38	0.60-0.80	0.15-0.35	0.035	0.040	0.80-1.05	---	---	---
EN 10083-3:2006 C1:2008	37Cr4	---	1.7034	0.34-0.41	0.60-0.90	0.40	0.025	0.035	0.90-1.20	---	---	---
	37CrS4	---	1.7038	0.34-0.41	0.60-0.90	0.40	0.025	0.020-0.040	0.90-1.20	---	---	---
GB/T 3077-1999	Grade 35Cr	---	---	0.32-0.39	0.50-0.80	0.17-0.37	0.035	0.035	0.80-1.10	0.30	0.15	Cu 0.30
GB/T 3078-94	Grade 35Cr	---	---	0.32-0.39	0.50-0.80	0.17-0.37	0.035	0.035	0.80-1.10	0.30	0.15	Cu 0.30
ISO 683-1:1987	Grade 37 Cr 4	---	---	0.34-0.41	0.60-0.90	0.10-0.40	0.035	0.035	0.90-1.20	---	---	---
	Grade 37 CrS 4	---	---	0.34-0.41	0.60-0.90	0.10-0.40	0.035	0.020-0.040	0.90-1.20	---	---	---
JIS G 4053:2008	Symbol SCr435	---	---	0.33-0.38	0.60-0.90	0.15-0.35	0.030	0.030	0.90-1.20	0.25	---	Cu 0.30
ASME SA-29/SA-29M	Grade 5140	G51400	---	0.38-0.43	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	---	---	---
ASTM A29/A29M-12e1	Grade 5140	G51400	---	0.38-0.43	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	---	---	---
ASTM A322-13	Grade 5140	G51400	---	0.38-0.43	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	---	---	---
EN 10083-3:2006 C1:2008	41Cr4	---	1.7035	0.38-0.45	0.60-0.90	0.40	0.025	0.035	0.90-1.20	---	---	---
	41CrS4	---	1.7039	0.38-0.45	0.60-0.90	0.40	0.025	0.020-0.040	0.90-1.20	---	---	---
GB/T 3077-1999	Grade 40Cr	---	---	0.37-0.44	0.50-0.80	0.17-0.37	0.035	0.035	0.80-1.10	0.30	0.15	Cu 0.30
GB/T 3078-94	Grade 40Cr	---	---	0.34-0.42	0.50-0.80	0.20	0.035	0.035	0.80-1.10	---	---	---
GB 5216-85	Grade 40CrH	---	---	0.37-0.44	0.50-0.85	0.17-0.37	0.035	0.035	0.70-1.10	0.30	---	Cu 0.30
GB 13791-92	Grade 40Cr	---	---	0.37-0.44	0.50-0.80	0.17-0.37	0.035	0.035	0.80-1.10	0.30	0.15	Cu 0.30
ISO 683-1:1987	Grade 41 Cr 4	---	---	0.38-0.45	0.60-0.90	0.10-0.40	0.035	0.035	0.90-1.20	---	---	---
	Grade 41 CrS 4	---	---	0.38-0.45	0.60-0.90	0.10-0.40	0.035	0.020-0.040	0.90-1.20	---	---	---
JIS G 4053:2008	Symbol SCr440	---	---	0.38-0.43	0.60-0.90	0.15-0.35	0.030	0.030	0.90-1.20	0.25	---	Cu 0.30
SAE J404 JAN09	Grade 5140	G51400	---	0.38-0.43	0.70-0.90	0.15-0.35	0.030	0.040	0.70-0.90	0.25	0.06	Cu 0.35

2.3 Chemical Composition of Alloy Steels for General Use (Continued)

2.3.1 Chromium (Cr) Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 5145	G51450	---	0.43-0.48	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	---	---	---
ASTM A29/A29M-12e1	Grade 5145	G51450	---	0.43-0.48	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	---	---	---
GB 5216-85	Grade 45CrH	---	---	0.42-0.49	0.50-0.85	0.17-0.37	0.035	0.035	0.70-1.10	0.30	---	Cu 0.30
GB/T 3077-1999	Grade 45Cr	---	---	0.42-0.49	0.50-0.80	0.17-0.37	0.035	0.035	0.80-1.10	0.30	0.15	Cu 0.30
GB/T 3078-94	Grade 45Cr	---	---	0.42-0.49	0.50-0.80	0.17-0.37	0.035	0.035	0.80-1.10	0.30	0.15	Cu 0.30
JIS G 4053:2008	Symbol SCr445	---	---	0.43-0.48	0.60-0.90	0.15-0.35	0.030	0.030	0.90-1.20	0.25	---	Cu 0.30
ASTM A29/A29M-12e1	Grade 5150	G51500	---	0.48-0.53	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	---	---	---
ASTM A322-13	Grade 5150	G51500	---	0.48-0.53	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	---	---	---
GB/T 3077-1999	Grade 50Cr	---	---	0.47-0.54	0.50-0.80	0.17-0.37	0.035	0.035	0.80-1.10	0.30	0.15	Cu 0.30
SAE J404 JAN09	Grade 5150	G51500	---	0.48-0.53	0.70-0.90	0.15-0.35	0.030	0.040	0.70-0.90	0.25	0.06	Cu 0.35

2.3 Chemical Composition of Alloy Steels for General Use (Continued)

2.3.2 Chromium-Molybdenum (Cr-Mo) Steels

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 4118	G41180	---	0.18-0.23	0.70-0.90	0.15-0.35	0.035	0.040	0.40-0.60	---	0.08-0.15	---
	Grade 4120	G41200	---	0.18-0.23	0.90-1.20	0.15-0.35	0.035	0.040	0.40-0.60	---	0.13-0.20	---
	Grade 4121	G41210	---	0.18-0.23	0.75-1.00	0.15-0.35	0.035	0.040	0.45-0.65	---	0.20-0.30	---
ASTM A29/A29M-12e1	Grade 4118	G41180	---	0.18-0.23	0.70-0.90	0.15-0.35	0.035	0.040	0.40-0.60	---	0.08-0.15	---
	Grade 4120	G41200	---	0.18-0.23	0.90-1.20	0.15-0.35	0.035	0.040	0.40-0.60	---	0.13-0.20	---
	Grade 4121	G41210	---	0.18-0.23	0.75-1.00	0.15-0.35	0.035	0.040	0.45-0.65	---	0.20-0.30	---
ASTM A322-13	Grade 4118	G41180	---	0.18-0.23	0.70-0.90	0.15-0.35	0.035	0.040	0.40-0.60	---	0.08-0.15	---
	Grade 4120	G41200	---	0.18-0.23	0.90-1.20	0.15-0.35	0.035	0.040	0.40-0.60	---	0.13-0.20	---
	Grade 4121	G41210	---	0.18-0.23	0.75-1.00	0.15-0.35	0.035	0.040	0.45-0.65	---	0.20-0.30	---
EN 10084:2008	18CrMo4	---	1.7243	0.15-0.21	0.60-0.90	0.40	0.025	0.035	0.90-1.20	---	0.15-0.25	---
	18CrMoS4	---	1.7244	0.15-0.21	0.60-0.90	0.40	0.025	0.020-0.040	0.90-1.20	---	0.15-0.25	---
	20MoCrS3	---	1.7319	0.17-0.23	0.60-0.90	0.40	0.025	0.020-0.040	0.40-0.70	---	0.30-0.40	---
	20MoCr3	---	1.7320	0.17-0.23	0.60-0.90	0.40	0.025	0.035	0.40-0.70	---	0.30-0.40	---
	20MoCr4	---	1.7321	0.17-0.23	0.70-1.00	0.40	0.025	0.035	0.30-0.60	---	0.40-0.50	---
	20MoCrS4	---	1.7323	0.17-0.23	0.70-1.00	0.40	0.025	0.020-0.040	0.30-0.60	---	0.40-0.50	---
	22CrMoS3-5	---	1.7333	0.19-0.24	0.70-1.00	0.40	0.025	0.020-0.040	0.70-1.00	---	0.40-0.50	---
GB/T 3077-1999	Grade 20CrMnMo	---	---	0.17-0.23	0.90-1.20	0.17-0.37	0.035	0.035	1.10-1.40	0.30	0.20-0.30	Cu 0.30
	Grade 20CrMo	---	---	0.17-0.24	0.40-0.70	0.17-0.37	0.035	0.035	0.80-1.10	0.30	0.15-0.25	Cu 0.30
GB/T 3078-94	Grade 20CrMnMo	---	---	0.17-0.23	0.90-1.20	0.17-0.37	0.035	0.035	1.10-1.40	0.30	0.20-0.30	Cu 0.30
	Grade 20CrMo	---	---	0.17-0.24	0.40-0.70	0.17-0.37	0.035	0.035	0.80-1.10	0.30	0.15-0.25	Cu 0.30
GB 5216-85	Grade 20CrMnMoH	---	---	0.17-0.23	0.85-1.20	0.17-0.37	0.035	0.035	1.05-1.40	0.30	0.20-0.30	Cu 0.30
GB 13791-92	Grade 20CrMo(A)	---	---	0.17-0.24	0.40-0.70	0.17-0.37	0.025	0.025	0.80-1.10	0.30	0.15-0.25	Cu 0.25
ISO 683-11:1987	Type 18 CrMo 4	---	---	0.15-0.21	0.60-0.90	0.15-0.40	0.035	0.035	0.90-1.20	---	0.15-0.25	---
	Type 18 CrMoS 4	---	---	0.15-0.21	0.60-0.90	0.15-0.40	0.035	0.020-0.040	0.90-1.20	---	0.15-0.25	---
JIS G 4053:2008	Symbol SCM418	---	---	0.16-0.21	0.60-0.90	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.25	Cu 0.30
	Symbol SCM420	---	---	0.18-0.23	0.60-0.90	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.25	Cu 0.30
	Symbol SCM421	---	---	0.17-0.23	0.70-1.00	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.25	Cu 0.30
	Symbol SCM822	---	---	0.20-0.25	0.60-0.90	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.35-0.45	Cu 0.30
SAE J404 JAN09	Grade 4118	G41180	---	0.18-0.23	0.70-0.90	0.15-0.35	0.030	0.040	0.40-0.60	0.25	0.08-0.15	Cu 0.35
	Grade 4120	G41200	---	0.18-0.23	0.90-1.20	0.15-0.35	0.030	0.040	0.40-0.60	0.25	0.13-0.20	Cu 0.35

2.3 Chemical Composition of Alloy Steels for General Use (Continued)

2.3.2 Chromium-Molybdenum (Cr-Mo) Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 4130	G41300	---	0.28-0.33	0.40-0.60	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A29/A29M-12e1	Grade 4130	G41300	---	0.28-0.33	0.40-0.60	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A322-13	Grade 4130	G41300	---	0.28-0.33	0.40-0.60	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
EN 10083-3:2006 C1:2008	25CrMoS4	---	1.7213	0.22-0.29	0.60-0.90	0.40	0.025	0.020-0.040	0.90-1.20	---	0.15-0.30	---
	25CrMo4	---	1.7218	0.22-0.29	0.60-0.90	0.40	0.025	0.035	0.90-1.20	---	0.15-0.30	---
GB/T 3077-1999	Grade 30CrMo	---	---	0.26-0.34	0.40-0.70	0.17-0.37	0.035	0.035	0.80-1.10	0.30	0.15-0.25	Cu 0.30
	Grade 30CrMoA	---	---	0.26-0.33	0.40-0.70	0.17-0.37	0.025	0.025	0.80-1.10	0.30	0.15-0.25	Cu 0.25
GB/T 3078-94	Grade 30CrMo	---	---	0.26-0.34	0.40-0.70	0.17-0.37	0.035	0.035	0.80-1.10	0.30	0.15-0.25	Cu 0.30
ISO 683-1:1987	Grade 25 CrMo 4	---	---	0.22-0.29	0.60-0.90	0.10-0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
	Grade 25 CrMoS 4	---	---	0.22-0.29	0.60-0.90	0.10-0.40	0.035	0.020-0.040	0.90-1.20	---	0.15-0.30	---
JIS G 4053:2008	Symbol SCM425	---	---	0.23-0.28	0.60-0.90	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.30	Cu 0.30
	Symbol SCM430	---	---	0.28-0.33	0.60-0.90	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.30	Cu 0.30
	Symbol SCM432	---	---	0.27-0.37	0.30-0.60	0.15-0.35	0.030	0.030	1.00-1.50	0.25	0.15-0.30	Cu 0.30
SAE J404 JAN09	Grade 4130	G41300	---	0.28-0.33	0.40-0.60	0.15-0.35	0.030	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
ASME SA-29/SA-29M	Grade 4137	G41370	---	0.35-0.40	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A29/A29M-12e1	Grade 4137	G41370	---	0.35-0.40	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A322-13	Grade 4137	G41370	---	0.35-0.40	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
EN 10083-3:2006 C1:2008	34CrMo4	---	1.7220	0.30-0.37	0.60-0.90	0.40	0.025	0.035	0.90-1.20	---	0.15-0.30	---
	34CrMoS4	---	1.7226	0.30-0.37	0.60-0.90	0.40	0.025	0.020-0.040	0.90-1.20	---	0.15-0.30	---
GB 13791-92	Grade 35CrMo(A)	---	---	0.32-0.40	0.40-0.70	0.17-0.37	0.025	0.025	0.80-1.10	0.30	0.15-0.25	Cu 0.25
GB/T 3077-1999	Grade 35CrMo	---	---	0.32-0.40	0.40-0.70	0.17-0.37	0.035	0.035	0.80-1.10	0.30	0.15-0.25	Cu 0.30
GB/T 3078-94	Grade 35CrMo	---	---	0.32-0.40	0.40-0.70	0.17-0.37	0.035	0.035	0.80-1.10	0.30	0.15-0.25	Cu 0.30
ISO 683-1:1987	Grade 34 CrMo 4	---	---	0.30-0.37	0.60-0.90	0.10-0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
	Grade 34 CrMoS 4	---	---	0.30-0.37	0.60-0.90	0.10-0.40	0.035	0.020-0.040	0.90-1.20	---	0.15-0.30	---
JIS G 4053:2008	Symbol SCM435	---	---	0.33-0.38	0.60-0.90	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.30	Cu 0.30
SAE J404 JAN09	Grade 4137	G41370	---	0.35-0.40	0.70-0.90	0.15-0.35	0.030	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35

2.3 Chemical Composition of Alloy Steels for General Use (Continued)

2.3.2 Chromium-Molybdenum (Cr-Mo) Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 4140	G41400	---	0.38-0.43	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A29/A29M-12e1	Grade 4140	G41400	---	0.38-0.43	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A322-13	Grade 4140	G41400	---	0.38-0.43	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
EN 10083-3:2006 C1:2008	42CrMo4	---	1.7225	0.38-0.45	0.60-0.90	0.40	0.025	0.035	0.90-1.20	---	0.15-0.30	---
	42CrMoS4	---	1.7227	0.38-0.45	0.60-0.90	0.40	0.025	0.020-0.040	0.90-1.20	---	0.15-0.30	---
GB/T 3077-1999	Grade 42CrMo	---	---	0.38-0.45	0.50-0.80	0.17-0.37	0.035	0.035	0.90-1.20	0.30	0.15-0.25	Cu 0.30
GB/T 3078-94	Grade 42CrMo	---	---	0.38-0.45	0.50-0.80	0.17-0.37	0.035	0.035	0.90-1.20	0.30	0.15-0.25	Cu 0.30
ISO 683-1:1987	Grade 42 CrMo 4	---	---	0.38-0.45	0.60-0.90	0.10-0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
	Grade 42 CrMoS 4	---	---	0.38-0.45	0.60-0.90	0.10-0.40	0.035	0.020-0.040	0.90-1.20	---	0.15-0.30	---
JIS G 4053:2008	Symbol SCM440	---	---	0.38-0.43	0.60-0.90	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.30	Cu 0.30
SAE J404 JAN09	Grade 4140	G41400	---	0.38-0.43	0.75-1.00	0.15-0.35	0.030	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
ASME SA-29/SA-29M	Grade 4145	G41450	---	0.43-0.48	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A29/A29M-12e1	Grade 4145	G41450	---	0.43-0.48	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A322-13	Grade 4145	G41450	---	0.43-0.48	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
JIS G 4053:2008	Symbol SCM445	---	---	0.43-0.48	0.60-0.90	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.30	Cu 0.30
SAE J404 JAN09	Grade 4145	G41450	---	0.43-0.48	0.75-1.00	0.15-0.35	0.030	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
ASME SA-29/SA-29M	Grade 4150	G41500	---	0.48-0.53	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A29/A29M-12e1	Grade 4150	G41500	---	0.48-0.53	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A322-13	Grade 4150	G41500	---	0.48-0.53	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
EN 10083-3:2006 C1:2008	50CrMo4	---	1.7228	0.46-0.54	0.50-0.80	0.40	0.025	0.035	0.90-1.20	---	0.15-0.30	---
ISO 683-1:1987	Grade 50 CrMo 4	---	---	0.46-0.54	0.50-0.80	0.10-0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
JIS G 7105:2000	Type 50CrMo4	---	---	0.46-0.54	0.50-0.80	0.10-0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
SAE J404 JAN09	Grade 4150	G41500	---	0.48-0.53	0.75-1.00	0.15-0.35	0.030	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35

2.3.3 Chromium-Nickel (Cr-Ni) Steels

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10084:2008	15NiCr13	---	1.5752	0.14-0.20	0.40-0.70	0.40	0.025	0.035	0.60-0.90	3.00-3.50	---	---
GB/T 3077-1999	Grade 12CrNi3	---	---	0.10-0.17	0.30-0.60	0.17-0.37	0.035	0.035	0.60-0.90	2.75-3.15	---	---
ISO 683-11:1987	Type 15 NiCr 13	---	---	0.12-0.18	0.35-0.65	0.15-0.40	0.035	0.035	0.60-0.90	3.00-3.50	---	---
JIS G 4053:2008	Symbol SNC815	---	---	0.12-0.18	0.35-0.65	0.15-0.35	0.030	0.030	0.60-1.00	3.00-3.50	---	Cu 0.30
GB/T 3077-1999	Grade 30CrNi3	---	---	0.27-0.33	0.30-0.60	0.17-0.37	---	---	0.60-0.90	2.75-3.15	---	---
JIS G 4053:2008	Symbol SNC631	---	---	0.27-0.35	0.35-0.65	0.15-0.35	0.030	0.030	0.60-1.00	2.50-3.00	---	Cu 0.30

2.3 Chemical Composition of Alloy Steels for General Use (Continued)

2.3.4 Nickel-Chromium-Molybdenum (Ni-Cr-Mo) Steels

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 683-11:1987	Type 17 NiCrMo 6	---	---	0.14-0.20	0.60-0.90	0.15-0.40	0.035	0.035	0.80-1.10	1.20-1.60	0.15-0.25	---
JIS G 4053:2008	Symbol SNCM415	---	---	0.12-0.18	0.40-0.70	0.15-0.35	0.030	0.030	0.40-0.60	1.60-2.00	0.15-0.30	Cu 0.30
ASME SA-29/SA-29M	Grade 4320	G43200	---	0.17-0.22	0.45-0.65	0.15-0.35	0.035	0.040	0.40-0.60	1.65-2.00	0.20-0.30	---
ASTM A29/A29M-12e1	Grade 4320	G43200	---	0.17-0.22	0.45-0.65	0.15-0.35	0.035	0.040	0.40-0.60	1.65-2.00	0.20-0.30	---
ASTM A322-13	Grade 4320	G43200	---	0.17-0.22	0.45-0.65	0.15-0.35	0.035	0.040	0.40-0.60	1.65-2.00	0.20-0.30	---
EN 10084:2008	20NiCrMoS6-4	---	1.6571	0.16-0.23	0.50-0.90	0.40	0.025	0.020-0.040	0.60-0.90	1.40-1.70	0.25-0.35	---
GB/T 3077-1999	Grade 20CrNiMo	---	---	0.17-0.23	0.60-0.95	0.17-0.37	0.035	0.035	0.40-0.70	0.35-0.75	0.20-0.30	---
JIS G 4053:2008	Symbol SNCM420	---	---	0.17-0.23	0.40-0.70	0.15-0.35	0.030	0.030	0.40-0.60	1.60-2.00	0.15-0.30	Cu 0.30
SAE J404 JAN09	Grade 4320	G43200	---	0.17-0.22	0.45-0.65	0.15-0.35	0.030	0.040	0.40-0.60	1.65-2.00	0.20-0.30	Cu 0.35
ASME SA-29/SA-29M	Grade 4340	G43400	---	0.38-0.43	0.60-0.80	0.15-0.35	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
	Grade E4340	G43406	---	0.38-0.43	0.65-0.85	0.15-0.35	0.025	0.025	0.70-0.90	1.65-2.00	0.20-0.30	---
ASTM A29/A29M-12e1	Grade 4340	G43400	---	0.38-0.43	0.60-0.80	0.15-0.35	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
	Grade E4340	G43406	---	0.38-0.43	0.65-0.85	0.15-0.35	0.025	0.025	0.70-0.90	1.65-2.00	0.20-0.30	---
ASTM A322-13	Grade 4340	G43400	---	0.38-0.43	0.60-0.80	0.15-0.35	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
	Grade E4340	G43406	---	0.38-0.43	0.65-0.85	0.15-0.35	0.025	0.025	0.70-0.90	1.65-2.00	0.20-0.30	---
GB/T 3077-1999	Grade 40CrNiMoA	---	---	0.37-0.44	0.50-0.80	0.17-0.37	0.025	0.025	0.60-0.90	1.25-1.65	0.15-0.25	Cu 0.25
GB/T 3078-94	Grade 40CrNiMoA	---	---	0.37-0.44	0.50-0.80	0.17-0.37	0.025	0.025	0.60-0.90	1.25-1.65	0.15-0.25	Cu 0.25
JIS G 4053:2008	Symbol SNCM439	---	---	0.36-0.43	0.60-0.90	0.15-0.35	0.030	0.030	0.60-1.00	1.60-2.00	0.15-0.30	Cu 0.30
SAE J404 JAN09	Grade 4340	G43400	---	0.38-0.43	0.60-0.80	0.15-0.35	0.030	0.040	0.70-0.90	1.65-2.00	0.20-0.30	Cu 0.35
	Grade E4340	G43406	---	0.38-0.43	0.65-0.85	0.15-0.35	0.025	0.025	0.70-0.90	1.65-2.00	0.20-0.30	Cu 0.35
ASME SA-29/SA-29M	Grade 8620	G86200	---	0.18-0.23	0.70-0.90	0.15-0.35	0.035	0.040	0.40-0.60	0.40-0.70	0.15-0.25	---
ASTM A29/A29M-12e1	Grade 8620	G86200	---	0.18-0.23	0.70-0.90	0.15-0.35	0.035	0.040	0.40-0.60	0.40-0.70	0.15-0.25	---
ASTM A322-13	Grade 8620	G86200	---	0.18-0.23	0.70-0.90	0.15-0.35	0.035	0.04	0.40-0.60	0.40-0.70	0.15-0.25	---
EN 10084:2008	20NiCrMo2-2	---	1.6523	0.17-0.23	0.65-0.95	0.40	0.025	0.035	0.35-0.70	0.40-0.70	0.15-0.25	---
	20NiCrMoS2-2	---	1.6526	0.17-0.23	0.65-0.95	0.40	0.025	0.020-0.040	0.35-0.70	0.40-0.70	0.15-0.25	---
GB 5216-85	Grade 20CrNiMoH	---	---	0.17-0.23	0.60-0.95	0.17-0.37	0.035	0.035	0.35-0.65	0.35-0.75	0.15-0.25	Cu 0.30
ISO 683-11:1987	Type 20 NiCrMo 2	---	---	0.17-0.23	0.65-0.95	0.15-0.4	0.035	0.035	0.30-0.65	0.40-0.70	0.15-0.25	---
	Type 20 NiCrMoS 2	---	---	0.17-0.23	0.65-0.95	0.15-0.4	0.035	0.020-0.040	0.30-0.65	0.40-0.70	0.15-0.25	---
JIS G 4053:2008	Symbol SNCM220	---	---	0.17-0.23	0.60-0.90	0.15-0.35	0.030	0.030	0.40-0.60	0.40-0.70	0.15-0.25	Cu 0.30
SAE J404 JAN09	Grade 8620	G86200	---	0.18-0.23	0.70-0.90	0.15-0.35	0.030	0.040	0.40-0.60	0.40-0.70	0.15-0.25	Cu 0.35

2.3 Chemical Composition of Alloy Steels for General Use (Continued)

2.3.4 Nickel-Chromium-Molybdenum (Ni-Cr-Mo) Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
ASME SA-29/SA-29M	Grade 8640	G86400	---	0.38-0.43	0.75-1.00	0.15-0.35	0.035	0.040	0.40-0.60	0.40-0.70	0.15-0.25	---
ASTM A29/A29M-12e1	Grade 8640	G86400	---	0.38-0.43	0.75-1.00	0.15-0.35	0.035	0.040	0.40-0.60	0.40-0.70	0.15-0.25	---
ASTM A322-13	Grade 8640	G86400	---	0.38-0.43	0.75-1.00	0.15-0.35	0.035	0.040	0.40-0.60	0.40-0.70	0.15-0.25	---
ISO 683-1:1987	Grade 41 CrNiMo 2	---	---	0.37-0.44	0.70-1.00	0.10-0.40	0.035	0.035	0.40-0.60	0.40-0.70	0.15-0.30	---
	Grade 41 CrNiMoS 2	---	---	0.37-0.44	0.70-1.00	0.10-0.40	0.035	0.020-0.040	0.40-0.60	0.40-0.70	0.15-0.30	---
JIS G 4053:2008	Symbol SNCM240	---	---	0.38-0.43	0.70-1.00	0.15-0.35	0.030	0.030	0.40-0.60	0.40-0.70	0.15-0.30	Cu 0.30
SAE J404 JAN09	Grade 8640	G86400	---	0.38-0.43	0.75-1.00	0.15-0.35	0.030	0.040	0.40-0.60	0.40-0.70	0.15-0.25	Cu 0.35
ASME SA-29/SA-29M	Grade E9310	G93106	---	0.08-0.13	0.45-0.65	0.15-0.30	0.025	0.025	1.00-1.40	3.00-3.50	0.08-0.15	---
ASTM A29/A29M-12e1	Grade E9310	G93106	---	0.08-0.13	0.45-0.65	0.15-0.30	0.025	0.025	1.00-1.40	3.00-3.50	0.08-0.15	---
EN 10084:2008	14NiCrMo13-4	---	1.6657	0.11-0.17	0.30-0.60	0.40	0.025	0.035	0.80-1.10	3.00-3.50	0.20-0.30	---

2.3.5 Chromium-Molybdenum-Aluminum (Cr-Mo-Al) Steels

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
ASTM A355-89 (2012)	Class A	K24065	---	0.38-0.43	0.50-0.70	0.15-0.35	0.035	0.040	1.40-1.80	---	0.30-0.40	Al 0.95-1.30
EN 10085:2001	32CrAlMo7-10	---	1.8505	0.28-0.35	0.40-0.70	0.40	0.025	0.035	1.50-1.80	---	0.20-0.40	Al 0.80-1.20
	34CrAlMo5-10	---	1.8507	0.30-0.37	0.40-0.70	0.40	0.025	0.035	1.00-1.30	---	0.15-0.25	Al 0.80-1.20
	41CrAlMo7-10	---	1.8509	0.38-0.45	0.40-0.70	0.40	0.025	0.035	1.50-1.80	---	0.20-0.35	Al 0.80-1.20
	34CrAlNi7-10	---	1.8550	0.30-0.37	0.40-0.70	0.40	0.025	0.035	1.50-1.80	0.85-1.15	0.15-0.25	Al 0.80-1.20
GB/T 3077-1999	Grade 38CrMoAl	---	---	0.35-0.42	0.30-0.60	0.20-0.45	0.035	0.035	1.35-1.65	0.30	0.15-0.25	Al 0.70-1.10; Cu 0.30
GB/T 3078-94	Grade 38CrMoAlA	---	---	0.35-0.42	0.30-0.60	0.20-0.45	0.025	0.025	1.35-1.65	0.30	0.15-0.25	Al 0.70-1.10; Cu 0.25
ISO 683-10:1987	Type 41 CrAlMo 74	---	---	0.38-0.45	0.50-0.80	0.50	0.030	0.035	1.50-1.80	---	0.15-0.30	Al 0.8-1.20
JIS G 4053:2008	Symbol SACM645	---	---	0.40-0.50	0.60	0.15-0.50	0.030	0.030	1.30-1.70	0.25	0.15-0.30	Al 0.70-1.20; Cu 0.30

2.3 Chemical Composition of Alloy Steels for General Use (Continued)

2.3.6 Boron (B) Steels

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A29/A29M-12e1	Grade 10B18	G10181	---	0.15-0.20	0.60-0.90	---	0.040	0.050	---	---	---	B 0.0005-0.003
EN 10263-3:2001 C1:2001	Grade 18B2	---	1.5503	0.16-0.20	0.60-0.80	0.30	0.025	0.025	---	---	---	B 0.0008-0.005; Cu 0.25
EN 10263-4:2001 C2:2003	Grade 17B2	---	1.5502	0.15-0.20	0.60-0.90	0.30	0.025	0.025	0.30	---	---	B 0.0008-0.005; Cu 0.25
SAE J403 JUN14	Grade 10B18	G10181	---	0.15-0.20	0.60-0.90	---	0.040	0.050	---	---	---	B 0.0005-0.003
ASTM A29/A29M-12e1	Grade 10B23	G10231	---	0.20-0.25	0.30-0.60	---	0.040	0.050	---	---	---	B 0.0005-0.003
EN 10263-4:2001 C2:2003	Grade 23B2	---	1.5508	0.20-0.25	0.60-0.90	0.30	0.025	0.025	0.30	---	---	B 0.0008-0.005; Cu 0.25
SAE J403 JUN14	Grade 10B23	G10231	---	0.20-0.25	0.30-0.60	---	0.040	0.050	---	---	---	B 0.0005-0.003
ASTM A29/A29M-12e1	Grade 10B29	G10291	---	0.25-0.31	0.60-0.90	---	0.040	0.050	---	---	---	B 0.0005-0.003
EN 10263-4:2001 C2:2003	Grade 28B2	---	1.5510	0.25-0.30	0.60-0.90	0.30	0.025	0.025	0.30	---	---	B 0.0008-0.005; Cu 0.25
SAE J403 JUN14	Grade 10B29	G10291	---	0.25-0.31	0.60-0.90	---	0.040	0.050	---	---	---	B 0.0005-0.003
ASTM A29/A29M-12e1	Grade 10B30	G10301	---	0.28-0.34	0.60-0.90	---	0.040	0.050	---	---	---	B0.0005-0.003
EN 10263-4:2001 C2:2003	Grade 33B2	---	1.5514	0.30-0.35	0.60-0.90	0.30	0.025	0.025	0.30	---	---	B 0.0008-0.005; Cu 0.25
SAE J403 JUN14	Grade 10B30	G10301	---	0.28-0.34	0.60-0.90	---	0.040	0.050	---	---	---	B0.0005-0.003
ASTM A29/A29M-12e1	Grade 10B38	G10381	---	0.35-0.42	0.60-0.90	---	0.040	0.050	---	---	---	B 0.0005-0.003
EN 10263-4:2001 C2:2003	Grade 38B2	---	1.5515	0.35-0.40	0.60-0.90	0.15-0.30	0.025	0.025	0.30	---	---	B 0.0008-0.005; Cu 0.25
EN 10269:2013	Grade 35B2	---	1.5511	0.32-0.39	0.50-0.80	0.40	0.030	0.015	---	---	---	B 0.0008-0.0050; Al 0.020 min.
SAE J403 JUN14	Grade 10B38	G10381	---	0.35-0.42	0.60-0.90	---	0.040	0.050	---	---	---	B 0.0005-0.003
ASTM A29/A29M-12e1	Grade 10B40	G10401	---	0.37-0.44	0.60-0.90	---	0.040	0.050	---	---	---	B 0.0005-0.003
GB/T 3077-1999	Grade 40B	---	---	0.37-0.44	0.60-0.90	0.17-0.37	0.035	0.035	0.30	0.30	0.15	B 0.0005-0.0035; Cu 0.30
GB/T 3078-94	Grade 40B	---	---	0.37-0.44	0.60-0.90	0.17-0.37	0.035	0.035	0.30	0.30	0.15	B 0.0005-0.0035; Cu 0.30
SAE J403 JUN14	Grade 10B40	G10401	---	0.37-0.44	0.60-0.90	---	0.040	0.050	---	---	---	B 0.0005-0.003
ASTM A29/A29M-12e1	Grade 10B45	G10451	---	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	B 0.0005-0.003
GB/T 3077-1999	Grade 45B	---	---	0.42-0.49	0.60-0.90	0.17-0.37	0.035	0.035	0.30	0.30	0.15	B 0.0005-0.0035; Cu 0.30
GB/T 3078-94	Grade 45B	---	---	0.42-0.49	0.60-0.90	0.17-0.37	0.035	0.035	0.30	0.30	0.15	B 0.0005-0.0035; Cu 0.30
SAE J403 JUN14	Grade 10B45	G10451	---	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	B 0.0005-0.003
ASTM A29/A29M-12e1	Grade 10B50	G10501	---	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	B 0.0005-0.003
GB 13791-92	Grade 50B	---	---	0.47-0.55	0.60-0.90	0.17-0.37	0.035	0.035	0.30	0.30	0.15	B 0.0005-0.0035; Cu 0.30
GB/T 3077-1999	Grade 50B	---	---	0.47-0.55	0.60-0.90	0.17-0.37	0.035	0.035	0.30	0.30	0.15	B 0.0005-0.0035; Cu 0.30
GB/T 3078-94	Grade 50B	---	---	0.47-0.55	0.60-0.90	0.17-0.37	0.035	0.035	0.30	0.30	0.15	B 0.0005-0.0035; Cu 0.30
SAE J403 JUN14	Grade 10B50	G10501	---	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	B 0.0005-0.0035
ASTM A29/A29M-12e1	Grade 15B22	G15221	---	0.18-0.24	1.10-1.40	---	0.040	0.050	---	---	---	B 0.0005-0.003
EN 10083-3:2006 C1:2008	Grade 20MnB5	---	1.5530	0.17-0.23	1.10-1.40	0.40	0.025	0.035	---	---	---	B 0.0008-0.0050
SAE J403 JUN14	Grade 15B22	G15221	---	0.18-0.24	1.10-1.40	---	0.040	0.050	---	---	---	B 0.0005-0.003

2.3 Chemical Composition of Alloy Steels for General Use (Continued)

2.3.6 Boron (B) Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 50B44	G50441	---	0.43-0.48	0.75-1.00	0.15-0.35	0.035	0.040	0.20-0.60	---	---	B 0.0005-0.003
	Grade 50B46	G50461	---	0.44-0.49	0.75-1.00	0.15-0.35	0.035	0.040	0.20-0.35	---	---	B 0.0005-0.003
	Grade 50B50	G50501	---	0.48-0.53	0.75-1.00	0.15-0.35	0.035	0.040	0.40-0.60	---	---	B 0.0005-0.003
ASTM A29/A29M-12e1	Grade 50B44	G50441	---	0.43-0.48	0.75-1.00	0.15-0.35	0.035	0.040	0.20-0.60	---	---	B 0.0005-0.003
	Grade 50B46	G50461	---	0.44-0.49	0.75-1.00	0.15-0.35	0.035	0.040	0.20-0.35	---	---	B 0.0005-0.003
	Grade 50B50	G50501	---	0.48-0.53	0.75-1.00	0.15-0.35	0.035	0.040	0.40-0.60	---	---	B 0.0005-0.003
ASTM A322-13	Grade 50B44	G50441	---	0.43-0.48	0.75-1.00	0.15-0.35	0.035	0.040	0.20-0.60	---	---	B 0.0005-0.003
	Grade 50B46	G50461	---	0.44-0.49	0.75-1.00	0.15-0.35	0.035	0.040	0.20-0.35	---	---	B 0.0005-0.003
	Grade 50B50	G50501	---	0.48-0.53	0.75-1.00	0.15-0.35	0.035	0.040	0.40-0.60	---	---	B 0.0005-0.003
ASTM A29/A29M-12e1	Grade 51B35	G51351	---	0.33-0.38	0.60-0.80	0.15-0.35	0.035	0.040	0.80-1.05	---	---	B 0.0005-0.003
EN 10263-4:2001 C2:2003	Grade 36CrB4	---	1.7077	0.34-0.38	0.70-1.00	0.30	0.025	0.025	0.90-1.20	---	---	B 0.0008-0.005; Cu 0.25
ASME SA-29/SA-29M	Grade 50B60	G50601	---	0.56-0.64	0.75-1.00	0.15-0.35	0.035	0.040	0.40-0.60	---	---	B 0.0005-0.003
	Grade 51B60	G51601	---	0.56-0.64	0.75-1.00	0.15-0.35	0.035	0.040	0.70-0.90	---	---	B 0.0005-0.003
ASTM A29/A29M-12e1	Grade 50B60	G50601	---	0.56-0.64	0.75-1.00	0.15-0.35	0.035	0.040	0.40-0.60	---	---	B 0.0005-0.003
	Grade 51B60	G51601	---	0.56-0.64	0.75-1.00	0.15-0.35	0.035	0.040	0.70-0.90	---	---	B 0.0005-0.003
ASTM A322-13	Grade 50B60	G50601	---	0.56-0.64	0.75-1.00	0.15-0.35	0.035	0.040	0.40-0.60	---	---	B 0.0005-0.003
	Grade 51B60	G51601	---	0.56-0.64	0.75-1.00	0.15-0.35	0.035	0.040	0.70-0.90	---	---	B 0.0005-0.003
SAE J404 JAN09	Grade 51B60	G51601	---	0.56-0.64	0.75-1.00	0.15-0.35	0.030	0.040	0.70-0.90	0.25	0.06	B 0.0005-0.003; Cu 0.35

2.3.7 Chromium-Vanadium (Cr-V) Steels

Specification	Designation	UNS No.	Steel No.	Weight, %max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 6150	G61500	---	0.48-0.53	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	---	---	V 0.15 min.
ASTM A29/A29M-12e1	Grade 6150	G61500	---	0.48-0.53	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	---	---	V 0.15 min.
ASTM A322-13	Grade 6150	G61500	---	0.48-0.53	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	---	---	V 0.15 min.
EN 10083-3:2006 C1:2008	51CrV4	---	1.8159	0.47-0.55	0.70-1.10	0.40	0.025	0.025	0.90-1.20	---	---	V 0.10-0.25
GB/T 3077-1999	Grade 50CrVA	---	---	0.47-0.54	0.50-0.80	0.17-0.37	0.025	0.025	0.80-1.10	0.30	0.10	V 0.10-0.20
ISO 683-1:1987	Grade 51 CrV 4	---	---	0.47-0.50	0.60-1.00	0.10-0.40	0.035	0.035	0.80-1.10	---	---	V 0.10-0.25
SAE J404 JAN09	Grade 6150	G61500	---	0.48-0.53	0.70-0.90	0.15-0.35	0.030	0.040	0.80-1.10	0.25	0.06	V 0.15 min.; Cu 0.35

Chapter

3

STRUCTURAL STEEL PLATES

ASME Standards

ASME SA-36/SA-36M	Carbon Structural Steel
ASME SA-283/SA-283M	Low and Intermediate Tensile Strength Carbon Steel Plates
ASME SA-572/SA-572M	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASME SA-1011/SA-1011M	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

ASTM Standards

ASTM A36/A36M-14	Carbon Structural Steel
ASTM A242/A242M-13	High-Strength Low-Alloy Structural Steel
ASTM A283/A283M-13	Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A514/A514M-14	High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A529/A529M-14	High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A572/A572M-15	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A573/A573M-13	Structural Carbon Steel Plates of Improved Toughness
ASTM A588/A588M-15	High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A606/A606M-09a	Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A633/A633M-13	Normalized High-Strength Low-Alloy Structural Steel Plates
ASTM A656/A656M-13	Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability
ASTM A709/A709M-13a	Structural Steel for Bridges
ASTM A710/A710M-02 (2013)	Precipitation-Strengthened Low-Carbon Nickel-Copper-Chromium-Molybdenum-Columbium Alloy Structural Steel Plates
ASTM A871/A871M-14	High-Strength Low-Alloy Structural Steel Plate with Atmospheric Corrosion Resistance
ASTM A1011/A1011M-14	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

CSA Standard

CSA G40.21-13	Structural Quality Steel - Plates, Sheet, Floor Plates, Bars, and Welded Shapes

EN Standard

EN 10025-2:2004	Hot rolled products of structural steels – Part 2: Technical delivery conditions for non-alloy structural steels

GB Standards

GB 700-88	Carbon Structural Steels
GB 711-88	Hot-Rolled Quality Carbon Structural Steel Plates and Wide Strips
GB 712-2000	Hull Structural Steel
GB/T 1591-94	High Strength Low Alloy Structural Steels
GB/T 3524-92	Hot-Rolled Carbon and Low Alloy Structural Steel Strips
GB 11251-89	Hot-Rolled Alloy Structural Steel Plates
GB/T 16270-1996	High Strength Structural Steel Plates and Strips: Products Supplied in the Heat-Treated or Controlled Rolled Condition
GB/T 18982-2003	Corrosion Resistant Steel Plates and Strips for Container

ISO Standards

ISO 630:1995 A1:2003	Structural Steels - Plates, Wide Flats, Bars, Sections and Profiles
ISO 4950-2:1995 A1:2003	High Yield Strength Flat Steel Products, Part 2: Products Supplied in the Normalized or Controlled Rolled Condition
ISO 4950-3:1995 A1:2003	High Yield Strength Flat Steel Products – Part 3: Products Supplied in the Heat-Treated (Quenched + Tempered) Condition
ISO 4952:2006	Structural Steels with Improved Atmospheric Corrosion Resistance - Second Edition
ISO 5952:2005	Continuously Hot-Rolled Steel Sheet of Structural Quality with Improved Atmospheric Corrosion Resistance

JIS Standards

JIS G 3101:2010	Rolled steels for general structure
JIS G 3106:2008	Rolled steels for welded structure
JIS G 3114:2008	Hot-rolled atmospheric corrosion resisting steels for welded structure
JIS G 3125:2010	Superior atmospheric corrosion resisting rolled steels
JIS G 3128:2009	High yield strength steel plates for welded structure
JIS G 3136:2012	Rolled steels for building structure

Heat Treatment Terms Applicable to this Chapter

Standard	Heat Treatment Terms
ASME SA-36/SA-36M	---
ASME SA-283/SA-283M	---
ASME SA-572/SA-572M	---
ASME SA-1011/SA-1011M	HR: hot-rolled
ASTM A36/A36M-14	SR: stress relieved
ASTM A242/A242M-13	---
ASTM A283/A283M-13	---
ASTM A514/A514M-14	QT: quenched and tempered; SR: stress relieved
ASTM A529/A529M-14	---
ASTM A572/A572M-15	---
ASTM A573/A573M-13	---
ASTM A588/A588M-15	---
ASTM A606/A606M-09a	HR: hot-rolled (as-rolled); CR: cold-rolled; A: annealed; N: normalized; HR+A: hot-rolled and annealed; HR+N: hot rolled and normalized
ASTM A633/A633M-13	N: normalized; NN: double normalized
ASTM A656/A656M-13	HR: hot-rolled
ASTM A709/A709M-13a	QT: quenched and tempered; AR: as rolled; CtR: control rolled; TMCP: thermo-mechanical control processed;
ASTM A710/A710M-02 (2013)	PHT: precipitation heat treatment; N+PHT: normalized followed by precipitation heat treatment; Q+PHT: quenched followed by precipitation heat treatment
ASTM A871/A871M-14	N: normalized; QT: quenched and tempered; AR: as rolled
ASTM A1011/A1011M-14	HR: hot-rolled
CSA G40.21-13	AR: as-rolled; QT: quenched and tempered; N: normalized; CtR: control rolled; SR: stress relieved; A: annealed;
EN 10025-2:2004	N: normalized rolled; TMCP: thermos-mechanically rolled; AR: as rolled
GB 700-88	HR: hot-rolled; CtR: control-rolled; N: normalized
GB 711-88	HR: hot-rolled; N: normalized; A: annealed; T: tempered
GB 712-2000	N: normalized; TMCP: thermo-mechanically control processed; HR: hot-rolled; CtR: controlled-rolled; QT: quenched and tempered
GB/T 1591-94	HR: hot-rolled; CtR: control rolled; N: normalized; NT: normalized and tempered; QT: quenched and tempered
GB/T 3524-92	HR: hot-rolled
GB 11251-89	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered;
GB/T 16270-1996	CtR: control rolled; N: normalized; QT: quenched and tempered; NT: normalized and tempered
GB/T 18982-2003	HR: hot-rolled; CR: cold-rolled
ISO 630:1995 A1:2003	AR: as rolled; N: normalized or equivalent (obtained by controlled rolling); BA: by agreement
ISO 4950-2:1995 A1:2003	N: normalized; NT: normalized and tempered; CtR: controlled rolled condition
ISO 4950-3:1995 A1:2003	QT: quenched and tempered
ISO 4952:2006	AR: as rolled; N: normalized or equivalent (obtained by controlled rolling)
ISO 5952:2005	HR: hot-rolled
JIS G 3101:2010	HR: hot-rolled
JIS G 3106:2008	N: normalized; QHT: quench-hardened and tempered; T: tempered; TMCP: thermo-mechanical control processed
JIS G 3114:2008	N: normalized; QT: quenched and tempered; TMCP: thermo-mechanical control processed; T: tempered
JIS G 3125:2010	CR: cold-rolled; HR: hot-rolled
JIS G 3128:2009	QT: quenched and tempered
JIS G 3136:2012	N: normalized; T: tempered; TMCP: thermo-mechanical control processed

Impact Testing Notes Applicable to this Chapter

see standard for supplementary impact testing: the standard includes impact testing as a supplementary requirement (optional to the purchaser).
 see standard for impact data: impact testing requirements are listed in the standard for multiple test temperatures.

3.1 Carbon Steels for Structural Steel Plates

3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ISO 630:1995 A1:2003	Grade E 185 (Fe 310), Quality 0	---	---	$3 \leq t \leq 16$	---	185	---	300-540	---	18	AR	---
				$16 < t \leq 25$	---	175	---	300-540	---	18	AR	---
ASME SA-283/SA-283M	Grade A	K01400	---	---	---	165	24	310-415	45-60	30	---	---
EN 10025-2:2004	S185	---	1.0035	$t < 3$	---	185	---	310-540	---	---	AR, N or TMCP	---
				$3 < t \leq 16$	---	185	---	290-510	---	18 L, 16 T	AR, N or TMCP	---
				$16 < t \leq 40$	---	175	---	290-510	---	18 L, 16 T	AR, N or TMCP	---
				$40 < t \leq 63$	---	175	---	290-510	---	17 L, 15 T	AR, N or TMCP	---
				$63 < t \leq 80$	---	175	---	290-510	---	16 L, 14 T	AR, N or TMCP	---
				$80 < t \leq 100$	---	175	---	290-510	---	16 L, 14 T	AR, N or TMCP	---
				$100 < t \leq 150$	---	165	---	280-500	---	15 L, 13 T	AR, N or TMCP	---
				$150 < t \leq 200$	---	155	---	270-490	---	15 L, 13 T	AR, N or TMCP	---
				$200 < t \leq 250$	---	145	---	270-490	---	15 L, 13 T	AR, N or TMCP	---
GB 700-88	Grade Q195	---	---	$t \leq 16$	---	---	---	315-390	---	33	HR, CtR or N	---
				$16 < t \leq 40$	---	---	---	315-390	---	32	HR, CtR or N	---
				$t > 40$	---	---	---	315-390	---	---	HR, CtR or N	---
GB 711-88	Grade 08F	---	---	$t \leq 60$	---	---	---	315	---	34	N, A, T or HR	---
GB/T 3524-92	Grade Q195	---	---	---	---	195	---	315-430	---	33	HR	---
GB 711-88	Grade 08	---	---	$t \leq 60$	---	---	---	325	---	33	N, A, T or HR	---
	Grade 10F	---	---	$t \leq 60$	---	---	---	325	---	32	N, A, T or HR	---
	Grade 10	---	---	$t \leq 60$	---	---	---	335	---	32	N, A, T or HR	---
JIS G 3101:2010	Symbol SS330	---	---	$t \leq 16$	---	205	---	330-430	---	see standard	HR	---
				$16 < t \leq 40$	---	195	---	330-430	---	see standard	HR	---
				$40 < t \leq 100$	---	175	---	330-430	---	see standard	HR	---
				$t > 100$	---	165	---	330-430	---	see standard	HR	---

Note: This section continued on next page.

3.1 Carbon Steels for Structural Steel Plates

3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 700-88	Grade Q215A	---	---	$t \leq 16$	---	215	---	335-410	---	31	HR or CtR	---
				$16 < t \leq 40$	---	205	---	335-410	---	30	HR or CtR	---
				$40 < t \leq 60$	---	195	---	335-410	---	29	HR or CtR	---
				$60 < t \leq 100$	---	185	---	335-410	---	28	HR or CtR	---
				$100 < t \leq 150$	---	175	---	335-410	---	27	HR or CtR	---
				$t > 150$	---	165	---	335-410	---	26	HR or CtR	---
	Grade Q215B	---	---	$t \leq 16$	---	215	---	335-410	---	31	HR, CtR or N	L: 27 J @ 20°C
				$16 < t \leq 40$	---	205	---	335-410	---	30	HR, CtR or N	L: 27 J @ 20°C
				$40 < t \leq 60$	---	195	---	335-410	---	29	HR, CtR or N	L: 27 J @ 20°C
				$60 < t \leq 100$	---	185	---	335-410	---	28	HR, CtR or N	L: 27 J @ 20°C
				$100 < t \leq 150$	---	175	---	335-410	---	27	HR, CtR or N	L: 27 J @ 20°C
				$t > 150$	---	165	---	335-410	---	26	HR, CtR or N	L: 27 J @ 20°C
GB/T 3524-92	Grade Q215A	---	---	---	---	215	---	335-450	---	31	HR	---
	Grade Q215B	---	---	---	---	215	---	335-450	---	31	HR	---
ASME SA-1011/SA-1011M	Grade 30 [205], SS	---	---	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	205	30	340 L	49 L	21 L	HR	---
				$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$	205	30	340 L	49 L	24 L	HR	---
				$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$	205	30	340 L	49 L	25 L	HR	---
ASTM A1011/A1011M-14	Grade 30 [205], SS	---	---	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	205	30	340 L	49 L	21 L	HR	---
				$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$	205	30	340 L	49 L	24 L	HR	---
				$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$	205	30	340 L	49 L	25 L	HR	---
ISO 630:1995 A1:2003	Grade E 235 (Fe 360), Quality A	---	---	$3 \leq t \leq 16$	---	235	---	340-470	---	26	AR	---
				$16 < t \leq 40$	---	225	---	340-470	---	26	AR	---
				$40 < t \leq 63$	---	215	---	340-470	---	25	AR	---
				$63 < t \leq 80$	---	215	---	340-470	---	24	AR	---
				$80 < t \leq 100$	---	215	---	340-470	---	24	AR	---
				$100 < t \leq 150$	---	195	---	340-470	---	22	AR	---
				$150 < t \leq 200$	---	185	---	340-470	---	21	AR	---
	Grade E 235 (Fe 360), Quality B	---	---	$3 \leq t \leq 16$	---	235	---	340-470	---	26	AR	---
	Grade E 235 (Fe 360), Quality B NF	---	---	$16 < t \leq 25$	---	225	---	340-470	---	26	AR	---
				$3 \leq t \leq 16$	---	235	---	340-470	---	26	AR	27 J @ 20°C
				$16 < t \leq 40$	---	225	---	340-470	---	26	AR	27 J @ 20°C
				$40 < t \leq 63$	---	215	---	340-470	---	25	AR	27 J @ 20°C
				$63 < t \leq 80$	---	215	---	340-470	---	24	AR	27 J @ 20°C
				$80 < t \leq 100$	---	215	---	340-470	---	24	AR	27 J @ 20°C
				$100 < t \leq 150$	---	195	---	340-470	---	22	AR	27 J @ 20°C
				$150 < t \leq 200$	---	185	---	340-470	---	21	AR	27 J @ 20°C

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3.1 Carbon Steels for Structural Steel Plates

3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ISO 630:1995 A1:2003	Grade E 235 (Fe 360), Quality C	---	---	$3 \leq t \leq 16$	---	235	---	340-470	---	26	AR	27 J @ 0°C
				$16 < t \leq 40$	---	225	---	340-470	---	26	AR	27 J @ 0°C
				$40 < t \leq 63$	---	215	---	340-470	---	25	AR	27 J @ 0°C
				$63 < t \leq 80$	---	215	---	340-470	---	24	AR	27 J @ 0°C
				$80 < t \leq 100$	---	215	---	340-470	---	24	AR	27 J @ 0°C
				$100 < t \leq 150$	---	195	---	340-470	---	22	AR	27 J @ 0°C
				$150 < t \leq 200$	---	185	---	340-470	---	21	AR	27 J @ 0°C
	Grade E 235 (Fe 360), Quality D	---	---	$3 \leq t \leq 16$	---	235	---	340-470	---	26	N or BA	27 J @ -20°C
				$16 < t \leq 40$	---	225	---	340-470	---	26	N or BA	27 J @ -20°C
				$40 < t \leq 63$	---	215	---	340-470	---	25	N or BA	27 J @ -20°C
				$63 < t \leq 80$	---	215	---	340-470	---	24	N or BA	27 J @ -20°C
				$80 < t \leq 100$	---	215	---	340-470	---	24	N or BA	27 J @ -20°C
				$100 < t \leq 150$	---	195	---	340-470	---	22	N or BA	27 J @ -20°C
				$150 < t \leq 200$	---	185	---	340-470	---	21	N or BA	27 J @ -20°C
ASME SA-283/SA-283M	Grade B	K01702	---	---	---	185	27	345-450	50-65	28	---	---

3.1 Carbon Steels for Structural Steel Plates

3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 711-88	Grade 15F	---	---	$t \leq 60$	---	---	---	355	---	30	N, A, T or HR	---
ASME SA-1011/SA-1011M	Grade 33 [230], SS	---	---	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	230	33	360 L	52 L	18 L	HR	---
				$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$	230	33	360 L	52 L	22 L	HR	---
				$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$	230	33	360 L	52 L	23 L	HR	---
ASTM A1011/A1011M-14	Grade 33 [230], SS	---	---	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	230	33	360 L	52 L	18 L	HR	---
				$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$	230	33	360 L	52 L	22 L	HR	---
				$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$	230	33	360 L	52 L	23 L	HR	---
EN 10025-2:2004	S235JR	---	1.0038	$t < 3$	---	235	---	360-510	---	---	AR, N or TMCP	---
				$3 \leq t \leq 16$	---	235	---	360-510	---	26 L, 24 T	AR, N or TMCP	L: 27 J @ 20°C
				$16 < t \leq 40$	---	225	---	360-510	---	26 L, 24 T	AR, N or TMCP	L: 27 J @ 20°C
				$40 < t \leq 63$	---	215	---	360-510	---	25 L, 24 T	AR, N or TMCP	L: 27 J @ 20°C
				$63 < t \leq 80$	---	215	---	360-510	---	24 L, 22 T	AR, N or TMCP	L: 27 J @ 20°C
				$80 < t \leq 100$	---	215	---	360-510	---	24 L, 22 T	AR, N or TMCP	L: 27 J @ 20°C
				$100 < t \leq 150$	---	195	---	350-500	---	22 L, 22 T	AR, N or TMCP	L: 27 J @ 20°C
				$150 < t \leq 200$	---	185	---	340-490	---	21 L, 21 T	AR, N or TMCP	L: 27 J @ 20°C
	S235J0	---	1.0114	$t < 3$	---	235	---	360-510	---	---	AR, N or TMCP	---
				$3 \leq t \leq 16$	---	235	---	360-510	---	26 L, 24 T	AR, N or TMCP	L: 27 J @ 0°C
				$16 < t \leq 40$	---	225	---	360-510	---	26 L, 24 T	AR, N or TMCP	L: 27 J @ 0°C
				$40 < t \leq 63$	---	215	---	360-510	---	25 L, 24 T	AR, N or TMCP	L: 27 J @ 0°C
				$63 < t \leq 80$	---	215	---	360-510	---	24 L, 22 T	AR, N or TMCP	L: 27 J @ 0°C
				$80 < t \leq 100$	---	215	---	360-510	---	24 L, 22 T	AR, N or TMCP	L: 27 J @ 0°C
				$100 < t \leq 150$	---	195	---	350-500	---	22 L, 22 T	AR, N or TMCP	L: 27 J @ 0°C
				$150 < t \leq 200$	---	185	---	340-490	---	21 L, 21 T	AR, N or TMCP	L: 27 J @ 0°C
				$200 < t \leq 250$	---	175	---	340-490	---	21 L, 21 T	AR, N or TMCP	L: 27 J @ 0°C
ASME SA-1011/SA-1011M	Grade 36 [250], Type 1, SS	---	---	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	250	36	365 L	53 L	17 L	HR	---
				$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$	250	36	365 L	53 L	21 L	HR	---
				$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$	250	36	365 L	53 L	22 L	HR	---
ASTM A1011/A1011M-14	Grade 36 [250], Type 1, SS	---	---	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	250	36	365 L	53 L	17 L	HR	---
				$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$	250	36	365 L	53 L	21 L	HR	---
				$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$	250	36	365 L	53 L	22 L	HR	---
GB 711-88	Grade 15	---	---	$t \leq 60$	---	---	---	370	---	30	N, A, T or HR	---

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3.1 Carbon Steels for Structural Steel Plates

3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 700-88	Grade Q235A	---	---	$t \leq 16$	---	235	---	375-460	---	26	HR or CtR	---
				$16 < t \leq 40$	---	225	---	375-460	---	25	HR or CtR	---
				$40 < t \leq 60$	---	215	---	375-460	---	24	HR or CtR	---
				$60 < t \leq 100$	---	205	---	375-460	---	23	HR or CtR	---
				$100 < t \leq 150$	---	195	---	375-460	---	22	HR or CtR	---
				$t > 150$	---	185	---	375-460	---	21	HR or CtR	---
	Grade Q235B	---	---	$t \leq 16$	---	235	---	375-460	---	26	HR, CtR or N	L: 27 J @ 20°C
				$16 < t \leq 40$	---	225	---	375-460	---	25	HR, CtR or N	L: 27 J @ 20°C
				$40 < t \leq 60$	---	215	---	375-460	---	24	HR, CtR or N	L: 27 J @ 20°C
				$60 < t \leq 100$	---	205	---	375-460	---	23	HR, CtR or N	L: 27 J @ 20°C
				$100 < t \leq 150$	---	195	---	375-460	---	22	HR, CtR or N	L: 27 J @ 20°C
				$t > 150$	---	185	---	375-460	---	21	HR, CtR or N	L: 27 J @ 20°C
	Grade Q235C	---	---	$t \leq 16$	---	235	---	375-460	---	26	HR, CtR or N	L: 27 J @ 0°C
				$16 < t \leq 40$	---	225	---	375-460	---	25	HR, CtR or N	L: 27 J @ 0°C
				$40 < t \leq 60$	---	215	---	375-460	---	24	HR, CtR or N	L: 27 J @ 0°C
				$60 < t \leq 100$	---	205	---	375-460	---	23	HR, CtR or N	L: 27 J @ 0°C
				$100 < t \leq 150$	---	195	---	375-460	---	22	HR, CtR or N	L: 27 J @ 0°C
				$t > 150$	---	185	---	375-460	---	21	HR, CtR or N	L: 27 J @ 0°C
	Grade Q235D	---	---	$t \leq 16$	---	235	---	375-460	---	26	HR, CtR or N	L: 27 J @ -20°C
				$16 < t \leq 40$	---	225	---	375-460	---	25	HR, CtR or N	L: 27 J @ -20°C
				$40 < t \leq 60$	---	215	---	375-460	---	24	HR, CtR or N	L: 27 J @ -20°C
				$60 < t \leq 100$	---	205	---	375-460	---	23	HR, CtR or N	L: 27 J @ -20°C
				$100 < t \leq 150$	---	195	---	375-460	---	22	HR, CtR or N	L: 27 J @ -20°C
				$t > 150$	---	185	---	375-460	---	21	HR, CtR or N	L: 27 J @ -20°C
GB/T 3524-92	Grade Q235A	---	---	---	---	235	---	375-500	---	26	HR	---
	Grade Q235B	---	---	---	---	235	---	375-500	---	26	HR	---
GB 711-88	Grade 20F	---	---	$t \leq 60$	---	---	---	380	---	27	N, A, T or HR	---
ASME SA-283/SA-283M	Grade C	K02401	---	---	---	205	30	380-515	55-75	25	---	---
ASTM A283/A283M-13	Grade C	K02401	---	---	---	205	30	380-515	55-75	25	---	---
ASME SA-1011/SA-1011M	Grade 40 [275], SS	---	---	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	275	40	380 L	55 L	15 L	HR	---
				$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$	275	40	380 L	55 L	20 L	HR	---
				$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$	275	40	380 L	55 L	21 L	HR	---
ASTM A1011/A1011M-14	Grade 40 [275], SS	---	---	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	275	40	380 L	55 L	15 L	HR	---
				$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$	275	40	380 L	55 L	20 L	HR	---
				$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$	275	40	380 L	55 L	21 L	HR	---

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3.1 Carbon Steels for Structural Steel Plates

3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A573/A573M-13	Grade 58 [400]	K02301	---	$t \leq 40$	$t \leq 1.5$	220	32	400-490	58-71	24	---	---
GB 712-2000	Grade A	---	---	---	---	235	---	400-520	---	22	N, TMCP, HR or CtR	see standard for impact data
	Grade B	---	---	---	---	235	---	400-520	---	22	N, TMCP, HR or CtR	
	Grade D	---	---	---	---	235	---	400-520	---	22	N, TMCP, HR or CtR	
	Grade E	---	---	---	---	235	---	400-520	---	22	see standard	
JIS G 3136:2012	Grade SN400A	---	---	$6 \leq t < 16$	---	235	---	400-510	---	17	N, T or TMCP	---
				$16 \leq t \leq 40$	---	235	---	400-510	---	21	N, T or TMCP	---
				$40 < t \leq 100$	---	215	---	400-510	---	23	N, T or TMCP	---
	Grade SN400B	---	---	$6 \leq t < 12$	---	235	---	400-510	---	18	N, T or TMCP	---
				$12 \leq t \leq 16$	---	235-355	---	400-510	---	18	N, T or TMCP	L: 27 J @ 0°C
				$16 < t \leq 40$	---	235-355	---	400-510	---	22	N, T or TMCP	L: 27 J @ 0°C
				$40 < t \leq 100$	---	215-335	---	400-510	---	24	N, T or TMCP	L: 27 J @ 0°C
	Grade SN400C	---	---	$6 \leq t < 16$	---	---	---	400-510	---	18	N, T or TMCP	---
				$16 \leq t \leq 40$	---	235-355	---	400-510	---	22	N, T or TMCP	L: 27 J @ 0°C
				$40 < t \leq 100$	---	215-335	---	400-510	---	24	N, T or TMCP	L: 27 J @ 0°C
JIS G 3101:2010	Symbol SS400	---	---	$t \leq 16$	---	245	---	400-510	---	see standard	HR	---
				$16 < t \leq 40$	---	235	---	400-510	---	see standard	HR	---
				$40 < t \leq 100$	---	215	---	400-510	---	see standard	HR	---
				$t > 100$	---	205	---	400-510	---	see standard	HR	---
JIS G 3106:2008	Grade SM400A	---	---	$t \leq 5$	---	245	---	400-510	---	23	N, QHT, T or TMCP	---
				$5 < t \leq 16$	---	245	---	400-510	---	18	N, QHT, T or TMCP	---
				$16 < t \leq 40$	---	235	---	400-510	---	22	N, QHT, T or TMCP	---
				$40 < t \leq 100$	---	215	---	400-510	---	24	N, QHT, T or TMCP	---
				$100 < t \leq 160$	---	205	---	400-510	---	24	N, QHT, T or TMCP	---
				$160 < t \leq 200$	---	195	---	400-510	---	24	N, QHT, T or TMCP	---
	Grade SM400B	---	---	$t \leq 5$	---	245	---	400-510	---	23	N, QHT, T or TMCP	---
				$5 < t \leq 16$	---	245	---	400-510	---	18	N, QHT, T or TMCP	L: 27 J @ 0°C
				$16 < t \leq 40$	---	235	---	400-510	---	22	N, QHT, T or TMCP	L: 27 J @ 0°C
				$40 < t \leq 100$	---	215	---	400-510	---	24	N, QHT, T or TMCP	L: 27 J @ 0°C
				$100 < t \leq 160$	---	205	---	400-510	---	24	N, QHT, T or TMCP	L: 27 J @ 0°C
				$160 < t \leq 200$	---	195	---	400-510	---	24	N, QHT, T or TMCP	L: 27 J @ 0°C
	Grade SM400C	---	---	$t \leq 5$	---	245	---	400-510	---	23	N, QHT, T or TMCP	---
				$5 < t \leq 16$	---	245	---	400-510	---	18	N, QHT, T or TMCP	L: 47 J @ 0°C
				$16 < t \leq 40$	---	235	---	400-510	---	22	N, QHT, T or TMCP	L: 47 J @ 0°C
				$40 < t \leq 100$	---	215	---	400-510	---	24	N, QHT, T or TMCP	L: 47 J @ 0°C
				$100 < t \leq 200$	---	---	---	400-510	---	24	N, QHT, T or TMCP	L: 47 J @ 0°C

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3.1 Carbon Steels for Structural Steel Plates

3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-36/SA-36M	---	K02595	---	100 < t ≤ 200	4 < t ≤ 8	250	36	400-550	58-80	23	---	---
				t > 200	t > 8	220	32	400-550	58-80	23	---	---
		K02596	---	65 < t ≤ 100	2.5 < t ≤ 4	250	36	400-550	58-80	23	---	---
		K02597	---	40 < t ≤ 65	1.5 < t ≤ 2.5	250	36	400-550	58-80	23	---	---
		K02598	---	20 < t ≤ 40	0.75 < t ≤ 1.5	250	36	400-550	58-80	23	---	---
		K02599	---	t ≤ 20	t ≤ 0.75	250	36	400-550	58-80	23	---	---
ASME SA-1011/SA-1011M	Grade 36 [250], Type 2, SS	---	---	0.65 ≤ t < 1.6	0.025 ≤ t < 0.064	250	36	400-550 L	58-80 L	16 L	HR	---
				1.6 ≤ t < 2.5	0.064 ≤ t < 0.097	250	36	400-550 L	58-80 L	20 L	HR	---
				2.5 ≤ t < 6.0	0.097 ≤ t < 0.230	250	36	400-550 L	58-80 L	21 L	HR	---
ASTM A36/A36M-14	---	K02595	---	100 < t ≤ 200	4 < t ≤ 8	250	36	400-550	58-80	23	SR or none	---
				t > 200	t > 8	220	32	400-550	58-80	23	SR or none	---
		K02596	---	65 < t ≤ 100	2.5 < t ≤ 4	250	36	400-550	58-80	23	SR or none	---
		K02597	---	40 < t ≤ 65	1.5 < t ≤ 2.5	250	36	400-550	58-80	23	SR or none	---
		K02598	---	20 < t ≤ 40	0.75 < t ≤ 1.5	250	36	400-550	58-80	23	SR or none	---
		K02599	---	t ≤ 20	t ≤ 0.75	250	36	400-550	58-80	23	SR or none	---
ASTM A709/A709M-13a	Grade 36 [250]	---	---	t ≤ 75	t ≤ 3	250	36	400	58	21	---	see standard for impact data
				t ≤ 100	t ≤ 4	250	36	400-550	58-80	23	QT	
				t > 75	t > 3	250	36	400	58	19	---	
ASTM A1011/A1011M-14	Grade 36 [250], Type 2, SS	---	---	0.65 ≤ t < 1.6	0.025 ≤ t < 0.064	250	36	400-550 L	58-80 L	16 L	HR	---
				1.6 ≤ t < 2.5	0.064 ≤ t < 0.097	250	36	400-550 L	58-80 L	20 L	HR	---
				2.5 ≤ t < 6.0	0.097 ≤ t < 0.230	250	36	400-550 L	58-80 L	21 L	HR	---

3.1 Carbon Steels for Structural Steel Plates

3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 711-88	Grade 20	---	---	$t \leq 60$	---	---	---	410	---	28	N, A, T or HR	---
GB 700-88	Grade Q255A	---	---	$t \leq 16$	---	255	---	410-510	---	24	HR or CtR	---
				$16 < t \leq 40$	---	245	---	410-510	---	23	HR or CtR	---
				$40 < t \leq 60$	---	235	---	410-510	---	22	HR or CtR	---
				$60 < t \leq 100$	---	225	---	410-510	---	21	HR or CtR	---
				$100 < t \leq 150$	---	215	---	410-510	---	20	HR or CtR	---
				$t > 150$	---	205	---	410-510	---	19	HR or CtR	---
	Grade Q255B	---	---	$t \leq 16$	---	255	---	410-510	---	24	HR, CtR or N	L: 27 J @ 20°C
				$16 < t \leq 40$	---	245	---	410-510	---	23	HR, CtR or N	L: 27 J @ 20°C
				$40 < t \leq 60$	---	235	---	410-510	---	22	HR, CtR or N	L: 27 J @ 20°C
				$60 < t \leq 100$	---	225	---	410-510	---	21	HR, CtR or N	L: 27 J @ 20°C
				$100 < t \leq 150$	---	215	---	410-510	---	20	HR, CtR or N	L: 27 J @ 20°C
				$t > 150$	---	205	---	410-510	---	19	HR, CtR or N	L: 27 J @ 20°C
GB/T 3524-92	Grade Q255A	---	---	---	---	255	---	410-550	---	24	HR	---
	Grade Q255B	---	---	---	---	255	---	410-550	---	24	HR	---
ISO 630:1995 A1:2003	Grade E 275 (Fe 430), Quality A	---	---	$3 \leq t \leq 16$	---	275	---	410-540	---	22	AR	---
				$16 < t \leq 40$	---	265	---	410-540	---	22	AR	---
				$40 < t \leq 63$	---	255	---	410-540	---	21	AR	---
				$63 < t \leq 80$	---	245	---	410-540	---	20	AR	---
				$80 < t \leq 100$	---	235	---	410-540	---	20	AR	---
				$100 < t \leq 150$	---	225	---	410-540	---	18	AR	---
				$150 < t \leq 200$	---	215	---	410-540	---	17	AR	---
	Grade E 275 (Fe 430), Quality B	---	---	$3 \leq t \leq 16$	---	275	---	410-540	---	22	AR	27 J @ 20°C
				$16 < t \leq 40$	---	265	---	410-540	---	22	AR	27 J @ 20°C
				$40 < t \leq 63$	---	255	---	410-540	---	21	AR	27 J @ 20°C
				$63 < t \leq 80$	---	245	---	410-540	---	20	AR	27 J @ 20°C
				$80 < t \leq 100$	---	235	---	410-540	---	20	AR	27 J @ 20°C
				$100 < t \leq 150$	---	225	---	410-540	---	18	AR	27 J @ 20°C
				$150 < t \leq 200$	---	215	---	410-540	---	17	AR	27 J @ 20°C
	Grade E 275 (Fe 430), Quality C	---	---	$3 \leq t \leq 16$	---	275	---	410-540	---	22	AR	27 J @ 0°C
				$16 < t \leq 40$	---	265	---	410-540	---	22	AR	27 J @ 0°C
				$40 < t \leq 63$	---	255	---	410-540	---	21	AR	27 J @ 0°C
				$63 < t \leq 80$	---	245	---	410-540	---	20	AR	27 J @ 0°C
				$80 < t \leq 100$	---	235	---	410-540	---	20	AR	27 J @ 0°C
				$100 < t \leq 150$	---	225	---	410-540	---	18	AR	27 J @ 0°C
				$150 < t \leq 200$	---	215	---	410-540	---	17	AR	27 J @ 0°C

Note: This section continued on next page.

3.1 Carbon Steels for Structural Steel Plates

3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ISO 630:1995 A1:2003	Grade E 275 (Fe 430), Quality D	---	---	$3 \leq t \leq 16$	---	275	---	410-540	---	22	N or BA	27 J @ -20°C
				$16 < t \leq 40$	---	265	---	410-540	---	22	N or BA	27 J @ -20°C
				$40 < t \leq 63$	---	255	---	410-540	---	21	N or BA	27 J @ -20°C
				$63 < t \leq 80$	---	245	---	410-540	---	20	N or BA	27 J @ -20°C
				$80 < t \leq 100$	---	235	---	410-540	---	20	N or BA	27 J @ -20°C
				$100 < t \leq 150$	---	225	---	410-540	---	18	N or BA	27 J @ -20°C
				$150 < t \leq 200$	---	215	---	410-540	---	17	N or BA	27 J @ -20°C
ASME SA-1011/SA-1011M	Grade 45 [310], SS	---	---	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	310	45	410 L	60 L	13 L	HR	---
				$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$	310	45	410 L	60 L	18 L	HR	---
				$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$	310	45	410 L	60 L	19 L	HR	---
ASTM A1011/A1011M-14	Grade 45 [310], Type 1, SS	---	---	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	310	45	410 L	60 L	13 L	HR	---
				$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$	310	45	410 L	60 L	18 L	HR	---
				$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$	310	45	410 L	60 L	19 L	HR	---
	Grade 45 [310], Type 2, SS	---	---	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	310-410	45-60	410 L	60 L	14 L	HR	---
				$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$	310-410	45-60	410 L	60 L	19 L	HR	---
				$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$	310-410	45-60	410 L	60 L	20 L	HR	---
ASME SA-283/SA-283M	Grade D	K02702	---	---	---	230	33	415-550	60-80	23	---	---
ASTM A283/A283M-13	Grade D	K02702	---	---	---	230	33	415-550	60-80	23	---	---
EN 10025-2:2004	S275JR	---	1.0044	$t < 3$	---	275	---	430-580	---	---	AR, N or TMCP	---
				$3 \leq t \leq 16$	---	275	---	410-560	---	23 L, 21 T	AR, N or TMCP	L: 27 J @ 20°C
				$16 < t \leq 40$	---	265	---	410-560	---	23 L, 21 T	AR, N or TMCP	L: 27 J @ 20°C
				$40 < t \leq 63$	---	255	---	410-560	---	22 L, 20 T	AR, N or TMCP	L: 27 J @ 20°C
				$63 < t \leq 80$	---	245	---	410-560	---	21 L, 19 T	AR, N or TMCP	L: 27 J @ 20°C
				$80 < t \leq 100$	---	235	---	410-560	---	21 L, 19 T	AR, N or TMCP	L: 27 J @ 20°C
				$100 < t \leq 150$	---	225	---	400-540	---	19 L, 19 T	AR, N or TMCP	L: 27 J @ 20°C
				$150 < t \leq 200$	---	215	---	380-540	---	18 L, 18 T	AR, N or TMCP	L: 27 J @ 20°C
				$200 < t \leq 250$	---	205	---	380-540	---	18 L, 18 T	AR, N or TMCP	L: 27 J @ 20°C
	S275J0	---	1.0143	$t < 3$	---	275	---	430-580	---	---	AR, N or TMCP	---
				$3 \leq t \leq 16$	---	275	---	410-560	---	23 L, 21 T	AR, N or TMCP	L: 27 J @ 0°C
				$16 < t \leq 40$	---	265	---	410-560	---	23 L, 21 T	AR, N or TMCP	L: 27 J @ 0°C
				$40 < t \leq 63$	---	255	---	410-560	---	22 L, 20 T	AR, N or TMCP	L: 27 J @ 0°C
				$63 < t \leq 80$	---	245	---	410-560	---	21 L, 19 T	AR, N or TMCP	L: 27 J @ 0°C
				$80 < t \leq 100$	---	235	---	410-560	---	21 L, 19 T	AR, N or TMCP	L: 27 J @ 0°C
				$100 < t \leq 150$	---	225	---	400-540	---	19 L, 19 T	AR, N or TMCP	L: 27 J @ 0°C
				$150 < t \leq 200$	---	215	---	380-540	---	18 L, 18 T	AR, N or TMCP	L: 27 J @ 0°C
				$200 < t \leq 250$	---	205	---	380-540	---	18 L, 18 T	AR, N or TMCP	L: 27 J @ 0°C

Note: This section continued on next page.

3.1 Carbon Steels for Structural Steel Plates

3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 712-2000	Grade A32	---	---	---	---	315	---	440-570	---	22	N, TMCP, QT, HR or CtR	see standard for impact data
	Grade D32	---	---	---	---	315	---	440-570	---	22	N, TMCP, QT, HR or CtR	
	Grade E32	---	---	---	---	315	---	440-570	---	22	see standard	
	Grade F32	---	---	---	---	315	---	440-570	---	22	see standard	
GB 711-88	Grade 20Mn	---	---	$t \leq 60$	---	---	---	450	---	24	N, A, T or HR	---
	Grade 25	---	---	$t \leq 60$	---	---	---	450	---	24	N, A, T or HR	---
ASTM A573/A573M-13	Grade 65 [450]	K02404	---	$t \leq 40$	$t \leq 1.5$	240	35	450-530	65-77	23	---	---
ASTM A529/A529M-14	Grade 50 [345]	K02703	---	$t \leq 25$	$t \leq 1$	345	50	450-690	65-100	21	---	---
ASME SA-1011/SA-1011M	Grade 50 [340], SS	---	---	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	340	50	450 L	65 L	11 L	HR	---
				$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$	340	50	450 L	65 L	16 L	HR	---
				$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$	340	50	450 L	65 L	17 L	HR	---
ASTM A1011/A1011M-14	Grade 50 [340], SS	---	---	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	340	50	450 L	65 L	11 L	HR	---
				$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$	340	50	450 L	65 L	16 L	HR	---
				$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$	340	50	450 L	65 L	17 L	HR	---
ASME SA-1011/SA-1011M	Grade 55 [380], SS	---	---	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	380	55	480	70 L	9 L	HR	---
				$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$	380	55	480	70 L	14 L	HR	---
				$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$	380	55	480	70 L	15 L	HR	---
ASTM A1011/A1011M-14	Grade 55 [380], SS	---	---	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	380	55	480	70 L	9 L	HR	---
				$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$	380	55	480	70 L	14 L	HR	---
				$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$	380	55	480	70 L	15 L	HR	---
ASTM A573/A573M-13	Grade 70 [485]	K02701	---	$t \leq 40$	$t \leq 1.5$	290	42	485-620	70-90	21	---	---
ASTM A529/A529M-14	Grade 55 [380]	K02703	---	$t \leq 25$	$t \leq 1$	380	55	485-690	70-100	20	---	---
GB 711-88	Grade 25Mn	---	---	$t \leq 60$	---	---	---	490	---	22	N, A, T or HR	---
	Grade 30	---	---	$t \leq 60$	---	---	---	490	---	22	N, A, T or HR	---
JIS G 3136:2012	Grade SN490C	---	---	$6 \leq t < 16$	---	---	---	490-610	---	17	N, T or TMCP	---
				$16 \leq t \leq 40$	---	325-445	---	490-610	---	21	N, T or TMCP	L: 27 J @ 0°C
				$40 < t \leq 100$	---	295-415	---	490-610	---	23	N, T or TMCP	L: 27 J @ 0°C
GB 700-88	Grade Q275	---	---	$t \leq 16$	---	275	---	490-610	---	20	HR, CtR or N	---
				$16 < t \leq 40$	---	265	---	490-610	---	19	HR, CtR or N	---
				$40 < t \leq 60$	---	255	---	490-610	---	18	HR, CtR or N	---
				$60 < t \leq 100$	---	245	---	490-610	---	17	HR, CtR or N	---
				$100 < t \leq 150$	---	235	---	490-610	---	16	HR, CtR or N	---
				$t > 150$	---	225	---	490-610	---	15	HR, CtR or N	---
GB/T 3524-92	Grade Q275	---	---	---	---	275	---	490-650	---	20	HR	---

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3.1 Carbon Steels for Structural Steel Plates

3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 3101:2010	Symbol SS490	---	---	$t \leq 16$	---	285	---	490-610	---	see standard	HR	---
				$16 < t \leq 40$	---	275	---	490-610	---	see standard	HR	---
				$40 < t \leq 100$	---	255	---	490-610	---	see standard	HR	---
				$t > 100$	---	245	---	490-610	---	see standard	HR	---
EN 10025-2:2004	E295	---	1.0050	$t < 3$	---	295	---	490-660	---	---	AR, N or TMCP	---
				$3 \leq t \leq 16$	---	295	---	470-610	---	20 L, 18 T	AR, N or TMCP	---
				$16 < t \leq 40$	---	285	---	470-610	---	20 L, 18 T	AR, N or TMCP	---
				$40 < t \leq 63$	---	275	---	470-610	---	19 L, 17 T	AR, N or TMCP	---
				$63 < t \leq 80$	---	265	---	470-610	---	18 L, 16 T	AR, N or TMCP	---
				$80 < t \leq 100$	---	255	---	470-610	---	18 L, 16 T	AR, N or TMCP	---
				$100 < t \leq 150$	---	245	---	450-610	---	16 L, 15 T	AR, N or TMCP	---
				$150 < t \leq 200$	---	235	---	440-610	---	15 L, 14 T	AR, N or TMCP	---
				$200 < t \leq 250$	---	225	---	440-610	---	15 L, 14 T	AR, N or TMCP	---
JIS G 3106:2008	Grade SM490A	---	---	$t \leq 5$	---	325	---	490-610	---	22	N, QHT, T or TMCP	---
				$5 < t \leq 16$	---	325	---	490-610	---	17	N, QHT, T or TMCP	---
				$16 < t \leq 40$	---	315	---	490-610	---	21	N, QHT, T or TMCP	---
				$40 < t \leq 100$	---	295	---	490-610	---	23	N, QHT, T or TMCP	---
				$100 < t \leq 160$	---	285	---	490-610	---	23	N, QHT, T or TMCP	---
				$160 < t \leq 200$	---	275	---	490-610	---	23	N, QHT, T or TMCP	---
	Grade SM490B	---	---	$t \leq 5$	---	325	---	490-610	---	22	N, QHT, T or TMCP	---
				$5 < t \leq 16$	---	325	---	490-610	---	17	N, QHT, T or TMCP	L: 27 J @ 0°C
				$16 < t \leq 40$	---	315	---	490-610	---	21	N, QHT, T or TMCP	L: 27 J @ 0°C
				$40 < t \leq 100$	---	295	---	490-610	---	23	N, QHT, T or TMCP	L: 27 J @ 0°C
				$100 < t \leq 160$	---	285	---	490-610	---	23	N, QHT, T or TMCP	L: 27 J @ 0°C
				$160 < t \leq 200$	---	275	---	490-610	---	23	N, QHT, T or TMCP	L: 27 J @ 0°C
	Grade SM490C	---	---	$t \leq 5$	---	325	---	490-610	---	22	N, QHT, T or TMCP	---
				$5 < t \leq 16$	---	325	---	490-610	---	17	N, QHT, T or TMCP	L: 47 J @ 0°C
				$16 < t \leq 40$	---	315	---	490-610	---	21	N, QHT, T or TMCP	L: 47 J @ 0°C
				$40 < t \leq 100$	---	295	---	490-610	---	23	N, QHT, T or TMCP	L: 47 J @ 0°C
				$100 < t \leq 200$	---	---	---	490-610	---	23	N, QHT, T or TMCP	L: 47 J @ 0°C
JIS G 3136:2012	Grade SN490B	---	---	$6 \leq t < 12$	---	325	---	490-610	---	17	N, T or TMCP	---
				$12 \leq t \leq 16$	---	325-445	---	490-610	---	17	N, T or TMCP	L: 27 J @ 0°C
				$16 < t \leq 40$	---	325-445	---	490-610	---	21	N, T or TMCP	L: 27 J @ 0°C
				$40 < t \leq 100$	---	295-415	---	490-610	---	23	N, T or TMCP	L: 27 J @ 0°C

Note: This section continued on next page.

3.1 Carbon Steels for Structural Steel Plates

3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 712-2000	Grade A36	---	---	---	---	355	---	490-630	---	21	N, TMCP, QT, HR or CTR	see standard for impact data
	Grade D36	---	---	---	---	355	---	490-630	---	21	N, TMCP, QT, HR or CTR	
	Grade E36	---	---	---	---	355	---	490-630	---	21	see standard	
	Grade F36	---	---	---	---	355	---	490-630	---	21	see standard	
ISO 630:1995 A1:2003	Grade E 355 (Fe 510), Quality C	---	---	3 ≤ t ≤ 16	---	355	---	490-640	---	22	AR	27 J @ 0°C
				16 < t ≤ 40	---	345	---	490-640	---	22	AR	27 J @ 0°C
				40 < t ≤ 63	---	335	---	490-640	---	21	AR	27 J @ 0°C
				63 < t ≤ 80	---	325	---	490-640	---	20	AR	27 J @ 0°C
				80 < t ≤ 100	---	315	---	490-640	---	20	AR	27 J @ 0°C
				100 < t ≤ 150	---	295	---	490-640	---	18	AR	27 J @ 0°C
				150 < t ≤ 200	---	285	---	490-640	---	17	AR	27 J @ 0°C
	Grade E 355 (Fe 510), Quality D	---	---	3 ≤ t ≤ 16	---	355	---	490-640	---	22	N or BA	27 J @ -20°C
				16 < t ≤ 40	---	345	---	490-640	---	22	N or BA	27 J @ -20°C
				40 < t ≤ 63	---	335	---	490-640	---	21	N or BA	27 J @ -20°C
				63 < t ≤ 80	---	325	---	490-640	---	20	N or BA	27 J @ -20°C
				80 < t ≤ 100	---	315	---	490-640	---	20	N or BA	27 J @ -20°C
				100 < t ≤ 150	---	295	---	490-640	---	18	N or BA	27 J @ -20°C
				150 < t ≤ 200	---	285	---	490-640	---	17	N or BA	27 J @ -20°C
JIS G 3106:2008	Grade SM490YA	---	---	t ≤ 5	---	365	---	490-610	---	19	N, QHT, T or TMCP	---
				5 < t ≤ 16	---	365	---	490-610	---	15	N, QHT, T or TMCP	---
				16 < t ≤ 40	---	355	---	490-610	---	19	N, QHT, T or TMCP	---
				40 < t ≤ 75	---	335	---	490-610	---	21	N, QHT, T or TMCP	---
				75 < t ≤ 100	---	325	---	490-610	---	21	N, QHT, T or TMCP	---
	Grade SM490YB	---	---	t ≤ 5	---	365	---	490-610	---	19	N, QHT, T or TMCP	---
				5 < t ≤ 16	---	365	---	490-610	---	15	N, QHT, T or TMCP	L: 27 J @ 0°C
				16 < t ≤ 40	---	355	---	490-610	---	19	N, QHT, T or TMCP	L: 27 J @ 0°C
				40 < t ≤ 75	---	335	---	490-610	---	21	N, QHT, T or TMCP	L: 27 J @ 0°C
				75 < t ≤ 100	---	325	---	490-610	---	21	N, QHT, T or TMCP	L: 27 J @ 0°C
GB 11251-89	Grade 40 B	---	---	---	---	---	---	500-700	---	20	A, N or NT	---

3.1 Carbon Steels for Structural Steel Plates

3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10025-2:2004	S355JR	---	1.0045	t < 3	---	355	---	510-680	---	---	AR, N or TMCP	---
				3 ≤ t ≤ 16	---	355	---	470-630	---	22 L, 20 T	AR, N or TMCP	L: 27 J @ 20°C
				16 < t ≤ 40	---	345	---	470-630	---	22 L, 20 T	AR, N or TMCP	L: 27 J @ 20°C
				40 < t ≤ 63	---	335	---	470-630	---	21 L, 19 T	AR, N or TMCP	L: 27 J @ 20°C
				63 < t ≤ 80	---	325	---	470-630	---	20 L, 18 T	AR, N or TMCP	L: 27 J @ 20°C
				80 < t ≤ 100	---	315	---	470-630	---	20 L, 18 T	AR, N or TMCP	L: 27 J @ 20°C
				100 < t ≤ 150	---	295	---	450-600	---	18 L, 18 T	AR, N or TMCP	L: 27 J @ 20°C
				150 < t ≤ 200	---	285	---	450-600	---	17 L, 17 T	AR, N or TMCP	L: 27 J @ 20°C
	S355J0	---	1.0553	200 < t ≤ 250	---	275	---	450-600	---	17 L, 17 T	AR, N or TMCP	L: 27 J @ 20°C
				t < 3	---	355	---	510-680	---	---	AR, N or TMCP	---
				3 ≤ t ≤ 16	---	355	---	470-630	---	22 L, 20 T	AR, N or TMCP	L: 27 J @ 0°C
				16 < t ≤ 40	---	345	---	470-630	---	22 L, 20 T	AR, N or TMCP	L: 27 J @ 0°C
				40 < t ≤ 63	---	335	---	470-630	---	21 L, 19 T	AR, N or TMCP	L: 27 J @ 0°C
				63 < t ≤ 80	---	325	---	470-630	---	20 L, 18 T	AR, N or TMCP	L: 27 J @ 0°C
GB 712-2000	Grade A40	---	---	---	---	390	---	510-660	---	20	N, TMCP, QT, HR or CtR	see standard for impact data
	Grade D40	---	---	---	---	390	---	510-660	---	20	N, TMCP or CtR	
	Grade E40	---	---	---	---	390	---	510-660	---	20	N, TMCP, QT	
	Grade F40	---	---	---	---	390	---	510-660	---	20	N, TMCP, QT	
JIS G 3106:2008	Grade SM520B	---	---	t ≤ 5	---	365	---	520-640	---	19	N, QHT, T or TMCP	---
				5 < t ≤ 16	---	365	---	520-640	---	15	N, QHT, T or TMCP	L: 27 J @ 0°C
				16 < t ≤ 40	---	355	---	520-640	---	19	N, QHT, T or TMCP	L: 27 J @ 0°C
				40 < t ≤ 75	---	335	---	520-640	---	21	N, QHT, T or TMCP	L: 27 J @ 0°C
				75 < t ≤ 100	---	325	---	520-640	---	21	N, QHT, T or TMCP	L: 27 J @ 0°C
	Grade SM520C	---	---	t ≤ 5	---	365	---	520-640	---	19	N, QHT, T or TMCP	---
				5 < t ≤ 16	---	365	---	520-640	---	15	N, QHT, T or TMCP	L: 47 J @ 0°C
				16 < t ≤ 40	---	355	---	520-640	---	19	N, QHT, T or TMCP	L: 47 J @ 0°C
				40 < t ≤ 75	---	335	---	520-640	---	21	N, QHT, T or TMCP	L: 47 J @ 0°C
				75 < t ≤ 100	---	325	---	520-640	---	21	N, QHT, T or TMCP	L: 47 J @ 0°C

Note: This section continued on next page.

3.1 Carbon Steels for Structural Steel Plates

3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 711-88	Grade 35	---	---	$t \leq 60$	---	---	---	530	---	20	N, A, T or HR	---
	Grade 30Mn	---	---	$t \leq 60$	---	---	---	540	---	20	N, A, T or HR	---
JIS G 3101:2010	Symbol SS540	---	---	$t \leq 16$	---	400	---	540	---	see standard	HR	---
				$16 < t \leq 40$	---	390	---	540	---	see standard	HR	---
GB 11251-89	Grade 45 B	---	---	---	---	---	---	550-750	---	18	A, N or NT	---
	Grade 45Mn2	---	---	---	---	---	---	600-850	---	13	A, N or NT	---
	Grade 50 B	---	---	---	---	---	---	550-750	---	16	A, N or NT	---
GB 711-88	Grade 40	---	---	$t \leq 60$	---	---	---	570	---	19	N, A, T or HR	---
	Grade 40Mn	---	---	$t \leq 60$	---	---	---	590	---	17	N, A, T or HR	---
	Grade 45	---	---	$t \leq 60$	---	---	---	600	---	17	N, A, T or HR	---
JIS G 3106:2008	Grade SM570	---	---	$t \leq 16$	---	460	---	570-720	---	19	N, QHT, T or TMCP	L: 47 J @ -5°C
				$16 < t \leq 40$	---	450	---	570-720	---	26	N, QHT, T or TMCP	L: 47 J @ -5°C
				$40 < t \leq 75$	---	430	---	570-720	---	26	N, QHT, T or TMCP	L: 47 J @ -5°C
				$75 < t \leq 100$	---	420	---	570-720	---	26	N, QHT, T or TMCP	L: 47 J @ -5°C
EN 10025-2:2004	E335	---	1.0060	$t < 3$	---	335	---	590-770	---	---	AR, N or TMCP	---
				$3 \leq t \leq 16$	---	335	---	570-710	---	16 L, 14 T	AR, N or TMCP	---
				$16 < t \leq 40$	---	325	---	570-710	---	16 L, 14 T	AR, N or TMCP	---
				$40 < t \leq 63$	---	315	---	570-710	---	15 L, 13 T	AR, N or TMCP	---
				$63 < t \leq 80$	---	305	---	570-710	---	14 L, 12 T	AR, N or TMCP	---
				$80 < t \leq 100$	---	295	---	570-710	---	14 L, 12 T	AR, N or TMCP	---
				$100 < t \leq 150$	---	275	---	550-710	---	12 L, 11 T	AR, N or TMCP	---
				$150 < t \leq 200$	---	265	---	540-710	---	11 L, 10 T	AR, N or TMCP	---
				$200 < t \leq 250$	---	255	---	540-710	---	11 L, 10 T	AR, N or TMCP	---

3.1 Carbon Steels for Structural Steel Plates

3.1A Mechanical Properties of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 711-88	Grade 50	---	---	$t \leq 60$	---	---	---	625	---	16	N, A, T or HR	---
	Grade 50Mn	---	---	$t \leq 60$	---	---	---	650	---	13	N, A, T or HR	---
	Grade 55	---	---	$t \leq 60$	---	---	---	645	---	13	N, A, T or HR	---
	Grade 60	---	---	$t \leq 60$	---	---	---	675	---	12	N, A, T or HR	---
	Grade 60Mn	---	---	$t \leq 60$	---	---	---	695	---	11	N, A, T or HR	---
	Grade 65	---	---	$t \leq 60$	---	---	---	695	---	10	N, A, T or HR	---
EN 10025-2:2004	E360	---	1.0070	$t < 3$	---	360	---	690-900	---	---	AR, N or TMCP	---
				$3 \leq t \leq 16$	---	360	---	670-830	---	11 L, 10 T	AR, N or TMCP	---
				$16 < t \leq 40$	---	355	---	670-830	---	11 L, 10 T	AR, N or TMCP	---
				$40 < t \leq 63$	---	345	---	670-830	---	10 L, 9 T	AR, N or TMCP	---
				$63 < t \leq 80$	---	335	---	670-830	---	9 L, 8 T	AR, N or TMCP	---
				$80 < t \leq 100$	---	325	---	670-830	---	9 L, 8 T	AR, N or TMCP	---
				$100 < t \leq 150$	---	305	---	650-830	---	8 L, 7 T	AR, N or TMCP	---
				$150 < t \leq 200$	---	295	---	640-830	---	7 L, 6 T	AR, N or TMCP	---
				$200 < t \leq 250$	---	285	---	640-830	---	7 L, 6 T	AR, N or TMCP	---

3.1 Carbon Steels for Structural Steel Plates

3.1B Chemical Composition of Carbon Steels for Structural Steel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 630:1995 A1:2003	Grade E 185 (Fe 310), Quality 0	---	---	$3 \leq t \leq 25$	---	---	---	---	---	---	---	---	---	---
ASME SA-283/SA-283M	Grade A	K01400	---	$t \leq 40$	$t \leq 1.5$	0.14	0.90	0.40	0.035	0.04	---	---	---	---
				$t > 40$	$t > 1.5$	0.14	0.90	0.15-0.40	0.035	0.04	---	---	---	---
EN 10025-2:2004	S185	---	1.0035	$t \leq 250$	---	---	---	---	---	---	---	---	---	---
GB 700-88	Grade Q195	---	---	---	---	0.06-0.12	0.25-0.50	0.30	0.045	0.050	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
GB 711-88	Grade 08F	---	---	$t \leq 60$	---	0.05-0.11	0.25-0.50	0.03	0.035	0.040	0.10	0.25	---	Cu 0.25; N 0.008
GB/T 3524-92	Grade Q195	---	---	---	---	0.06-0.12	0.25-0.50	0.30	0.045	0.050	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
GB 711-88	Grade 08	---	---	$t \leq 60$	---	0.05-0.12	0.35-0.65	0.17-0.37	0.035	0.040	0.10	0.25	---	Cu 0.25; N 0.008
	Grade 10F	---	---	$t \leq 60$	---	0.07-0.14	0.25-0.50	0.07	0.035	0.040	0.15	0.25	---	Cu 0.25; N 0.008
	Grade 10	---	---	$t \leq 60$	---	0.07-0.14	0.35-0.65	0.17-0.37	0.035	0.040	0.15	0.25	---	Cu 0.25; N 0.008
JIS G 3101:2010	Symbol SS330	---	---	---	---	---	---	---	0.050	0.050	---	---	---	---
GB 700-88	Grade Q215A	---	---	---	---	0.09-0.15	0.25-0.55	0.30	0.045	0.050	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
	Grade Q215B	---	---	---	---	0.09-0.15	0.25-0.55	0.30	0.045	0.045	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
GB/T 3524-92	Grade Q215A	---	---	---	---	0.09-0.15	0.25-0.55	0.30	0.045	0.050	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
	Grade Q215B	---	---	---	---	0.09-0.15	0.25-0.55	0.30	0.045	0.045	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
ASME SA-1011/SA-1011M	Grade 30 [205], SS	---	---	---	---	0.25	0.90	---	0.035	0.04	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008
ASTM A1011/A1011M-14	Grade 30 [205], SS	---	---	---	---	0.25	0.90	---	0.035	0.04	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008
ISO 630:1995 A1:2003	Grade E 235 (Fe 360), Quality A	---	---	$t \geq 3$	---	0.22	---	---	0.050	0.050	---	---	---	---
	Grade E 235 (Fe 360), Quality B	---	---	$3 \leq t \leq 16$	---	0.17	1.40	0.40	0.045	0.045	---	---	---	---
				$16 < t \leq 25$	---	0.20	1.40	0.40	0.045	0.045	---	---	---	---
	Grade E 235 (Fe 360), Quality B NF	---	---	$3 \leq t \leq 40$	---	0.17	1.40	0.40	0.045	0.045	---	---	---	---
				$t > 40$	---	0.20	1.40	0.40	0.045	0.045	---	---	---	---
	Grade E 235 (Fe 360), Quality C	---	---	$t \geq 3$	---	0.17	1.40	0.40	0.040	0.040	---	---	---	---
ASME SA-283/SA-283M	Grade B	K01702	---	$t \leq 40$	$t \leq 1.5$	0.17	0.90	0.40	0.035	0.04	---	---	---	---
				$t > 40$	$t > 1.5$	0.17	0.90	0.15-0.40	0.035	0.04	---	---	---	---

3.1 Carbon Steels for Structural Steel Plates

3.1B Chemical Composition of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB 711-88	Grade 15F	---	---	t ≤ 60	---	0.12-0.19	0.25-0.50	0.07	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
ASME SA-1011/SA-1011M	Grade 33 [230], SS	---	---	---	---	0.25	0.90	---	0.035	0.04	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008
ASTM A1011/A1011M-14	Grade 33 [230], SS	---	---	---	---	0.25	0.90	---	0.035	0.04	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008
EN 10025-2:2004	S235JR	---	1.0038	t ≤ 40	---	0.17	1.40	---	0.035	0.035	---	---	---	Cu 0.55; N 0.012
				40 < t ≤ 150	---	0.20	1.40	---	0.035	0.035	---	---	---	Cu 0.55; N 0.012
				150 < t ≤ 250	---	0.20	1.40	---	0.035	0.035	---	---	---	Cu 0.55; N 0.012
	S235J0	---	1.0114	t ≤ 40	---	0.17	1.40	---	0.030	0.030	---	---	---	Cu 0.55; N 0.012
				40 < t ≤ 150	---	0.17	1.40	---	0.030	0.030	---	---	---	Cu 0.55; N 0.012
				150 < t ≤ 250	---	0.17	1.40	---	0.030	0.030	---	---	---	Cu 0.55; N 0.012
ASME SA-1011/SA-1011M	Grade 36 [250], Type 1, SS	---	---	---	---	0.25	0.90	---	0.035	0.04	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008
ASTM A1011/A1011M-14	Grade 36 [250], Type 1, SS	---	---	---	---	0.25	0.90	---	0.035	0.04	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008
GB 711-88	Grade 15	---	---	t ≤ 60	---	0.12-0.19	0.35-0.65	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
GB 700-88	Grade Q235A	---	---	---	---	0.14-0.22	0.30-0.65	0.30	0.045	0.050	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
	Grade Q235B	---	---	---	---	0.12-0.20	0.30-0.70	0.30	0.045	0.045	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
	Grade Q235C	---	---	---	---	0.18	0.35-0.80	0.30	0.040	0.040	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
	Grade Q235D	---	---	---	---	0.17	0.35-0.80	0.30	0.035	0.035	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
GB/T 3524-92	Grade Q235A	---	---	---	---	0.14-0.22	0.30-0.65	0.30	0.045	0.050	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
	Grade Q235B	---	---	---	---	0.12-0.20	0.30-0.70	0.30	0.045	0.045	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
GB 711-88	Grade 20F	---	---	t ≤ 60	---	0.17-0.24	0.25-0.50	0.07	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
ASME SA-283/SA-283M	Grade C	K02401	---	t ≤ 40	t ≤ 1.5	0.24	0.90	0.40	0.035	0.04	---	---	---	---
				t > 40	t > 1.5	0.24	0.90	0.15-0.40	0.035	0.04	---	---	---	---
ASTM A283/A283M-13	Grade C	K02401	---	t ≤ 40	t ≤ 1.5	0.24	0.90	0.40	0.030	0.030	---	---	---	---
				t > 40	t > 1.5	0.24	0.90	0.15-0.40	0.030	0.030	---	---	---	---
ASME SA-1011/SA-1011M	Grade 40 [275], SS	---	---	---	---	0.25	0.90	---	0.035	0.04	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008
ASTM A1011/A1011M-14	Grade 40 [275], SS	---	---	---	---	0.25	0.90	---	0.035	0.04	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008
ASTM A573/A573M-13	Grade 58 [400]	K02301	---	t ≤ 13	t ≤ 0.5	0.23	0.60-0.90	0.10-0.35	0.030	0.030	---	---	---	---
				13 < t ≤ 40	0.5 < t ≤ 1.5	0.23	0.60-0.90	0.10-0.35	0.030	0.030	---	---	---	---
GB 712-2000	Grade A	---	---	---	---	0.21	---	0.50	0.035	0.035	0.20	0.40	---	Cu 0.35; Mn 2.5xC min.
	Grade B	---	---	---	---	0.21	0.80-1.20	0.35	0.035	0.035	0.20	0.40	---	Cu 0.35
	Grade D	---	---	---	---	0.21	0.60-1.20	0.35	0.035	0.035	0.20	0.40	---	Cu 0.35
	Grade E	---	---	---	---	0.18	0.70-1.20	0.35	0.035	0.035	0.20	0.40	---	Cu 0.35

Note: This section continued on next page.

3.1 Carbon Steels for Structural Steel Plates

3.1B Chemical Composition of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3136:2012	Grade SN400A	---	---	$6 \leq t \leq 100$	---	0.24	---	---	0.050	0.050	---	---	---	---
	Grade SN400B	---	---	$6 \leq t \leq 50$	---	0.20	0.60-1.50	0.35	0.030	0.015	---	---	---	---
				$50 < t \leq 100$	---	0.22	0.60-1.50	0.35	0.030	0.015	---	---	---	---
	Grade SN400C	---	---	$16 \leq t \leq 50$	---	0.20	0.60-1.50	0.35	0.020	0.008	---	---	---	---
				$50 < t \leq 100$	---	0.22	0.60-1.50	0.35	0.020	0.008	---	---	---	---
JIS G 3101:2010	Symbol SS400	---	---	---	---	---	---	---	0.050	0.050	---	---	---	---
JIS G 3106:2008	Grade SM400A	---	---	$t \leq 50$	---	0.23	---	---	0.035	0.035	---	---	---	---
				$50 < t \leq 200$	---	0.25	---	---	0.035	0.035	---	---	---	---
	Grade SM400B	---	---	$t \leq 50$	---	0.20	0.60-1.50	0.35	0.035	0.035	---	---	---	---
				$50 < t \leq 200$	---	0.22	0.60-1.50	0.35	0.035	0.035	---	---	---	---
	Grade SM400C	---	---	$t \leq 100$	---	0.18	0.60-1.50	0.35	0.035	0.035	---	---	---	---
ASME SA-36/SA-36M	---	K02595	---	$t > 100$	$t > 4$	0.29	0.85-1.20	0.15-0.40	0.04	0.05	---	---	---	---
		K02596	---	$65 < t \leq 100$	$2.5 < t \leq 4$	0.27	0.85-1.20	0.15-0.40	0.04	0.05	---	---	---	---
		K02597	---	$40 < t \leq 65$	$1.5 < t \leq 2.5$	0.26	0.80-1.20	0.15-0.40	0.04	0.05	---	---	---	---
		K02598	---	$20 < t \leq 40$	$0.75 < t \leq 1.5$	0.25	0.80-1.20	0.40	0.04	0.05	---	---	---	---
		K02599	---	$t \leq 20$	$t \leq 0.75$	0.25	---	0.40	0.04	0.05	---	---	---	---
ASME SA-1011/SA-1011M	Grade 36 [250], Type 2, SS	---	---	---	---	0.25	1.35	---	0.035	0.04	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008
ASTM A36/A36M-14	---	K02595	---	$t > 100$	$t > 4$	0.29	0.85-1.20	0.15-0.40	0.04	0.05	---	---	---	---
		K02596	---	$65 < t \leq 100$	$2.5 < t \leq 4$	0.27	0.85-1.20	0.15-0.40	0.04	0.05	---	---	---	---
		K02597	---	$40 < t \leq 65$	$1.5 < t \leq 2.5$	0.26	0.80-1.20	0.15-0.40	0.04	0.05	---	---	---	---
		K02598	---	$20 < t \leq 40$	$0.75 < t \leq 1.5$	0.25	0.80-1.20	0.40	0.04	0.05	---	---	---	---
		K02599	---	$t \leq 20$	$t \leq 0.75$	0.25	---	0.40	0.04	0.05	---	---	---	---
ASTM A709/A709M-13a	Grade 36 [250]	---	---	$t \leq 20$	$t \leq 0.75$	0.25	---	0.40	0.04	0.05	---	---	---	---
				$20 < t \leq 40$	$0.75 < t \leq 1.5$	0.25	0.80-1.20	0.40	0.04	0.05	---	---	---	---
				$40 < t \leq 65$	$1.5 < t \leq 2.5$	0.26	0.80-1.20	0.15-0.40	0.04	0.05	---	---	---	---
				$65 < t \leq 100$	$2.5 < t \leq 4$	0.27	0.85-1.20	0.15-0.40	0.04	0.05	---	---	---	---
				$t \leq 20$	$t \leq 0.75$	0.26	---	0.40	0.04	0.05	---	---	---	---
				$20 < t \leq 40$	$0.75 < t \leq 1.5$	0.27	0.60-0.90	0.40	0.04	0.05	---	---	---	---
				$40 < t \leq 100$	$1.5 < t \leq 4$	0.28	0.60-0.90	0.40	0.04	0.05	---	---	---	---
				---	---	0.26	---	0.40	0.04	0.05	---	---	---	---
ASTM A1011/A1011M-14	Grade 36 [250], Type 2, SS	---	---	---	---	0.25	1.35	---	0.035	0.04	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008

3.1 Carbon Steels for Structural Steel Plates

3.1B Chemical Composition of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB 711-88	Grade 20	---	---	$t \leq 60$	---	0.17-0.24	0.35-0.65	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
GB 700-88	Grade Q255A	---	---	---	---	0.18-0.28	0.40-0.70	0.30	0.045	0.050	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
	Grade Q255B	---	---	---	---	0.18-0.28	0.40-0.70	0.30	0.045	0.045	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
GB/T 3524-92	Grade Q255A	---	---	---	---	0.18-0.28	0.40-0.70	0.30	0.045	0.050	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
	Grade Q255B	---	---	---	---	0.18-0.28	0.40-0.70	0.30	0.045	0.045	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
ISO 630:1995 A1:2003	Grade E 275 (Fe 430), Quality A	---	---	$t \geq 3$	---	0.24	---	---	0.050	0.050	---	---	---	---
	Grade E 275 (Fe 430), Quality B	---	---	$3 \leq t \leq 40$	---	0.21	1.50	0.40	0.045	0.045	---	---	---	---
				$t > 40$	---	0.22	1.50	0.40	0.045	0.045	---	---	---	---
	Grade E 275 (Fe 430), Quality C	---	---	$t \geq 3$	---	0.20	1.50	0.40	0.040	0.040	---	---	---	---
	Grade E 275 (Fe 430), Quality D	---	---	$t \geq 3$	---	0.20	1.50	0.40	0.035	0.035	---	---	---	---
ASME SA-1011/SA-1011M	Grade 45 [310], SS	---	---	---	---	0.25	1.35	---	0.035	0.04	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008
ASTM A1011/A1011M-14	Grade 45 [310], Type 1, SS	---	---	---	---	0.25	1.35	---	0.035	0.04	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008
	Grade 45 [310], Type 2, SS	---	---	---	---	0.02-0.08	0.30-1.00	0.60	0.030-0.070	0.025	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.008; Cb 0.008; Al 0.02-0.08; N 0.010-0.030
ASME SA-283/SA-283M	Grade D	K02702	---	$t \leq 40$	$t \leq 1.5$	0.27	0.90	0.40	0.035	0.04	---	---	---	---
				$t > 40$	$t > 1.5$	0.27	0.90	0.15-0.40	0.035	0.04	---	---	---	---
ASTM A283/A283M-13	Grade D	K02702	---	$t \leq 40$	$t \leq 1.5$	0.27	0.90	0.40	0.030	0.030	---	---	---	---
				$t > 40$	$t > 1.5$	0.27	0.90	0.15-0.40	0.030	0.030	---	---	---	---
EN 10025-2:2004	S275JR	---	1.0044	$t \leq 40$	---	0.21	1.50	---	0.035	0.035	---	---	---	Cu 0.55; N 0.012
				$40 < t \leq 150$	---	0.22	1.50	---	0.035	0.035	---	---	---	Cu 0.55; N 0.012
				$150 < t \leq 250$	---	0.22	1.50	---	0.035	0.035	---	---	---	Cu 0.55; N 0.012
	S275J0	---	1.0143	$t \leq 40$	---	0.18	1.50	---	0.030	0.030	---	---	---	Cu 0.55; N 0.012
				$40 < t \leq 150$	---	0.18	1.50	---	0.030	0.030	---	---	---	Cu 0.55; N 0.012
GB 712-2000	Grade A32	---	---	---	---	0.18	0.90-1.60	0.50	0.035	0.035	0.20	0.40	0.08	V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05
	Grade D32	---	---	---	---	0.18	0.90-1.60	0.50	0.035	0.035	0.20	0.40	0.08	V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05
	Grade E32	---	---	---	---	0.18	0.90-1.60	0.50	0.035	0.035	0.20	0.40	0.08	V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05
	Grade F32	---	---	---	---	0.16	0.90-1.60	0.50	0.025	0.025	0.20	0.8	0.08	V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05; N 0.009

Note: This section continued on next page.

3.1 Carbon Steels for Structural Steel Plates

3.1B Chemical Composition of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB 711-88	Grade 20Mn	---	---	t ≤ 60	---	0.17-0.24	0.70-1.00	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
	Grade 25	---	---	t ≤ 60	---	0.22-0.30	0.50-0.80	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
ASTM A573/A573M-13	Grade 65 [450]	K02404	---	t ≤ 13	t ≤ 0.5	0.24	0.85-1.20	0.15-0.40	0.030	0.030	---	---	---	---
				13 < t ≤ 40	0.5 < t ≤ 1.5	0.26	0.85-1.20	0.15-0.40	0.030	0.030	---	---	---	---
ASTM A529/A529M-14	Grade 50 [345]	K02703	---	t ≤ 25	t ≤ 1	0.27	1.35	0.40	0.04	0.05	---	---	---	---
ASME SA-1011/SA-1011M	Grade 50 [340], SS	---	---	---	---	0.25	1.35	---	0.035	0.04	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008
ASTM A1011/A1011M-14	Grade 50 [340], SS	---	---	---	---	0.25	1.35	---	0.035	0.04	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008
ASME SA-1011/SA-1011M	Grade 55 [380], SS	---	---	---	---	0.25	1.35	---	0.035	0.04	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008
ASTM A1011/A1011M-14	Grade 55 [380], SS	---	---	---	---	0.25	1.35	---	0.035	0.04	0.15	0.20	0.06	V 0.008; Cu 0.20 nom.; Ti 0.025; Cb 0.008
ASTM A573/A573M-13	Grade 70 [485]	K02701	---	t ≤ 13	t ≤ 0.5	0.27	0.85-1.20	0.15-0.40	0.030	0.030	---	---	---	---
				13 < t ≤ 40	0.5 < t ≤ 1.5	0.28	0.85-1.20	0.15-0.40	0.030	0.030	---	---	---	---
ASTM A529/A529M-14	Grade 55 [380]	K02703	---	t ≤ 25	t ≤ 1	0.27	1.35	0.40	0.04	0.05	---	---	---	---
GB 711-88	Grade 25Mn	---	---	t ≤ 60	---	0.22-0.30	0.70-1.00	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
	Grade 30	---	---	t ≤ 60	---	0.27-0.35	0.50-0.80	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
JIS G 3136:2012	Grade SN490C	---	---	16 ≤ t ≤ 50	---	0.18	1.65	0.55	0.020	0.008	---	---	---	---
				50 < t ≤ 100	---	0.20	1.65	0.55	0.020	0.008	---	---	---	---
GB 700-88	Grade Q275	---	---	---	---	0.28-0.38	0.50-0.80	0.35	0.045	0.050	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
GB/T 3524-92	Grade Q275	---	---	---	---	0.28-0.38	0.50-0.80	0.35	0.045	0.050	0.30	0.30	---	Cu 0.30; N 0.008; As 0.080
JIS G 3101:2010	Symbol SS490	---	---	---	---	---	---	---	0.050	0.050	---	---	---	---
EN 10025-2:2004	E295	---	1.0050	t ≤ 250	---	---	---	---	0.045	0.045	---	---	---	N 0.012
JIS G 3106:2008	Grade SM490A	---	---	t ≤ 50	---	0.20	1.65	0.55	0.035	0.035	---	---	---	---
				50 < t ≤ 200	---	0.22	1.65	0.55	0.035	0.035	---	---	---	---
	Grade SM490B	---	---	t ≤ 50	---	0.18	1.65	0.55	0.035	0.035	---	---	---	---
				50 < t ≤ 200	---	0.20	1.65	0.55	0.035	0.035	---	---	---	---
	Grade SM490C	---	---	t ≤ 100	---	0.18	1.65	0.55	0.035	0.035	---	---	---	---
JIS G 3136:2012	Grade SN490B	---	---	6 ≤ t ≤ 50	---	0.18	1.65	0.55	0.030	0.015	---	---	---	---
				50 < t ≤ 100	---	0.20	1.65	0.55	0.030	0.015	---	---	---	---

Note: This section continued on next page.

3.1 Carbon Steels for Structural Steel Plates

3.1B Chemical Composition of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB 712-2000	Grade A36	---	---	---	---	0.18	0.90-1.60	0.50	0.035	0.035	0.20	0.40	0.08	V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05
	Grade D36	---	---	---	---	0.18	0.90-1.60	0.50	0.035	0.035	0.20	0.40	0.08	V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05
	Grade E36	---	---	---	---	0.18	0.90-1.60	0.50	0.035	0.035	0.20	0.40	0.08	V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05
	Grade F36	---	---	---	---	0.16	0.90-1.60	0.50	0.025	0.025	0.20	0.80	0.08	V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05; N 0.009
ISO 630:1995 A1:2003	Grade E 355 (Fe 510), Quality C	---	---	$3 \leq t \leq 30$	---	0.20	1.60	0.55	0.040	0.040	---	---	---	---
				$t > 30$	---	0.22	1.60	0.55	0.040	0.040	---	---	---	---
	Grade E 355 (Fe 510), Quality D	---	---	$3 \leq t \leq 30$	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
				$t > 30$	---	0.22	1.60	0.55	0.035	0.035	---	---	---	---
JIS G 3106:2008	Grade SM490YA	---	---	$t \leq 100$	---	0.20	1.65	0.55	0.035	0.035	---	---	---	---
	Grade SM490YB	---	---	$t \leq 100$	---	0.20	1.65	0.55	0.035	0.035	---	---	---	---
GB 11251-89	Grade 40 B	---	---	---	---	0.37-0.44	0.17-0.37	0.60-0.90	---	---	---	---	---	B 0.0005-0.0035

3.1 Carbon Steels for Structural Steel Plates

3.1B Chemical Composition of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10025-2:2004	S355JR	---	1.0045	$t \leq 30$	---	0.24	1.60	0.55	0.035	0.035	---	---	---	Cu 0.55; N 0.012
				$30 < t \leq 150$	---	0.24	1.60	0.55	0.035	0.035	---	---	---	Cu 0.55; N 0.012
				$150 < t \leq 250$	---	0.24	1.60	0.55	0.035	0.035	---	---	---	Cu 0.55; N 0.012
	S355J0	---	1.0553	$t \leq 30$	---	0.20	1.60	0.55	0.030	0.030	---	---	---	Cu 0.55; N 0.012
				$30 < t \leq 40$	---	0.22	1.60	0.55	0.030	0.030	---	---	---	Cu 0.55; N 0.012
				$40 < t \leq 150$	---	0.22	1.60	0.55	0.030	0.030	---	---	---	Cu 0.55; N 0.012
				$150 < t \leq 250$	---	0.22	1.60	0.55	0.030	0.030	---	---	---	Cu 0.55; N 0.012
GB 712-2000	Grade A40	---	---	---	---	0.18	0.90-1.60	0.50	0.035	0.035	0.20	0.40	0.08	V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05
	Grade D40	---	---	---	---	0.18	0.90-1.60	0.50	0.035	0.035	0.20	0.40	0.08	V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05
	Grade E40	---	---	---	---	0.18	0.90-1.60	0.50	0.035	0.035	0.20	0.40	0.08	V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05
	Grade F40	---	---	---	---	0.16	0.90-1.60	0.50	0.025	0.025	0.20	0.80	0.08	V 0.05-0.10; Cu 0.35; Ti 0.02; Nb 0.02-0.05; N 0.009
JIS G 3106:2008	Grade SM520B	---	---	$t \leq 100$	---	0.20	1.65	0.55	0.035	0.035	---	---	---	---
	Grade SM520C	---	---	$t \leq 100$	---	0.20	1.65	0.55	0.035	0.035	---	---	---	---
GB 711-88	Grade 35	---	---	$t \leq 60$	---	0.32-0.40	0.50-0.80	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
	Grade 30Mn	---	---	$t \leq 60$	---	0.27-0.35	0.70-1.00	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
JIS G 3101:2010	Symbol SS540	---	---	---	---	0.30	1.60	---	0.040	0.040	---	---	---	---
GB 11251-89	Grade 45 B	---	---	---	---	0.42-0.49	0.60-0.90	0.17-0.37	0.035	0.035	0.30	0.30	0.15	Cu 0.30; B 0.0005-0.0035
	Grade 45Mn2	---	---	---	---	0.42-0.49	1.40-1.80	0.17-0.37	0.035	0.035	0.30	0.30	0.15	Cu 0.30
	Grade 50 B	---	---	---	---	0.47-0.55	0.60-0.90	0.17-0.37	0.035	0.035	0.30	0.30	0.15	Cu 0.30

3.1 Carbon Steels for Structural Steel Plates

3.1B Chemical Composition of Carbon Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB 711-88	Grade 40	---	---	$t \leq 60$	---	0.37-0.45	0.50-0.80	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
	Grade 40Mn	---	---	$t \leq 60$	---	0.37-0.45	0.70-1.00	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
	Grade 45	---	---	$t \leq 60$	---	0.42-0.50	0.50-0.80	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
JIS G 3106:2008	Grade SM570	---	---	$t \leq 100$	---	0.18	1.70	0.55	0.035	0.035	---	---	---	---
EN 10025-2:2004	E335	---	1.0060	$t \leq 250$	---	---	---	---	0.045	0.045	---	---	---	N 0.012
GB 711-88	Grade 50	---	---	$t \leq 60$	---	0.47-0.55	0.50-0.80	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
	Grade 50Mn	---	---	$t \leq 60$	---	0.48-0.56	0.70-1.00	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
	Grade 55	---	---	$t \leq 60$	---	0.52-0.60	0.50-0.80	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
	Grade 60	---	---	$t \leq 60$	---	0.57-0.65	0.50-0.80	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
	Grade 60Mn	---	---	$t \leq 60$	---	0.57-0.65	0.70-1.00	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
	Grade 65	---	---	$t \leq 60$	---	0.62-0.70	0.50-0.80	0.17-0.37	0.035	0.040	0.25	0.25	---	Cu 0.25; N 0.008
EN 10025-2:2004	E360	---	1.0070	$t \leq 250$	---	---	---	---	0.045	0.045	---	---	---	N 0.012

3.2 Alloy Steels for Structural Steel Plates

3.2.1A Mechanical Properties of High-Strength Low-Alloy Structural Steel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB/T 1591-94	Grade Q295A	---	---	$t \leq 16$	---	295	---	390-570	---	23	HR, CtR, N or NT	---
				$16 < t \leq 35$	---	275	---	390-570	---	23	HR, CtR, N or NT	---
				$35 < t \leq 50$	---	255	---	390-570	---	23	HR, CtR, N or NT	---
				$50 < t \leq 100$	---	235	---	390-570	---	23	HR, CtR, N or NT	---
	Grade Q295B	---	---	$t \leq 16$	---	295	---	390-570	---	23	HR, CtR, N or NT	L: 34 J @ 20°C
				$16 < t \leq 35$	---	275	---	390-570	---	23	HR, CtR, N or NT	---
				$35 < t \leq 50$	---	255	---	390-570	---	23	HR, CtR, N or NT	---
				$50 < t \leq 100$	---	235	---	390-570	---	23	HR, CtR, N or NT	---
CSA G40.21-13	Grade 260W (38W)	---	---	---	---	260	38	410-590	60-85	23	AR, N or CtR	---
				$t \leq 65$	$t \leq 2.5$	260	38	410-590	60-85	23 L, 21 T	AR, N or CtR	---
				$65 < t \leq 200$	$2.5 \leq t \leq 8$	250	36	410-590	60-85	23 L, 21 T	AR, N or CtR	---
	Grade 260WT (38WT)	---	---	---	---	260	38	410-590	60-85	23	AR, N or CtR	see standard for impact data
				$t \leq 65$	$t \leq 2.5$	260	38	410-590	60-85	23 L, 21 T	AR, N or CtR	
				$65 < t \leq 200$	$2.5 < t \leq 8$	250	36	410-590	60-85	23 L, 21 T	AR, N or CtR	
ASME SA-1011/SA-1011M	Grade 45 [310], Class 1, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	310	45	410 L	60 L	23 L	HR	---
				$t > 2.5$	$t > 0.097$	310	45	410 L	60 L	25 L	HR	---
ASTM A1011/A1011M-14	Grade 45 [310], Class 1, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	310	45	410 L	60 L	23 L	HR	---
				$t > 2.5$	$t > 0.097$	310	45	410 L	60 L	25 L	HR	---
ASME SA-1011/SA-1011M	Grade 50 [340], Class 2, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	340	50	410 L	60 L	20 L	HR	---
				$t > 2.5$	$t > 0.097$	340	50	410 L	60 L	22 L	HR	---
ASTM A1011/A1011M-14	Grade 50 [340], Class 2, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	340	50	410 L	60 L	20 L	HR	---
				$t > 2.5$	$t > 0.097$	340	50	410 L	60 L	22 L	HR	---
ASME SA-572/SA-572M	Grade 42 [290], Type 1	---	---	---	---	290	42	415	60	24	---	---
	Grade 42 [290], Type 2	---	---	---	---	290	42	415	60	24	---	---
	Grade 42 [290], Type 3	---	---	---	---	290	42	415	60	24	---	---
	Grade 42 [290], Type 5	---	---	---	---	290	42	415	60	24	---	---
ASTM A572/A572M-15	Grade 42 [290], Type 1	---	---	---	---	290	42	415	60	24	---	---
	Grade 42 [290], Type 2	---	---	---	---	290	42	415	60	24	---	---
	Grade 42 [290], Type 3	---	---	---	---	290	42	415	60	24	---	---
	Grade 42 [290], Type 5	---	---	---	---	290	42	415	60	24	---	---
ASTM A656/A656M-13	Grade 50 [345], Type 3	---	---	$t \leq 50$	$t \leq 2$	345	50	415	60	23	HR	---
	Grade 50 [345], Type 7	---	---	$t \leq 50$	$t \leq 2$	345	50	415	60	23	HR	---
	Grade 50 [345], Type 8	---	---	$t \leq 50$	$t \leq 2$	345	50	415	60	23	HR	---
ASTM A633/A633M-13	Grade A	K01802	---	$t \leq 100$	$t \leq 4$	290	42	430-570	63-83	23	N	---

Note: This section continued on next page.

3.2 Alloy Steels for Structural Steel Plates

3.2.1A Mechanical Properties of High-Strength Low-Alloy Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
CSA G40.21-13	Grade 300W (44W)	---	---	---	---	300	44	440-620	64-90	23	AR, N or CtR	---
				---	---	300	44	410-590	60-85	23	SR, A or N	---
				$t \leq 65$	$t \leq 2.5$	300	44	440-620	64-90	23 L, 21 T	AR, N or CtR	---
				$65 < t \leq 200$	$2.5 \leq t \leq 8$	280	40	440-620	64-90	23 L, 21 T	AR, N or CtR	---
	Grade 300WT (44WT)	---	---	---	---	300	44	440-620	64-90	23	AR, N or CtR	see standard for impact data
				$t \leq 65$	$t \leq 2.5$	300	44	440-620	64-90	23 L, 21 T	AR, N or CtR	
				$65 < t \leq 200$	$2.5 < t \leq 8$	280	40	440-620	64-90	23 L, 21 T	AR, N or CtR	
ASME SA-1011/SA-1011M	Grade 50 [340], Class 1, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	340	50	450 L	65 L	20 L	HR	---
				$t > 2.5$	$t > 0.097$	340	50	450 L	65 L	22 L	HR	---
ASTM A1011/A1011M-14	Grade 50 [340], Class 1, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	340	50	450 L	65 L	20 L	HR	---
				$t > 2.5$	$t > 0.097$	340	50	450 L	65 L	22 L	HR	---
ASME SA-572/SA-572M	Grade 50 [345], Type 1	---	---	---	---	345	50	450	65	21	---	---
	Grade 50 [345], Type 2	---	---	---	---	345	50	450	65	21	---	---
	Grade 50 [345], Type 3	---	---	---	---	345	50	450	65	21	---	---
	Grade 50 [345], Type 5	---	---	---	---	345	50	450	65	21	---	---
ASTM A572/A572M-15	Grade 50 [345], Type 1	---	---	---	---	345	50	450	65	21	---	---
	Grade 50 [345], Type 2	---	---	---	---	345	50	450	65	21	---	---
	Grade 50 [345], Type 3	---	---	---	---	345	50	450	65	21	---	---
	Grade 50 [345], Type 5	---	---	---	---	345	50	450	65	21	---	---
ASTM A709/A709M-13a	Grade 50 [345], Type 1	---	---	$t \leq 100$	$t \leq 4$	345	50	450	65	21	QT	see standard for impact data
	Grade 50 [345], Type 2	---	---	$t \leq 100$	$t \leq 4$	345	50	450	65	21	QT	
	Grade 50 [345], Type 3	---	---	$t \leq 100$	$t \leq 4$	345	50	450	65	21	QT	
	Grade 50 [345], Type 5	---	---	$t \leq 100$	$t \leq 4$	345	50	450	65	21	QT	
CSA G40.21-13	Grade 350W (50W)	---	---	---	---	350	50	450-650	65-95	22	AR, N or CtR	---
				---	---	350	50	450-620	65-90	22	SR, A or N	---
				$t \leq 65$	$t \leq 2.5$	350	50	450-650	65-95	22 L, 20 T	AR, N or CtR	---
				$65 < t \leq 200$	$2.5 \leq t \leq 8$	320	46	450-650	65-95	22 L, 20 T	AR, N or CtR	---
ASME SA-1011/SA-1011M	Grade 55 [380], Class 2, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	380	55	450 L	65 L	18 L	HR	---
				$t > 2.5$	$t > 0.097$	380	55	450 L	65 L	20 L	HR	---
ASTM A1011/A1011M-14	Grade 55 [380], Class 2, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	380	55	450 L	65 L	18 L	HR	---
				$t > 2.5$	$t > 0.097$	380	55	450 L	65 L	20 L	HR	---

3.2 Alloy Steels for Structural Steel Plates

3.2.1A Mechanical Properties of High-Strength Low-Alloy Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB/T 1591-94	Grade Q345A	---	---	$t \leq 16$	---	345	---	470-630	---	21	HR, CtR, N or NT	---
				$16 < t \leq 35$	---	325	---	470-630	---	21	HR, CtR, N or NT	---
				$35 < t \leq 50$	---	295	---	470-630	---	21	HR, CtR, N or NT	---
				$50 < t \leq 100$	---	275	---	470-630	---	21	HR, CtR, N or NT	---
	Grade Q345B	---	---	$t \leq 16$	---	345	---	470-630	---	21	HR, CtR, N or NT	L: 34 J @ 20°C
				$16 < t \leq 35$	---	325	---	470-630	---	21	HR, CtR, N or NT	---
				$35 < t \leq 50$	---	295	---	470-630	---	21	HR, CtR, N or NT	---
				$50 < t \leq 100$	---	275	---	470-630	---	21	HR, CtR, N or NT	---
	Grade Q345C	---	---	$t \leq 16$	---	345	---	470-630	---	22	HR, CtR, N or NT	---
				$16 < t \leq 35$	---	325	---	470-630	---	22	HR, CtR, N or NT	L: 34 J @ 0°C
				$35 < t \leq 50$	---	295	---	470-630	---	22	HR, CtR, N or NT	---
				$50 < t \leq 100$	---	275	---	470-630	---	22	HR, CtR, N or NT	---
	Grade Q345D	---	---	$t \leq 16$	---	345	---	470-630	---	22	HR, CtR, N or NT	---
				$16 < t \leq 35$	---	325	---	470-630	---	22	HR, CtR, N or NT	---
				$35 < t \leq 50$	---	295	---	470-630	---	22	HR, CtR, N or NT	L: 34 J @ -20°C
				$50 < t \leq 100$	---	275	---	470-630	---	22	HR, CtR, N or NT	---
	Grade Q345E	---	---	$t \leq 16$	---	345	---	470-630	---	22	HR, CtR, N or NT	---
				$16 < t \leq 35$	---	325	---	470-630	---	22	HR, CtR, N or NT	---
				$35 < t \leq 50$	---	295	---	470-630	---	22	HR, CtR, N or NT	---
				$50 < t \leq 100$	---	275	---	470-630	---	22	HR, CtR, N or NT	L: 27 J @ -40°C
ASTM A242/A242M-13	Type 1	K11510	---	$t \leq 20$	$t \leq 0.75$	345	50	480	70	21	---	---
				$20 < t \leq 40$	$0.75 < t \leq 1.5$	315	46	460	67	21	---	---
				$t \leq 40$	$t \leq 1.5$	345	50	485	70	21	---	---
				$40 < t \leq 50$	$1.5 < t \leq 2$	315	46	460	67	21	---	---
				$40 < t \leq 100$	$1.5 < t \leq 4$	290	42	435	63	21	---	---
				$t > 50$	$t > 2$	290	42	435	63	21	---	---
CSA G40.21-13	Grade 350WT (50WT)	---	---	---	---	350	50	450-650	65-95	22	AR, N or CtR	see standard for impact data
				---	---	350	50	450-620	65-90	22	SR, A or N	
				$t \leq 65$	$t \leq 2.5$	350	50	450-650	65-95	22 L, 20 T	AR, N or CtR	
				$65 < t \leq 200$	$2.5 < t \leq 8$	320	46	450-650	65-95	22 L, 20 T	AR, N or CtR	
	Grade 380W (55W)	---	---	---	---	380	55	480-650	65-95	21	AR, N or CtR	---
				---	---	380	55	480-650	70-95	21	SR, A or N	---
				$t \leq 65$	$t \leq 2.5$	380	55	480-650	70-95	21 L	AR, N or CtR	---
				$65 < t \leq 200$	$2.5 < t \leq 8$	350	50	480-650	70-95	21 L	AR, N or CtR	---
ASME SA-1011/SA-1011M	Grade 55 [380], Class 1, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	380	55	480 L	70 L	18 L	HR	---
				$t > 2.5$	$t > 0.097$	380	55	480 L	70 L	20 L	HR	---
	Grade 60 [410], Class 2, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	410	60	480 L	70 L	16 L	HR	---
				$t > 2.5$	$t > 0.097$	410	60	480 L	70 L	18 L	HR	---

Note: This section continued on next page.

3.2 Alloy Steels for Structural Steel Plates

3.2.1A Mechanical Properties of High-Strength Low-Alloy Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A1011/A1011M-14	Grade 55 [380], Class 1 HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	380	55	480 L	70 L	18 L	HR	---
				$t > 2.5$	$t > 0.097$	380	55	480 L	70 L	20 L	HR	---
	Grade 60 [410], Class 2 HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	410	60	480 L	70 L	16 L	HR	---
				$t > 2.5$	$t > 0.097$	410	60	480 L	70 L	18 L	HR	---
ASTM A588/A588M-15	Grade A	K11947	---	---	---	345	50	485	70	21	---	---
				$t \leq 100$	$t \leq 4$	345	50	485	70	21	---	---
				$100 < t \leq 125$	$4 < t \leq 5$	315	46	460	67	21	---	---
				$125 < t \leq 200$	$5 < t \leq 8$	290	42	435	63	21	---	---
	Grade B	K12043	---	---	---	345	50	485	70	21	---	---
				$t \leq 100$	$t \leq 4$	345	50	485	70	21	---	---
				$100 < t \leq 125$	$4 < t \leq 5$	315	46	460	67	21	---	---
				$125 < t \leq 200$	$5 < t \leq 8$	290	42	435	63	21	---	---
	Grade K	---	---	---	---	345	50	485	70	21	---	---
				$t \leq 100$	$t \leq 4$	345	50	485	70	21	---	---
				$100 < t \leq 125$	$4 < t \leq 5$	315	46	460	67	21	---	---
				$125 < t \leq 200$	$5 < t \leq 8$	290	42	435	63	21	---	---
ASTM A633/A633M-13	Grade C	K12000	---	$t \leq 65$	$t \leq 2.5$	345	50	485-620	70-90	23	N	---
				$65 < t \leq 100$	$2.5 < t \leq 4$	315	46	450-590	65-85	23	N	---
	Grade D	K12037	---	$t \leq 65$	$t \leq 2.5$	345	50	485-620	70-90	23	N	---
				$65 < t \leq 100$	$2.5 < t \leq 4$	315	46	450-590	65-85	23	N	---
ASME SA-572/SA-572M	Grade 55 [380], Type 1	---	---	---	---	380	55	485	70	20	---	---
	Grade 55 [380], Type 2	---	---	---	---	380	55	485	70	20	---	---
	Grade 55 [380], Type 3	---	---	---	---	380	55	485	70	20	---	---
	Grade 55 [380], Type 5	---	---	---	---	380	55	485	70	20	---	---
ASTM A572/A572M-15	Grade 55 [380], Type 1	---	---	---	---	380	55	485	70	20	---	---
	Grade 55 [380], Type 2	---	---	---	---	380	55	485	70	20	---	---
	Grade 55 [380], Type 3	---	---	---	---	380	55	485	70	20	---	---
	Grade 55 [380], Type 5	---	---	---	---	380	55	485	70	20	---	---
ASTM A656/A656M-13	Grade 60 [415], Type 3	---	---	$t \leq 40$	$t \leq 1.5$	415	60	485	70	20	HR	---
	Grade 60 [415], Type 7	---	---	$t \leq 40$	$t \leq 1.5$	415	60	485	70	20	HR	---
	Grade 60 [415], Type 8	---	---	$t \leq 40$	$t \leq 1.5$	415	60	485	70	20	HR	---

3.2 Alloy Steels for Structural Steel Plates

3.2.1A Mechanical Properties of High-Strength Low-Alloy Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
CSA G40.21-13	Grade 400W (60W)	---	---	---	---	400	60	520-690	75-100	18	AR, N or CtR	---
				---	---	400	60	520-690	75-100	20	SR, A or N	---
				$t \leq 65$	$t \leq 2.5$	400	60	520-690	75-100	18 L, 15 T	AR, N or CtR	---
				$65 < t \leq 200$	$2.5 < t \leq 8$	370	54	520-690	75-100	18 L, 15 T	AR, N or CtR	---
	Grade 400WT (60WT)	---	---	---	---	400	60	520-690	75-100	20	AR, N or CtR	see standard for impact data
				---	---	400	60	520-690	75-100	20	SR, A or N	
				$t \leq 65$	$t \leq 2.5$	400	60	520-690	75-100	20 L, 17 T	AR, N or CtR	
				$65 < t \leq 200$	$2.5 < t \leq 8$	370	54	520-690	75-100	20 L, 17 T	AR, N or CtR	
ASME SA-1011/SA-1011M	Grade 60 [410], Class 1, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	410	60	520 L	75 L	16 L	HR	---
				$t > 2.5$	$t > 0.097$	410	60	520 L	75 L	18 L	HR	---
	Grade 65 [450], Class 2, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	450	65	520 L	75 L	14 L	HR	---
				$t > 2.5$	$t > 0.097$	450	65	520 L	75 L	16 L	HR	---
ASTM A1011/A1011M-14	Grade 60 [410], Class 1, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	410	60	520 L	75 L	16 L	HR	---
				$t > 2.5$	$t > 0.097$	410	60	520 L	75 L	18 L	HR	---
	Grade 65 [450], Class 2, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	450	65	520 L	75 L	14 L	HR	---
				$t > 2.5$	$t > 0.097$	450	65	520 L	75 L	16 L	HR	---
ASME SA-572/SA-572M	Grade 60 [415], Type 1	---	---	---	---	415	60	520	75	18	---	---
	Grade 60 [415], Type 2	---	---	---	---	415	60	520	75	18	---	---
	Grade 60 [415], Type 3	---	---	---	---	415	60	520	75	18	---	---
	Grade 60 [415], Type 5	---	---	---	---	415	60	520	75	18	---	---
ASTM A572/A572M-15	Grade 60 [415], Type 1	---	---	---	---	415	60	520	75	18	---	---
	Grade 60 [415], Type 2	---	---	---	---	415	60	520	75	18	---	---
	Grade 60 [415], Type 3	---	---	---	---	415	60	520	75	18	---	---
	Grade 60 [415], Type 5	---	---	---	---	415	60	520	75	18	---	---
GB/T 1591-94	Grade Q420A	---	---	$t \leq 16$	---	420	---	520-680	---	18	HR, CtR, N or NT	---
				$16 < t \leq 35$	---	400	---	520-680	---	18	HR, CtR, N or NT	---
				$35 < t \leq 50$	---	380	---	520-680	---	18	HR, CtR, N or NT	---
				$50 < t \leq 100$	---	360	---	520-680	---	18	HR, CtR, N or NT	---
	Grade Q420B	---	---	$t \leq 16$	---	420	---	520-680	---	18	HR, CtR, N or NT	L: 34 J @ 20°C
				$16 < t \leq 35$	---	400	---	520-680	---	18	HR, CtR, N or NT	
				$35 < t \leq 50$	---	380	---	520-680	---	18	HR, CtR, N or NT	
				$50 < t \leq 100$	---	360	---	520-680	---	18	HR, CtR, N or NT	
	Grade Q420C	---	---	$t \leq 16$	---	420	---	520-680	---	19	HR, CtR, N, NT or QT	---
				$16 < t \leq 35$	---	400	---	520-680	---	19	HR, CtR, N, NT or QT	L: 34 J @ 0°C
				$35 < t \leq 50$	---	380	---	520-680	---	19	HR, CtR, N, NT or QT	
				$50 < t \leq 100$	---	360	---	520-680	---	19	HR, CtR, N, NT or QT	

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3.2 Alloy Steels for Structural Steel Plates

3.2.1A Mechanical Properties of High-Strength Low-Alloy Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB/T 1591-94	Grade Q420D	---	---	$t \leq 16$	---	420	---	520-680	---	19	HR, Ctr, N, NT or QT	---
				$16 < t \leq 35$	---	400	---	520-680	---	19	HR, Ctr, N, NT or QT	---
				$35 < t \leq 50$	---	380	---	520-680	---	19	HR, Ctr, N, NT or QT	L: 34 J @ -20°C
				$50 < t \leq 100$	---	360	---	520-680	---	19	HR, Ctr, N, NT or QT	---
	Grade Q420E	---	---	$t \leq 16$	---	420	---	520-680	---	19	HR, Ctr, N, NT or QT	---
				$16 < t \leq 35$	---	400	---	520-680	---	19	HR, Ctr, N, NT or QT	---
				$35 < t \leq 50$	---	380	---	520-680	---	19	HR, Ctr, N, NT or QT	---
				$50 < t \leq 100$	---	360	---	520-680	---	19	HR, Ctr, N, NT or QT	L: 27 J @ -40°C
GB/T 16270-1996	Grade Q420C	---	---	$t \leq 50$	---	420	---	520-670 T	---	18 T	Ctr, N, QT or NT	see standard for impact data
				$50 < t \leq 100$	---	400	---	520-670 T	---	18 T	Ctr, N, QT or NT	
	Grade Q420D	---	---	$t \leq 50$	---	420	---	520-670 T	---	18 T	Ctr, N, QT or NT	
				$50 < t \leq 100$	---	400	---	520-670 T	---	18 T	Ctr, N, QT or NT	
	Grade Q420E	---	---	$t \leq 50$	---	420	---	520-670 T	---	18 T	Ctr, N, QT or NT	
				$50 < t \leq 100$	---	400	---	520-670 T	---	18 T	Ctr, N, QT or NT	
ASTM A633/A633M-13	Grade E	K12202	---	$t \leq 100$	$t \leq 4$	415	60	550-690	80-100	23	N or NN	---
				$100 < t \leq 150$	$4 < t \leq 6$	380	55	515-655	75-95	23	NN	---
ASME SA-572/SA-572M	Grade 65 [450], Type 1	---	---	---	---	450	65	550	80	17	---	---
	Grade 65 [450], Type 2	---	---	---	---	450	65	550	80	17	---	---
	Grade 65 [450], Type 3	---	---	---	---	450	65	550	80	17	---	---
	Grade 65 [450], Type 5	---	---	---	---	450	65	550	80	17	---	---
ASTM A572/A572M-15	Grade 65 [450], Type 1	---	---	---	---	450	65	550	80	17	---	---
	Grade 65 [450], Type 2	---	---	---	---	450	65	550	80	17	---	---
	Grade 65 [450], Type 3	---	---	---	---	450	65	550	80	17	---	---
	Grade 65 [450], Type 5	---	---	---	---	450	65	550	80	17	---	---
ASME SA-1011/SA-1011M	Grade 65 [450], Class 1, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	450	65	550 L	80 L	14 L	HR	---
				$t > 2.5$	$t > 0.097$	450	65	550 L	80 L	16 L	HR	---
ASTM A1011/A1011M-14	Grade 65 [450], Class 1, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	450	65	550 L	80 L	14 L	HR	---
				$t > 2.5$	$t > 0.097$	450	65	550 L	80 L	16 L	HR	---
ASTM A656/A656M-13	Grade 70 [485], Type 3	---	---	$t \leq 25$	$t \leq 1$	485	70	550	80	17	HR	---
	Grade 70 [485], Type 7	---	---	$t \leq 25$	$t \leq 1$	485	70	550	80	17	HR	---
	Grade 70 [485], Type 8	---	---	$t \leq 25$	$t \leq 1$	485	70	550	80	17	HR	---
ASME SA-1011/SA-1011M	Grade 70 [480], Class 1, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	480	70	585 L	85 L	12 L	HR	---
				$t > 2.5$	$t > 0.097$	480	70	585 L	85 L	14 L	HR	---
ASTM A1011/A1011M-14	Grade 70 [480], Class 1, HSLAS	---	---	$t \leq 2.5$	$t \leq 0.097$	480	70	585 L	85 L	12 L	HR	---
				$t > 2.5$	$t > 0.097$	480	70	585 L	85 L	14 L	HR	---

3.2 Alloy Steels for Structural Steel Plates

3.2.1B Chemical Composition of High-Strength Low-Alloy Structural Steel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB/T 1591-94	Grade Q295A	---	---	---	---	0.16	0.80-1.50	0.55	0.045	0.045	0.30	0.30	---	V 0.02-0.15; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
	Grade Q295B	---	---	---	---	0.16	0.80-1.50	0.55	0.040	0.040	0.30	0.30	---	V 0.02-0.15; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
CSA G40.21-13	Grade 260W (38W)	---	---	---	---	0.20	0.50-1.50	0.40	0.04	0.05	---	---	---	---
	Grade 260WT (38WT)	---	---	---	---	0.20	0.80-1.50	0.15-0.40	0.03	0.04	---	---	---	---
ASME SA-1011/SA-1011M	Grade 45 [310], Class 1, HSLAS	---	---	---	---	0.22	1.35	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
ASTM A1011/A1011M-14	Grade 45 [310], Class 1, HSLAS	---	---	---	---	0.22	1.35	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
ASME SA-1011/SA-1011M	Grade 50 [340], Class 2, HSLAS	---	---	---	---	0.15	1.35	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
ASTM A1011/A1011M-14	Grade 50 [340], Class 2, HSLAS	---	---	---	---	0.15	1.35	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
ASME SA-572/SA-572M	Grade 42 [290], Type 1	---	---	t ≤ 150	t ≤ 6	0.21	0.50-1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
	Grade 42 [290], Type 2	---	---	t ≤ 150	t ≤ 6	0.21	0.50-1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15
	Grade 42 [290], Type 3	---	---	t ≤ 150	t ≤ 6	0.21	0.50-1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02-0.15
	Grade 42 [290], Type 5	---	---	t ≤ 150	t ≤ 6	0.21	0.50-1.25	0.40	0.04	0.05	---	---	---	V 0.06; Ti 0.006-0.04; N 0.003-0.015
ASTM A572/A572M-15	Grade 42 [290], Type 1	---	---	t ≤ 150	t ≤ 6	0.21	0.50-1.35	0.40	0.030	0.030	---	---	---	Cb 0.005-0.05
	Grade 42 [290], Type 2	---	---	t ≤ 150	t ≤ 6	0.21	0.50-1.35	0.40	0.030	0.030	---	---	---	V 0.01-0.15
	Grade 42 [290], Type 3	---	---	t ≤ 150	t ≤ 6	0.21	0.50-1.35	0.40	0.030	0.030	---	---	---	V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02-0.15
	Grade 42 [290], Type 5	---	---	t ≤ 150	t ≤ 6	0.21	0.50-1.25	0.40	0.030	0.030	---	---	---	V 0.06; Ti 0.006-0.04; N 0.003-0.015
ASTM A656/A656M-13	Grade 50 [345], Type 3	---	---	t ≤ 50	t ≤ 2	0.18	1.65	0.60	0.025	0.030	---	---	---	V 0.08; Cb 0.008-0.10; N 0.030
	Grade 50 [345], Type 7	---	---	t ≤ 50	t ≤ 2	0.18	1.65	0.60	0.025	0.030	---	---	---	V 0.15; Cb 0.10; N 0.030
	Grade 50 [345], Type 8	---	---	t ≤ 50	t ≤ 2	0.18	1.65	0.60	0.025	0.030	---	---	---	V 0.15; Ti 0.15; Cb 0.10; N 0.030
ASTM A633/A633M-13	Grade A	K01802	---	t ≤ 100	t ≤ 4	0.18	1.00-1.35	0.15-0.50	0.030	0.030	---	---	---	Cb 0.05
CSA G40.21-13	Grade 300W (44W)	---	---	---	---	0.22	0.50-1.50	0.40	0.04	0.05	---	---	---	---
	Grade 300WT (44WT)	---	---	---	---	0.22	0.80-1.50	0.15-0.40	0.03	0.04	---	---	---	---
ASME SA-1011/SA-1011M	Grade 50 [340], Class 1, HSLAS	---	---	---	---	0.23	1.35	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
ASTM A1011/A1011M-14	Grade 50 [340], Class 1, HSLAS	---	---	---	---	0.23	1.35	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.

Note: This section continued on next page.

3.2 Alloy Steels for Structural Steel Plates

3.2.1B Chemical Composition of High-Strength Low-Alloy Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-572/SA-572M	Grade 50 [345], Type 1	---	---	$t \leq 100$	$t \leq 4$	0.23	0.50-1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
	Grade 50 [345], Type 2	---	---	$t \leq 100$	$t \leq 4$	0.23	0.50-1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15
	Grade 50 [345], Type 3	---	---	$t \leq 100$	$t \leq 4$	0.23	0.50-1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02-0.15
	Grade 50 [345], Type 5	---	---	$t \leq 100$	$t \leq 4$	0.23	0.50-1.35	0.40	0.04	0.05	---	---	---	V 0.06; Ti 0.006-0.04; N 0.003-0.015
ASTM A572/A572M-15	Grade 50 [345], Type 1	---	---	$t \leq 100$	$t \leq 4$	0.23	0.50-1.35	0.40	0.030	0.030	---	---	---	Cb 0.005-0.05
	Grade 50 [345], Type 2	---	---	$t \leq 100$	$t \leq 4$	0.23	0.50-1.35	0.40	0.030	0.030	---	---	---	V 0.01-0.15
	Grade 50 [345], Type 3	---	---	$t \leq 100$	$t \leq 4$	0.23	0.50-1.35	0.40	0.030	0.030	---	---	---	V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02-0.15
	Grade 50 [345], Type 5	---	---	$t \leq 100$	$t \leq 4$	0.23	0.50-1.35	0.40	0.030	0.030	---	---	---	V 0.06; Ti 0.006-0.04; N 0.003-0.015
ASTM A709/A709M-13a	Grade 50 [345], Type 1	---	---	$t \leq 100$	$t \leq 4$	0.23	0.50-1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
	Grade 50 [345], Type 2	---	---	$t \leq 100$	$t \leq 4$	0.23	0.50-1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15
	Grade 50 [345], Type 3	---	---	$t \leq 100$	$t \leq 4$	0.23	0.50-1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02-0.15
	Grade 50 [345], Type 5	---	---	$t \leq 100$	$t \leq 4$	0.23	0.50-1.35	0.40	0.04	0.05	---	---	---	V 0.06; Ti 0.006-0.04; N 0.003-0.015
CSA G40.21-13	Grade 350W (50W)	---	---	---	---	0.23	0.50-1.50	0.40	0.04	0.05	---	---	---	---
ASME SA-1011/SA-1011M	Grade 55 [380], Class 2, HSLAS	---	---	---	---	0.15	1.35	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
ASTM A1011/A1011M-14	Grade 55 [380], Class 2, HSLAS	---	---	---	---	0.15	1.35	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
GB/T 1591-94	Grade Q345A	---	---	---	---	0.20	1.00-1.60	0.55	0.045	0.045	0.30	0.30	---	V 0.02-0.15; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
	Grade Q345B	---	---	---	---	0.20	1.00-1.60	0.55	0.040	0.040	0.30	0.30	---	V 0.02-0.15; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
	Grade Q345C	---	---	---	---	0.20	1.00-1.60	0.55	0.035	0.035	0.30	0.30	---	V 0.02-0.15; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
	Grade Q345D	---	---	---	---	0.18	1.00-1.60	0.55	0.030	0.030	0.30	0.30	---	V 0.02-0.15; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
	Grade Q345E	---	---	---	---	0.18	1.00-1.60	0.55	0.025	0.025	0.30	0.30	---	V 0.02-0.15; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
ASTM A242/A242M-13	Type 1	K11510	---	$t \leq 100$	$t \leq 4$	0.15	1.00	---	0.15	0.05	---	---	---	Cu 0.20 min.

Note: This section continued on next page.

3.2 Alloy Steels for Structural Steel Plates

3.2.1B Chemical Composition of High-Strength Low-Alloy Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
CSA G40.21-13	Grade 350WT (50WT)	---	---	---	---	0.22	0.80-1.50	0.15-0.40	0.03	0.04	---	---	---	---
	Grade 380W (55W)	---	---	---	---	0.23	0.50-1.50	0.40	0.04	0.05	---	---	---	---
ASME SA-1011/SA-1011M	Grade 55 [380], Class 1, HSLAS	---	---	---	---	0.25	1.35	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
	Grade 60 [410], Class 2, HSLAS	---	---	---	---	0.15	1.50	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
ASTM A1011/A1011M-14	Grade 55 [380], Class 1, HSLAS	---	---	---	---	0.25	1.35	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
	Grade 60 [410], Class 2, HSLAS	---	---	---	---	0.15	1.50	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
ASTM A588/A588M-15	Grade A	K11947	---	$t \leq 200$	$t \leq 8$	0.19	0.80-1.25	0.30-0.65	0.030	0.030	0.40-0.65	0.40	---	V 0.02-0.10; Cu 0.25-0.40
	Grade B	K12043	---	$t \leq 200$	$t \leq 8$	0.20	0.75-1.35	0.15-0.50	0.030	0.030	0.40-0.70	0.50	---	V 0.01-0.10; Cu 0.20-0.40
	Grade K	---	---	$t \leq 200$	$t \leq 8$	0.17	0.50-1.20	0.25-0.50	0.030	0.030	0.40-0.70	0.40	0.10	Cu 0.30-0.50; Cb 0.005-0.05
ASTM A633/A633M-13	Grade C	K12000	---	$t \leq 100$	$t \leq 4$	0.20	1.15-1.50	0.15-0.50	0.030	0.030	---	---	---	Cb 0.01-0.05
	Grade D	K12037	---	$t \leq 40$	$t \leq 1.5$	0.20	0.70-1.35	0.15-0.50	0.030	0.030	0.25	0.25	0.08	Cu 0.35
				$40 < t \leq 100$	$1.5 < t \leq 4$	0.20	1.00-1.60	0.15-0.50	0.030	0.030	0.25	0.25	0.08	Cu 0.35
ASME SA-572/SA-572M	Grade 55 [380], Type 1	---	---	$t \leq 50$	$t \leq 2$	0.25	0.50-1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
	Grade 55 [380], Type 2	---	---	$t \leq 50$	$t \leq 2$	0.25	0.50-1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15
	Grade 55 [380], Type 3	---	---	$t \leq 50$	$t \leq 2$	0.25	0.50-1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02-0.15
	Grade 55 [380], Type 5	---	---	$t \leq 50$	$t \leq 2$	0.25	0.50-1.35	0.40	0.04	0.05	---	---	---	V 0.06; Ti 0.006-0.04; N 0.003-0.015
ASTM A572/A572M-15	Grade 55 [380], Type 1	---	---	$t \leq 50$	$t \leq 2$	0.25	0.50-1.35	0.40	0.030	0.030	---	---	---	Cb 0.005-0.05
	Grade 55 [380], Type 2	---	---	$t \leq 50$	$t \leq 2$	0.25	0.50-1.35	0.40	0.030	0.030	---	---	---	V 0.01-0.15
	Grade 55 [380], Type 3	---	---	$t \leq 50$	$t \leq 2$	0.25	0.50-1.35	0.40	0.030	0.030	---	---	---	V 0.01-0.15; Cb 0.005-0.05 (Cb+V) 0.02-0.15
	Grade 55 [380], Type 5	---	---	$t \leq 50$	$t \leq 2$	0.25	0.50-1.35	0.40	0.030	0.030	---	---	---	V 0.06; Ti 0.006-0.04; N 0.003-0.015
ASTM A656/A656M-13	Grade 60 [415], Type 3	---	---	$t \leq 40$	$t \leq 1.5$	0.18	1.65	0.60	0.025	0.030	---	---	---	V 0.08; Cb 0.008-0.10; N 0.030
	Grade 60 [415], Type 7	---	---	$t \leq 40$	$t \leq 1.5$	0.18	1.65	0.60	0.025	0.030	---	---	---	V 0.15; Cb 0.10; N 0.030
	Grade 60 [415], Type 8	---	---	$t \leq 40$	$t \leq 1.5$	0.18	1.65	0.60	0.025	0.030	---	---	---	V 0.15; Ti 0.15; Cb 0.10; N 0.030

3.2 Alloy Steels for Structural Steel Plates

3.2.1B Chemical Composition of High-Strength Low-Alloy Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
CSA G40.21-13	Grade 400W (60W)	---	---	---	---	0.23	0.50-1.50	0.40	0.04	0.05	---	---	---	---
	Grade 400WT (60WT)	---	---	---	---	0.22	0.80-1.60	0.15-0.40	0.03	0.04	---	---	---	---
ASME SA-1011/SA-1011M	Grade 60 [410], Class 1, HSLAS	---	---	---	---	0.26	1.50	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
	Grade 65 [450], Class 2, HSLAS	---	---	---	---	0.15	1.50	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
ASTM A1011/A1011M-14	Grade 60 [410], Class 1, HSLAS	---	---	---	---	0.26	1.50	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
	Grade 65 [450], Class 2, HSLAS	---	---	---	---	0.15	1.50	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
ASME SA-572/SA-572M	Grade 60 [415], Type 1	---	---	t ≤ 32	t ≤ 1.25	0.26	0.50-1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
	Grade 60 [415], Type 2	---	---	t ≤ 32	t ≤ 1.25	0.26	0.50-1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15
	Grade 60 [415], Type 3	---	---	t ≤ 32	t ≤ 1.25	0.26	0.50-1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02 to 0.15
	Grade 60 [415], Type 5	---	---	t ≤ 32	t ≤ 1.25	0.26	0.50-1.35	0.40	0.04	0.05	---	---	---	V 0.06; Ti 0.006-0.04; N 0.003-0.015
ASTM A572/A572M-15	Grade 60 [415], Type 1	---	---	t ≤ 32	t ≤ 1.25	0.26	0.50-1.35	0.40	0.030	0.030	---	---	---	Cb 0.005-0.05
	Grade 60 [415], Type 2	---	---	t ≤ 32	t ≤ 1.25	0.26	0.50-1.35	0.40	0.030	0.030	---	---	---	V 0.01-0.15
	Grade 60 [415], Type 3	---	---	t ≤ 32	t ≤ 1.25	0.26	0.50-1.35	0.40	0.030	0.030	---	---	---	V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02 to 0.15
	Grade 60 [415], Type 5	---	---	t ≤ 32	t ≤ 1.25	0.26	0.50-1.35	0.40	0.030	0.030	---	---	---	V 0.06; Ti 0.006-0.04; N 0.003-0.015
GB/T 1591-94	Grade Q420A	---	---	---	---	0.20	1.00-1.70	0.55	0.045	0.045	0.40	0.70	---	V 0.02-0.20; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
	Grade Q420B	---	---	---	---	0.20	1.00-1.70	0.55	0.040	0.040	0.40	0.70	---	V 0.02-0.20; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
	Grade Q420C	---	---	---	---	0.20	1.00-1.70	0.55	0.035	0.035	0.40	0.70	---	V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
	Grade Q420D	---	---	---	---	0.20	1.00-1.70	0.55	0.030	0.030	0.40	0.70	---	V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
	Grade Q420E	---	---	---	---	0.20	1.00-1.70	0.55	0.025	0.025	0.40	0.70	---	V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
GB/T 16270-1996	Grade Q420C	---	---	---	---	0.20	1.00-1.60	0.55	0.035	0.035	0.30	0.70	0.20	V 0.10; Ti 0.20; Nb 0.06
	Grade Q420D	---	---	---	---	0.18	1.00-1.60	0.55	0.030	0.030	0.30	0.70	0.20	V 0.10; Ti 0.20; Nb 0.06
	Grade Q420E	---	---	---	---	0.18	1.00-1.60	0.55	0.025	0.025	0.30	0.70	0.20	V 0.10; Ti 0.20; Nb 0.06

Note: This section continued on next page.

3.2 Alloy Steels for Structural Steel Plates

3.2.1B Chemical Composition of High-Strength Low-Alloy Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A633/A633M-13	Grade E	K12202	---	$t \leq 150$	$t \leq 6$	0.22	1.15-1.50	0.15-0.50	0.030	0.030	---	---	---	V 0.04-0.11; N 0.03; Cb 0.01-0.05
ASME SA-572/SA-572M	Grade 65 [450], Type 1	---	---	$13 < t \leq 32$	$0.5 < t \leq 1.25$	0.23	0.80-1.65	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
				$t \leq 13$	$t \leq 0.5$	0.26	0.50-1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
	Grade 65 [450], Type 2	---	---	$13 < t \leq 32$	$0.5 < t \leq 1.25$	0.23	0.80-1.65	0.40	0.04	0.05	---	---	---	V 0.01-0.15
				$t \leq 13$	$t \leq 0.5$	0.26	0.50-1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15
	Grade 65 [450], Type 3	---	---	$13 < t \leq 32$	$0.5 < t \leq 1.25$	0.23	0.80-1.65	0.40	0.04	0.05	---	---	---	V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02 to 0.15
				$t \leq 13$	$t \leq 0.5$	0.26	0.50-1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15; Cb 0.005-0.05; (Cb+V) 0.02 to 0.15
ASTM A572/A572M-15	Grade 65 [450], Type 1	---	---	$13 < t \leq 32$	$0.5 < t \leq 1.25$	0.23	0.80-1.65	0.40	0.030	0.030	---	---	---	Cb 0.005-0.05
				$t \leq 13$	$t \leq 0.5$	0.26	0.50-1.35	0.40	0.030	0.030	---	---	---	Cb 0.005-0.05
	Grade 65 [450], Type 2	---	---	$13 < t \leq 32$	$0.5 < t \leq 1.25$	0.23	0.80-1.65	0.40	0.030	0.030	---	---	---	V 0.01-0.15
				$t \leq 13$	$t \leq 0.5$	0.26	0.50-1.35	0.40	0.030	0.030	---	---	---	V 0.01-0.15
	Grade 65 [450], Type 3	---	---	$13 < t \leq 32$	$0.5 < t \leq 1.25$	0.23	0.80-1.65	0.40	0.030	0.030	---	---	---	V 0.01-0.15; Cb 0.005-0.05 (Cb+V) 0.02 to 0.15
				$t \leq 13$	$t \leq 0.5$	0.26	0.50-1.35	0.40	0.030	0.030	---	---	---	V 0.01-0.15; Cb 0.005-0.05 (Cb+V) 0.02 to 0.15
ASME SA-1011/SA-1011M	Grade 65 [450], Class 1, HSLAS	---	---	$13 < t \leq 32$	$0.5 < t \leq 1.25$	0.23	0.80-1.65	0.40	0.030	0.030	---	---	---	V 0.06; Ti 0.006-0.04; N 0.003-0.015
				$t \leq 13$	$t \leq 0.5$	0.26	0.50-1.35	0.40	0.030	0.030	---	---	---	V 0.06; Ti 0.006-0.04; N 0.003-0.015
ASME SA-1011/SA-1011M	Grade 65 [450], Class 1, HSLAS	---	---	---	---	0.26	1.50	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
ASTM A1011/A1011M-14	Grade 65 [450], Class 1, HSLAS	---	---	---	---	0.26	1.50	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
ASTM A656/A656M-13	Grade 70 [485], Type 3	---	---	$t \leq 25$	$t \leq 1$	0.18	1.65	0.60	0.025	0.030	---	---	---	V 0.08; Cb 0.008-0.10; N 0.030
	Grade 70 [485], Type 7	---	---	$t \leq 25$	$t \leq 1$	0.18	1.65	0.60	0.025	0.030	---	---	---	V 0.15; Cb 0.10; N 0.030
	Grade 70 [485], Type 8	---	---	$t \leq 25$	$t \leq 1$	0.18	1.65	0.60	0.025	0.030	---	---	---	V 0.15; Ti 0.15; Cb 0.10; N 0.030
ASME SA-1011/SA-1011M	Grade 70 [480], Class 1, HSLAS	---	---	---	---	0.26	1.65	---	0.04	0.04	0.15	0.20	0.06	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.
ASTM A1011/A1011M-14	Grade 70 [480], Class 1, HSLAS	---	---	---	---	0.26	1.65	---	0.04	0.04	0.15	0.20	0.16	V 0.005 min.; Cu 0.20 nom.; Ti 0.005 min.; Cb 0.005 min.

3.2 Alloy Steels for Structural Steel Plates

3.2.2A Mechanical Properties of Alloy Steels for Structural Steel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 11251-89	Grade 15 Cr	---	---	---	---	---	---	400-600	---	21	A, N or NT	---
	Grade 20 Cr	---	---	---	---	---	---	400-650	---	20	A, N or NT	---
	Grade 20CrMnSiA	---	---	---	---	---	---	450-700	---	21	A, N or NT	---
ISO 4950-2:1995 A1:2003	Grade E 355, Quality DD	---	---	3 ≤ t ≤ 16	---	355	---	470-630	---	22	N, NT or CtR	see standard for impact data
				16 < t ≤ 35	---	345	---	470-630	---	22	N, NT or CtR	
				35 < t ≤ 50	---	335	---	470-630	---	22	N, NT or CtR	
				50 < t ≤ 70	---	325	---	470-630	---	22	N, NT or CtR	
				70 < t ≤ 100	---	305	---	450-610	---	22	N, NT or CtR	
				100 < t ≤ 125	---	295	---	440-600	---	22	N, NT or CtR	
				125 < t ≤ 150	---	285	---	430-590	---	22	N, NT or CtR	
	Grade E 355, Quality E	---	---	3 ≤ t ≤ 16	---	355	---	470-630	---	22	N, NT or CtR	see standard for impact data
				16 < t ≤ 35	---	345	---	470-630	---	22	N, NT or CtR	
				35 < t ≤ 50	---	335	---	470-630	---	22	N, NT or CtR	
				50 < t ≤ 70	---	325	---	470-630	---	22	N, NT or CtR	
				70 < t ≤ 100	---	305	---	450-610	---	22	N, NT or CtR	
				100 < t ≤ 125	---	295	---	440-600	---	22	N, NT or CtR	
				125 < t ≤ 150	---	285	---	430-590	---	22	N, NT or CtR	
ASTM A709/A709M-13a	Grade 50W [345W], Type A	---	---	t ≤ 100	t ≤ 4	345	50	485	70	21	QT	see standard for impact data
	Grade 50W [345W], Type B	---	---	t ≤ 100	t ≤ 4	345	50	485	70	21	QT	

Note: This section continued on next page.

3.2 Alloy Steels for Structural Steel Plates

3.2.2A Mechanical Properties of Alloy Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB/T 1591-94	Grade Q390A	---	---	$t \leq 16$	---	390	---	490-650	---	19	HR, CtR, N or NT	---
				$16 < t \leq 35$	---	370	---	490-650	---	19	HR, CtR, N or NT	---
				$35 < t \leq 50$	---	350	---	490-650	---	19	HR, CtR, N or NT	---
				$50 < t \leq 100$	---	330	---	490-650	---	19	HR, CtR, N or NT	---
	Grade Q390B	---	---	$t \leq 16$	---	390	---	490-650	---	19	HR, CtR, N or NT	L: 34 J @ 20°C
				$16 < t \leq 35$	---	370	---	490-650	---	19	HR, CtR, N or NT	---
				$35 < t \leq 50$	---	350	---	490-650	---	19	HR, CtR, N or NT	---
				$50 < t \leq 100$	---	330	---	490-650	---	19	HR, CtR, N or NT	---
	Grade Q390C	---	---	$t \leq 16$	---	390	---	490-650	---	20	HR, CtR, N or NT	---
				$16 < t \leq 35$	---	370	---	490-650	---	20	HR, CtR, N or NT	L: 34 J @ 0°C
				$35 < t \leq 50$	---	350	---	490-650	---	20	HR, CtR, N or NT	---
				$50 < t \leq 100$	---	330	---	490-650	---	20	HR, CtR, N or NT	---
	Grade Q390D	---	---	$t \leq 16$	---	390	---	490-650	---	20	HR, CtR, N or NT	---
				$16 < t \leq 35$	---	370	---	490-650	---	20	HR, CtR, N or NT	---
				$35 < t \leq 50$	---	350	---	490-650	---	20	HR, CtR, N or NT	L: 34 J @ -20°C
				$50 < t \leq 100$	---	330	---	490-650	---	20	HR, CtR, N or NT	---
	Grade Q390E	---	---	$t \leq 16$	---	390	---	490-650	---	20	HR, CtR, N or NT	---
				$16 < t \leq 35$	---	370	---	490-650	---	20	HR, CtR, N or NT	---
				$35 < t \leq 50$	---	350	---	490-650	---	20	HR, CtR, N or NT	---
				$50 < t \leq 100$	---	330	---	490-650	---	20	HR, CtR, N or NT	L: 27 J @ -40°C
ASTM A710/A710M-02 (2013)	Grade A, Class 2	K20747	---	$t \leq 25$	$t \leq 1$	450	65	495	72	20	N+PHT	---
				$25 < t \leq 50$	$1 < t \leq 2$	415	60	495	72	20	N+PHT	---
				$50 < t \leq 100$	$2 < t \leq 4$	380	55	450	65	20	N+PHT	---
				$t > 100$	$t > 4$	345	50	415	60	20	N+PHT	---
GB 11251-89	Grade 25CrMnSiA	---	---	---	---	---	---	500-700	---	20	A, N or NT	152-221 HB
				---	---	---	---	1000	---	10	QT	39 J @ RT
	Grade 30 Cr	---	---	---	---	---	---	500-700	---	19	A, N or NT	---

3.2 Alloy Steels for Structural Steel Plates

3.2.2A Mechanical Properties of Alloy Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 11251-89	Grade 30CrMnSiA	---	---	---	---	---	---	550-750	---	19	A, N or NT	152-221 HB
				---	---	---	---	1100	---	10	QT	39 J @ RT
	Grade 35 Cr	---	---	---	---	---	---	550-750	---	18	A, N or NT	---
	Grade 27SiMn	---	---	---	---	---	---	550-800	---	18	A, N or NT	---
	Grade 40 Cr	---	---	---	---	---	---	550-800	---	16	A, N or NT	---
GB/T 1591-94	Grade Q460C	---	---	$t \leq 16$	---	460	---	550-720	---	17	HR, CtR, N, NT or QT	---
				$16 < t \leq 35$	---	440	---	550-720	---	17	HR, CtR, N, NT or QT	L: 34 J @ 0°C
				$35 < t \leq 50$	---	420	---	550-720	---	17	HR, CtR, N, NT or QT	---
				$50 < t \leq 100$	---	400	---	550-720	---	17	HR, CtR, N, NT or QT	---
	Grade Q460D	---	---	$t \leq 16$	---	460	---	550-720	---	17	HR, CtR, N, NT or QT	---
				$16 < t \leq 35$	---	440	---	550-720	---	17	HR, CtR, N, NT or QT	---
				$35 < t \leq 50$	---	420	---	550-720	---	17	HR, CtR, N, NT or QT	L: 34 J @ -20°C
				$50 < t \leq 100$	---	400	---	550-720	---	17	HR, CtR, N, NT or QT	---
	Grade Q460E	---	---	$t \leq 16$	---	460	---	550-720	---	17	HR, CtR, N, NT or QT	---
				$16 < t \leq 35$	---	440	---	550-720	---	17	HR, CtR, N, NT or QT	---
				$35 < t \leq 50$	---	420	---	550-720	---	17	HR, CtR, N, NT or QT	---
				$50 < t \leq 100$	---	400	---	550-720	---	17	HR, CtR, N, NT or QT	L: 27 J @ -40°C
GB/T 16270-1996	Grade Q460C	---	---	$t \leq 50$	---	460	---	550-710 T	---	17 T	CtR, N, QT or NT	see standard for impact data
				$50 < t \leq 100$	---	440	---	550-710 T	---	17 T	CtR, N, QT or NT	see standard for impact data
	Grade Q460D	---	---	$t \leq 50$	---	460	---	550-710 T	---	17 T	CtR, N, QT or NT	see standard for impact data
				$50 < t \leq 100$	---	440	---	550-710 T	---	17 T	CtR, N, QT or NT	see standard for impact data
	Grade Q460E	---	---	$t \leq 50$	---	460	---	550-710 T	---	17 T	CtR, N, QT or NT	see standard for impact data
				$50 < t \leq 100$	---	440	---	550-710 T	---	17 T	CtR, N, QT or NT	impact data

Note: This section continued on next page.

3.2 Alloy Steels for Structural Steel Plates

3.2.2A Mechanical Properties of Alloy Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ISO 4950-3:1995 A1:2003	Grade E 460, Quality DD	---	---	$3 \leq t \leq 50$	---	460	---	570-720 T	---	17 T	QT	see standard for impact data
				$50 < t \leq 70$	---	440	---	570-720 T	---	17 T	QT	
	Grade E 460, Quality E	---	---	$3 \leq t \leq 50$	---	460	---	570-720 T	---	17 T	QT	see standard for impact data
				$50 < t \leq 70$	---	440	---	570-720 T	---	17 T	QT	
ASTM A709/A709M-13a	Grade HPS 70W [HPS 485W]	---	---	$t \leq 100$	$t \leq 4$	485	70	585-760	85-110	19	AR, Ctr, TMCP or QT	see standard for impact data
ASTM A710/A710M-02 (2013)	Grade A, Class 3	K20747	---	$t \leq 30$	$t \leq 1.25$	550	80	585	85	20	Q+PHT	---
				$30 < t \leq 50$	$1.25 < t \leq 2$	515	75	585	85	20	Q+PHT	---
				$50 < t \leq 100$	$2 < t \leq 4$	450	65	515	75	20	Q+PHT	---
				$t > 100$	$t > 4$	415	60	485	70	20	Q+PHT	---
CSA G40.21-13	Grade 480WT (70WT)	---	---	---	---	480	70	590-790	85-115	17	AR, N or Ctr	see standard for impact data
				---	---	480	70	590-790	85-115	17	SR, A or N	
				$t \leq 65$	$t \leq 2.5$	480	70	590-790	85-115	17 L, 14 T	AR, N or Ctr	
				$65 < t \leq 200$	$2.5 < t \leq 8$	450	65	590-790	85-115	17 L, 14 T	AR, N or Ctr	
GB 11251-89	Grade 35CrMnSiA	---	---	---	---	---	---	600-800	---	16	A, N or NT	---

3.2 Alloy Steels for Structural Steel Plates

3.2.2A Mechanical Properties of Alloy Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB/T 16270-1996	Grade Q500D	---	---	$t \leq 50$	---	500	---	610-770 T	---	16 T	CtR, N, QT or NT	see standard for impact data
				$50 < t \leq 100$	---	480	---	610-770 T	---	16 T	CtR, N, QT or NT	
	Grade Q500E	---	---	$t \leq 50$	---	500	---	610-770 T	---	16 T	CtR, N, QT or NT	
				$50 < t \leq 100$	---	480	---	610-770 T	---	16 T	CtR, N, QT or NT	
CSA G40.21-13	Grade 550WT (80WT)	---	---	---	---	550	80	620-860	90-125	15	SR, A or N	see standard for impact data
				$t \leq 65$	$t \leq 2.5$	550	80	620-860	90-125	15 L, 12 T	AR, N or CtR	
				$65 < t \leq 200$	$2.5 < t \leq 8$	520	75	620-860	90-125	15 L, 12 T	AR, N or CtR	
ASTM A710/A710M-02 (2013)	Grade A, Class 1	K20747	---	$t \leq 8$	$t \leq 0.3125$	585	85	620	90	20	PHT	see standard for impact data
				$8 < t \leq 20$	$0.3125 < t \leq 0.75$	550	80	620	90	20	PHT	

3.2 Alloy Steels for Structural Steel Plates

3.2.2A Mechanical Properties of Alloy Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB/T 16270-1996	Grade Q550D	---	---	$t \leq 50$	---	550	---	670-830 T	---	16 T	CtR, N, QT or NT	see standard for impact data
				$50 < t \leq 100$	---	530	---	670-830 T	---	16 T	CtR, N, QT or NT	
	Grade Q550E	---	---	$t \leq 50$	---	550	---	670-830 T	---	16 T	CtR, N, QT or NT	
				$50 < t \leq 100$	---	530	---	670-830 T	---	16 T	CtR, N, QT or NT	
	Grade Q620D	---	---	$t \leq 50$	---	620	---	720-890 T	---	15 T	CtR, N, QT or NT	see standard for impact data
				$50 < t \leq 100$	---	600	---	720-890 T	---	15 T	CtR, N, QT or NT	see standard for impact data
	Grade Q620E	---	---	$t \leq 50$	---	620	---	720-890 T	---	15 T	CtR, N, QT or NT	see standard for impact data
				$50 < t \leq 100$	---	600	---	720-890 T	---	15 T	CtR, N, QT or NT	see standard for impact data
ASTM A514/A514M-14	Grade A	K11856	---	$t \leq 20$	$t \leq 0.75$	690	100	760-895	110-130	18 L	QT or SR	235-293 HB
				$20 < t \leq 32$	$0.75 < t \leq 1.25$	690	100	760-895	110-130	18 L	QT or SR	---
	Grade B	K11630	---	$t \leq 20$	$t \leq 0.75$	690	100	760-895	110-130	18 L	QT or SR	235-293 HB
				$20 < t \leq 32$	$0.75 < t \leq 1.25$	690	100	760-895	110-130	18 L	QT or SR	---
	Grade E	K21604	---	$t \leq 20$	$t \leq 0.75$	690	100	760-895	110-130	18 L	QT or SR	235-293 HB
				$20 < t \leq 65$	$0.75 < t \leq 2.5$	690	100	760-895	110-130	18 L	QT or SR	---
				$65 < t \leq 150$	$2.5 < t \leq 6$	620	90	690-895	100-130	16 L	QT or SR	---
	Grade F	K11576	---	$t \leq 20$	$t \leq 0.75$	690	100	760-895	110-130	18 L	QT or SR	235-293 HB
				$20 < t \leq 65$	$0.75 < t \leq 2.5$	690	100	760-895	110-130	18 L	QT or SR	---
	Grade H	K11646	---	$t \leq 20$	$t \leq 0.75$	690	100	760-895	110-130	18 L	QT or SR	235-293 HB
				$20 < t \leq 50$	$0.75 < t \leq 2$	690	100	760-895	110-130	18 L	QT or SR	---
	Grade P	K21650	---	$t \leq 20$	$t \leq 0.75$	690	100	760-895	110-130	18 L	QT or SR	235-293 HB
				$20 < t \leq 65$	$0.75 < t \leq 2.5$	690	100	760-895	110-130	18 L	QT or SR	---
				$65 < t \leq 150$	$2.5 < t \leq 6$	620	90	690-895	100-130	16 L	QT or SR	---
	Grade Q	---	---	$t \leq 20$	$t \leq 0.75$	690	100	760-895	110-130	18 L	QT or SR	235-293 HB
				$20 < t \leq 65$	$0.75 < t \leq 2.5$	690	100	760-895	110-130	18 L	QT or SR	---
				$65 < t \leq 150$	$2.5 < t \leq 6$	620	90	690-895	100-130	16 L	QT or SR	---
	Grade S	---	---	$t \leq 20$	$t \leq 0.75$	690	100	760-895	110-130	18 L	QT or SR	235-293 HB
				$20 < t \leq 65$	$0.75 < t \leq 2.5$	690	100	760-895	110-130	18 L	QT or SR	---

Note: This section continued on next page.

3.2 Alloy Steels for Structural Steel Plates

3.2.2A Mechanical Properties of Alloy Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A709/A709M-13a	Grade HPS 100W [HPS 690W]	---	---	$t \leq 65$	$t \leq 2.5$	690	100	760-895	110-130	18	QT	see standard for impact data
				$65 < t \leq 100$	$2.5 < t \leq 4$	620	90	690-895	100-130	16	QT	see standard for impact data
CSA G40.21-13	Grade 700Q (100Q)	---	---	$t \leq 65$	$t \leq 2.5$	700	100	760-895	110-130	18 L, 16 T	QT	---
				$65 < t \leq 100$	$2.5 < t \leq 4$	620	90	760-895	110-130	18 L, 16 T	QT	---
	Grade 700QT (100QT)	---	---	$t \leq 65$	$t \leq 2.5$	700	100	760-895	110-130	18 L, 16 T	QT	see standard for impact data
				$65 < t \leq 100$	$2.5 < t \leq 4$	620	90	760-895	110-130	18 L, 16 T	QT	see standard for impact data
GB/T 16270-1996	Grade Q690D	---	---	$t \leq 50$	---	690	---	770-940 T	---	14 T	CtR, N, QT or NT	see standard for impact data
				$50 < t \leq 100$	---	670	---	770-940 T	---	14 T	CtR, N, QT or NT	see standard for impact data
	Grade Q690E	---	---	$t \leq 50$	---	690	---	770-940 T	---	14 T	CtR, N, QT or NT	see standard for impact data
				$50 < t \leq 100$	---	670	---	770-940 T	---	14 T	CtR, N, QT or NT	see standard for impact data
JIS G 3128:2009	Grade SHY685	---	---	$6 \leq t \leq 16$	---	685	---	780-930 T	---	16 T	QT	see standard for impact data
				$16 < t \leq 20$	---	685	---	780-930 T	---	24 T	QT	L: 47 J @ -20°C
				$20 < t \leq 50$	---	685	---	780-930 T	---	16 T	QT	L: 47 J @ -20°C
				$50 < t \leq 100$	---	665	---	760-910 T	---	16 T	QT	L: 47 J @ -20°C
	Grade SHY685N	---	---	$6 \leq t \leq 16$	---	685	---	780-930 T	---	16 T	QT	see standard for impact data
				$16 < t \leq 20$	---	685	---	780-930 T	---	24 T	QT	L: 47 J @ -20°C
				$20 < t \leq 50$	---	685	---	780-930 T	---	16 T	QT	L: 47 J @ -20°C
				$50 < t \leq 100$	---	665	---	760-910 T	---	16 T	QT	L: 47 J @ -20°C
	Grade SHY685NS	---	---	$6 \leq t \leq 16$	---	685	---	780-930 T	---	16 T	QT	see standard for impact data
				$16 < t \leq 20$	---	685	---	780-930 T	---	24 T	QT	47 J @ -40°C
				$20 < t \leq 50$	---	685	---	780-930 T	---	16 T	QT	47 J @ -40°C
				$50 < t \leq 100$	---	665	---	760-910 T	---	16 T	QT	see standard for impact data

3.2 Alloy Steels for Structural Steel Plates

3.2.2B Chemical Composition of Alloy Steels for Structural Steel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB 11251-89	Grade 15 Cr	---	---	---	---	0.12-0.18	0.40-0.70	0.17-0.37	0.035	0.035	0.70-1.00	0.30	0.15	Cu 0.30
	Grade 20 Cr	---	---	---	---	0.18-0.24	0.50-0.80	0.17-0.37	0.035	0.035	0.70-1.00	0.30	0.15	Cu 0.30
	Grade 20CrMnSiA	---	---	---	---	0.17-0.23	0.80-1.10	0.90-1.20	---	---	---	---	---	---
ISO 4950-2:1995 A1:2003	Grade E 355, Quality DD	---	---	---	---	0.18	0.9-1.6	0.50	0.030	0.030	0.25	0.30	0.10	V 0.02-0.10; Al 0.020 min.; Cu 0.35; Ti 0.02-0.20; Nb 0.015-0.060
	Grade E 355, Quality E	---	---	---	---	0.18	0.9-1.6	0.50	0.025	0.025	0.25	0.30	0.10	V 0.02-0.10; Al 0.020 min.; Cu 0.35; Ti 0.02-0.20; Nb 0.015-0.060
ASTM A709/A709M-13a	Grade 50W [345W], Type A	---	---	t ≤ 100	t ≤ 4	0.19	0.80-1.25	0.30-0.65	0.04	0.05	0.40-0.65	0.40	---	V 0.02-0.10; Cu 0.25-0.40
	Grade 50W [345W], Type B	---	---	t ≤ 100	t ≤ 4	0.20	0.75-1.35	0.15-0.50	0.04	0.05	0.40-0.70	0.50	---	V 0.01-0.10; Cu 0.20-0.40
GB/T 1591-94	Grade Q390A	---	---	---	---	0.20	1.00-1.60	0.55	0.045	0.045	0.30	0.70	---	V 0.02-0.20; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
	Grade Q390B	---	---	---	---	0.20	1.00-1.60	0.55	0.040	0.040	0.30	0.70	---	V 0.02-0.20; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
	Grade Q390C	---	---	---	---	0.20	1.00-1.60	0.55	0.035	0.035	0.30	0.70	---	V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
	Grade Q390D	---	---	---	---	0.20	1.00-1.60	0.55	0.030	0.030	0.30	0.70	---	V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
	Grade Q390E	---	---	---	---	0.20	1.00-1.60	0.55	0.025	0.025	0.30	0.70	---	V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
ASTM A710/A710M-02 (2013)	Grade A, Class 2	K20747	---	---	---	0.07	0.40-0.70	0.40	0.025	0.025	0.60-0.90	0.70-1.00	0.15-0.25	Cu 1.00-1.30; Cb 0.02 min.
GB 11251-89	Grade 25CrMnSiA	---	---	---	---	---	---	---	---	---	---	---	---	---
	Grade 30 Cr	---	---	---	---	0.27-0.34	0.50-0.80	0.17-0.37	---	---	0.80-1.10	---	---	---

3.2 Alloy Steels for Structural Steel Plates

3.2.2B Chemical Composition of Alloy Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB 11251-89	Grade 30CrMnSiA	---	---	---	---	0.28-0.34	0.80-1.10	0.90-1.20	---	---	0.80-1.10	---	---	---
	Grade 35 Cr	---	---	---	---	0.32-0.39	0.50-0.80	0.17-0.37	---	---	---	---	---	---
	Grade 27SiMn	---	---	---	---	0.24-0.32	1.10-1.40	1.10-1.40	---	---	---	---	---	---
	Grade 40 Cr	---	---	---	---	0.37-0.44	0.50-0.80	0.17-0.37	---	---	0.80-1.10	---	---	---
GB/T 1591-94	Grade Q460C	---	---	---	---	0.20	1.00-1.70	0.55	0.035	0.035	0.70	0.70	---	V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
	Grade Q460D	---	---	---	---	0.20	1.00-1.70	0.55	0.030	0.030	0.70	0.70	---	V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
	Grade Q460E	---	---	---	---	0.20	1.00-1.70	0.55	0.025	0.025	0.70	0.70	---	V 0.02-0.20; Al 0.015 min.; Cu 0.30; Ti 0.02-0.20; Nb 0.015-0.060
GB/T 16270-1996	Grade Q460C	---	---	---	---	0.20	1.00-1.60	0.55	0.035	0.035	0.30	0.70	0.20	V 0.10; Ti 0.20; Nb 0.06
	Grade Q460D	---	---	---	---	0.18	1.00-1.60	0.55	0.030	0.030	0.30	0.70	0.20	V 0.10; Ti 0.20; Nb 0.06
	Grade Q460E	---	---	---	---	0.18	1.00-1.60	0.55	0.025	0.025	0.30	0.70	0.20	V 0.10; Ti 0.20; Nb 0.06
ISO 4950-3:1995 A1:2003	Grade E 460, Quality DD	---	---	---	---	0.20	0.7-1.7	0.55	0.035	0.035	2	2	1	V 0.10; Cu 1.5; Ti 0.20; Nb 0.060; N 0.020; B 0.005; Zr 0.15
	Grade E 460, Quality E	---	---	---	---	0.20	0.7-1.7	0.55	0.030	0.030	2	2	1	V 0.10; Cu 1.5; Ti 0.20; Nb 0.060; N 0.020; B 0.005; Zr 0.15
ASTM A709/A709M-13a	Grade HPS 70W [HPS 485W]	---	---	---	---	0.11	1.10-1.35	0.30-0.50	0.020	0.006	0.45-0.70	0.25-0.40	0.02-0.08	V 0.04-0.08; Al 0.010-0.040; Cu 0.25-0.40; N 0.015

Note: This section continued on next page.

3.2 Alloy Steels for Structural Steel Plates

3.2.2B Chemical Composition of Alloy Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A710/A710M-02 (2013)	Grade A, Class 3	K20747	---	---	---	0.07	0.40-0.70	0.40	0.025	0.025	0.60-0.90	0.70-1.00	0.15-0.25	Cu 1.00-1.30; Cb 0.02 min.
CSA G40.21-13	Grade 480WT (70WT)	---	---	---	---	0.26	0.80-1.50	0.15-0.40	0.03	0.04	---	---	---	---
GB 11251-89	Grade 35CrMnSiA	---	---	---	---	0.32-0.39	0.80-1.10	1.10-1.40	---	---	1.10-1.40	---	---	---
GB/T 16270-1996	Grade Q500D	---	---	---	---	0.18	1.00-1.60	0.55	0.030	0.030	0.60	1.00	0.40	V 0.10; Ti 0.20; Nb 0.06; B 0.003
	Grade Q500E	---	---	---	---	0.18	1.00-1.60	0.55	0.025	0.025	0.60	1.00	0.40	V 0.10; Ti 0.20; Nb 0.06; B 0.003
CSA G40.21-13	Grade 550WT (80WT)	---	---	---	---	0.15	1.75	0.15-0.40	0.03	0.04	---	---	---	--
ASTM A710/A710M-02 (2013)	Grade A, Class 1	K20747	---	$t \leq 20$	$t \leq 0.75$	0.07	0.40-0.70	0.40	0.025	0.025	0.60-0.90	0.70-1.00	0.15-0.25	Cu 1.00-1.30; Cb 0.02 min.

3.2 Alloy Steels for Structural Steel Plates

3.2.2B Chemical Composition of Alloy Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB/T 16270-1996	Grade Q550D	---	---	---	---	0.18	1.00-1.60	0.55	0.030	0.030	0.60	1.00	0.40	V 0.10; Ti 0.20; Nb 0.06; B 0.003
	Grade Q550E	---	---	---	---	0.18	1.00-1.60	0.55	0.025	0.025	0.60	1.00	0.40	V 0.10; Ti 0.20; Nb 0.06; B 0.003
	Grade Q620D	---	---	---	---	0.18	1.00-1.60	0.55	0.030	0.030	0.80	1.20	0.60	V 0.10; Ti 0.20; Nb 0.06; B 0.003
	Grade Q620E	---	---	---	---	0.18	1.00-1.60	0.55	0.025	0.025	0.80	1.20	0.60	V 0.10; Ti 0.20; Nb 0.06; B 0.003
ASTM A514/A514M-14	Grade A	K11856	---	t ≤ 32	t ≤ 1.25	0.15-0.21	0.80-1.10	0.40-0.80	0.030	0.030	0.50-0.80	---	0.18-0.28	B 0.0025; Zr 0.05-0.15
	Grade B	K11630	---	t ≤ 32	t ≤ 1.25	0.12-0.21	0.70-1.00	0.20-0.35	0.030	0.030	0.40-0.65	---	0.15-0.25	V 0.03-0.08; Ti 0.01-0.10; B 0.0005-0.005
	Grade E	K21604	---	t ≤ 150	t ≤ 6	0.12-0.20	0.40-0.70	0.20-0.40	0.030	0.030	1.40-2.00	---	0.40-0.60	Ti 0.01-0.10; B 0.001-0.005
	Grade F	K11576	---	t ≤ 65	t ≤ 2.5	0.10-0.20	0.60-1.00	0.15-0.35	0.030	0.030	0.40-0.65	0.70-1.00	0.40-0.60	V 0.03-0.08; Cu 0.15-0.50; B 0.0005-0.006
	Grade H	K11646	---	t ≤ 50	t ≤ 2	0.12-0.21	0.95-1.30	0.20-0.35	0.030	0.030	0.40-0.65	0.30-0.70	0.20-0.30	V 0.03-0.08; B 0.0005-0.005
	Grade P	K21650	---	t ≤ 150	t ≤ 6	0.12-0.21	0.45-0.70	0.20-0.35	0.030	0.030	0.85-1.20	1.20-1.50	0.45-0.60	B 0.001-0.005
	Grade Q	---	---	t ≤ 150	t ≤ 6	0.14-0.21	0.95-1.30	0.15-0.35	0.030	0.030	1.00-1.50	1.20-1.50	0.40-0.60	V 0.03-0.08
	Grade S	---	---	t ≤ 65	t ≤ 2.5	0.11-0.21	1.10-1.50	0.15-0.45	0.030	0.020	---	---	0.10-0.60	V 0.06; Cb 0.06; B 0.001-0.005
ASTM A709/A709M-13a	Grade HPS 100W [HPS 690W]	---	---	t ≤ 100	t ≤ 4	0.08	0.95-1.50	0.15-0.35	0.015	0.006	0.40-0.65	0.65-0.90	0.40-0.65	V 0.04-0.08; Cb 0.01-0.03; Cu 0.90-1.20; N 0.015; Al 0.020-0.050

Note: This section continued on next page.

3.2 Alloy Steels for Structural Steel Plates

3.2.2B Chemical Composition of Alloy Steels for Structural Steel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
CSA G40.21-13	Grade 700Q (100Q)	---	---	---	---	0.20	1.50	0.15-0.40	0.03	0.04	---	---	---	B 0.0005-0.005
	Grade 700QT (100QT)	---	---	---	---	0.20	1.50	0.15-0.40	0.03	0.04	---	---	---	B 0.0005-0.005
GB/T 16270-1996	Grade Q690D	---	---	---	---	0.18	1.00-1.60	0.55	0.030	0.030	1.20	1.50	0.60	V 0.10; Ti 0.20; Nb 0.06; B 0.003
	Grade Q690E	---	---	---	---	0.18	1.00-1.60	0.55	0.025	0.025	1.20	1.50	0.60	V 0.10; Ti 0.20; Nb 0.06; B 0.003
JIS G 3128:2009	Grade SHY685	---	---	6 ≤ t ≤ 50	---	0.18	1.50	0.55	0.030	0.025	1.20	---	0.60	V 0.10; Cu 0.50; B 0.005
				50 < t ≤ 75	---	0.18	1.50	0.55	0.030	0.025	1.20	---	0.60	V 0.10; Cu 0.50; B 0.005
				75 < t ≤ 100	---	0.18	1.50	0.55	0.030	0.025	1.20	---	0.60	V 0.10; Cu 0.50; B 0.005
	Grade SHY685N	---	---	6 ≤ t ≤ 50	---	0.18	1.50	0.55	0.030	0.025	0.80	0.30-1.50	0.60	V 0.10; Cu 0.50; B 0.005
				50 < t ≤ 75	---	0.18	1.50	0.55	0.030	0.025	0.80	0.30-1.50	0.60	V 0.10; Cu 0.50; B 0.005
				75 < t ≤ 100	---	0.18	1.50	0.55	0.030	0.025	0.80	0.30-1.50	0.60	V 0.10; Cu 0.50; B 0.005
	Grade SHY685NS	---	---	6 ≤ t ≤ 50	---	0.14	1.50	0.55	0.015	0.015	0.80	0.30-1.50	0.60	V 0.05; Cu 0.50; B 0.005
				50 < t ≤ 75	---	0.14	1.50	0.55	0.015	0.015	0.80	0.30-1.50	0.60	V 0.05; Cu 0.50; B 0.005
				75 < t ≤ 100	---	0.14	1.50	0.55	0.015	0.015	0.80	0.30-1.50	0.60	V 0.05; Cu 0.50; B 0.005

3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

3.3A Mechanical Properties of Structural Steels with Improved Atmospheric Corrosion-Resistance

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ISO 4952:2006	Grade S235W, Quality B	---	---	$t \leq 16$	---	235	---	360-520	---	26	AR	27 J @ 20°C
				$16 < t \leq 40$	---	225	---	360-520	---	26	AR	27 J @ 20°C
				$40 < t \leq 63$	---	215	---	360-520	---	25	AR	27 J @ 20°C
	Grade S235W, Quality C	---	---	$t \leq 16$	---	235	---	360-520	---	26	AR	27 J @ 0°C
				$16 < t \leq 40$	---	225	---	360-520	---	26	AR	27 J @ 0°C
				$40 < t \leq 63$	---	215	---	360-520	---	25	AR	27 J @ 0°C
	Grade S235W, Quality D	---	---	$t \leq 16$	---	235	---	360-520	---	26	AR or N	27 J @ -20°C
				$16 < t \leq 40$	---	225	---	360-520	---	26	AR or N	27 J @ -20°C
				$40 < t \leq 63$	---	215	---	360-520	---	25	AR or N	27 J @ -20°C
ISO 5952:2005	Grade HSA 235W, Class B	---	---	$t < 3$	---	235	---	360-510	---	20	HR	---
				$t \geq 3$	---	235	---	340-470	---	24	HR	---
	Grade HSA 235W, Class D	---	---	$t < 3$	---	235	---	360-510	---	20	HR	---
				$t \geq 3$	---	235	---	340-470	---	24	HR	---
GB/T 18982-2003	Grade Q295GNHJ	---	---	---	---	295	---	390 L	---	24 L	HR	L: 47 J @ 20°C

3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

3.3A Mechanical Properties of Structural Steels with Improved Atmospheric Corrosion-Resistance (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ISO 5952:2005	Grade HSA 245W, Class B	---	---	t < 3	---	245	---	400-540	---	20	HR	---
				t ≥ 3	---	245	---	400-540	---	24	HR	---
	Grade HSA 245W, Class D	---	---	t < 3	---	245	---	400-540	---	20	HR	---
				t ≥ 3	---	245	---	400-540	---	24	HR	---
JIS G 3114:2008	Symbol SMA400AW	---	---	t ≤ 16	---	245	---	400-540	---	see standard	N, QT, T or TMCP	---
				16 < t ≤ 40	---	235	---	400-540	---	see standard	N, QT, T or TMCP	---
				40 < t ≤ 100	---	215	---	400-540	---	see standard	N, QT, T or TMCP	---
				100 < t ≤ 160	---	205	---	400-540	---	see standard	N, QT, T or TMCP	---
				160 < t ≤ 200	---	195	---	400-540	---	see standard	N, QT, T or TMCP	---
	Symbol SMA400BW	---	---	t ≤ 16	---	245	---	400-540	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				16 < t ≤ 40	---	235	---	400-540	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				40 < t ≤ 100	---	215	---	400-540	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				100 < t ≤ 160	---	205	---	400-540	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				160 < t ≤ 200	---	195	---	400-540	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
	Symbol SMA400CW	---	---	t ≤ 16	---	245	---	400-540	---	see standard	N, QT, T or TMCP	L: 47 J @ 0°C
				16 < t ≤ 40	---	235	---	400-540	---	see standard	N, QT, T or TMCP	L: 47 J @ 0°C
				40 < t ≤ 100	---	215	---	400-540	---	see standard	N, QT, T or TMCP	L: 47 J @ 0°C
	Symbol SMA400AP	---	---	t ≤ 16	---	245	---	400-540	---	see standard	N, QT, T or TMCP	---
				16 < t ≤ 40	---	235	---	400-540	---	see standard	N, QT, T or TMCP	---
				40 < t ≤ 100	---	215	---	400-540	---	see standard	N, QT, T or TMCP	---
				100 < t ≤ 160	---	205	---	400-540	---	see standard	N, QT, T or TMCP	---
				160 < t ≤ 200	---	195	---	400-540	---	see standard	N, QT, T or TMCP	---
	Symbol SMA400BP	---	---	t ≤ 16	---	245	---	400-540	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				16 < t ≤ 40	---	235	---	400-540	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				40 < t ≤ 100	---	215	---	400-540	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				100 < t ≤ 160	---	205	---	400-540	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				160 < t ≤ 200	---	195	---	400-540	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
	Symbol SMA400CP	---	---	t ≤ 16	---	245	---	400-540	---	see standard	N, QT, T or TMCP	L: 47 J @ 0°C
				16 < t ≤ 40	---	235	---	400-540	---	see standard	N, QT, T or TMCP	L: 47 J @ 0°C
				40 < t ≤ 100	---	215	---	400-540	---	see standard	N, QT, T or TMCP	L: 47 J @ 0°C
GB/T 18982-2003	Grade Q245NHJ	---	---	---	---	245	---	400 L	---	19 L	HR	---
	Grade Q310GNHJ	---	---	---	---	310	---	440 L	---	26 L	CR	---
	Grade Q310GNHLJ	---	---	---	---	310	---	440 L	---	26 L	CR	---

3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

3.3A Mechanical Properties of Structural Steels with Improved Atmospheric Corrosion-Resistance (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 3125:2010	Symbol SPA-C	---	---	$0.6 \leq t \leq 2.3$	---	315	---	450	---	26	CR	---
ISO 4952:2006	Grade S355WP, Quality A	---	---	$t \leq 12$	---	355	---	470-630	---	21	AR	---
	Grade S355WP, Quality D	---	---	$t \leq 12$	---	355	---	470-630	---	21	AR	27 J @ -20°C
	Grade S355W, Quality B	---	---	$t \leq 16$	---	355	---	470-630	---	22	AR	27 J @ 20°C
				$16 < t \leq 40$	---	345	---	470-630	---	22	AR	27 J @ 20°C
				$40 < t \leq 63$	---	335	---	470-630	---	21	AR	27 J @ 20°C
	Grade S355W, Quality C	---	---	$t \leq 16$	---	355	---	470-630	---	22	AR	27 J @ 0°C
				$16 < t \leq 40$	---	345	---	470-630	---	22	AR	27 J @ 0°C
				$40 < t \leq 63$	---	335	---	470-630	---	21	AR	27 J @ 0°C
	Grade S355W, Quality D	---	---	$t \leq 16$	---	355	---	470-630	---	22	AR	27 J @ -20°C
				$16 < t \leq 40$	---	345	---	470-630	---	22	AR	27 J @ -20°C
				$40 < t \leq 63$	---	335	---	470-630	---	21	AR	27 J @ -20°C
ASTM A606/A606M-09a	Type 2	---	---	---	---	340	50	480	70	22	HR	---
				---	---	310	45	450	65	22	HR+A or HR+N	---
				---	---	310	45	450	65	22	CR	---
	Type 4	---	---	---	---	340	50	480	70	22	HR	---
				---	---	310	45	450	65	22	HR+A or HR+N	---
				---	---	310	45	450	65	22	CR	---
CSA G40.21-13	Grade 350A (50A)	---	---	---	---	350	50	480-650	70-95	21	AR, N or CtR	---
				---	---	350	50	480-650	70-95	21	SR, A or N	---
				$t \leq 100$	$t \leq 4$	350	50	480-650	70-95	21 L, 19 T	AR, N or CtR	---
	Grade 350AT (50AT)	---	---	---	---	350	50	480-650	70-95	21	AR, N or CtR	see standard for impact data
				$t \leq 100$	$t \leq 4$	350	50	480-650	70-95	21 L, 19 T	AR, N or CtR	
	Grade 350R (50R)	---	---	---	---	350	50	480-650	70-95	21	AR, N or CtR	---
				$t \leq 65$	$t \leq 2.5$	350	50	480-650	70-95	21 L, 18 T	AR, N or CtR	---
GB/T 18982-2003	Grade Q325NHYJ	---	---	---	---	325	---	490 L	---	18 L	HR	---
	Grade Q345GNHJ	---	---	---	---	345	---	480 L	---	24 L	HR	L: 47 J @ 20°C
	Grade Q345GNHLJ	---	---	---	---	345	---	480 L	---	24 L	HR	L: 47 J @ 20°C
ISO 5952:2005	Grade HSA 365W, Class B	---	---	$t < 3$	---	365	---	490-610	---	15	HR	---
				$3 \leq t \leq 6$	---	365	---	490-610	---	17	HR	---
				$t > 6$	---	365	---	490-610	---	21	HR	---
	Grade HSA 365W, Class D	---	---	$t < 3$	---	365	---	490-610	---	15	HR	---
				$3 \leq t \leq 6$	---	365	---	490-610	---	17	HR	---
				$t > 6$	---	365	---	490-610	---	21	HR	---

Note: This section continued on next page

3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

3.3A Mechanical Properties of Structural Steels with Improved Atmospheric Corrosion-Resistance (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 3114:2008	Symbol SMA490AW	---	---	$t \leq 16$	---	365	---	490-610	---	see standard	N, QT, T or TMCP	---
				$16 < t \leq 40$	---	355	---	490-610	---	see standard	N, QT, T or TMCP	---
				$40 < t \leq 75$	---	335	---	490-610	---	see standard	N, QT, T or TMCP	---
				$75 < t \leq 100$	---	325	---	490-610	---	see standard	N, QT, T or TMCP	---
				$100 < t \leq 160$	---	305	---	490-610	---	see standard	N, QT, T or TMCP	---
				$160 < t \leq 200$	---	295	---	490-610	---	see standard	N, QT, T or TMCP	---
	Symbol SMA490AP	---	---	$t \leq 16$	---	365	---	490-610	---	see standard	N, QT, T or TMCP	---
				$16 < t \leq 40$	---	355	---	490-610	---	see standard	N, QT, T or TMCP	---
				$40 < t \leq 75$	---	335	---	490-610	---	see standard	N, QT, T or TMCP	---
				$75 < t \leq 100$	---	325	---	490-610	---	see standard	N, QT, T or TMCP	---
				$100 < t \leq 160$	---	305	---	490-610	---	see standard	N, QT, T or TMCP	---
				$160 < t \leq 200$	---	295	---	490-610	---	see standard	N, QT, T or TMCP	---
	Symbol SMA490BW	---	---	$t \leq 16$	---	365	---	490-610	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				$16 < t \leq 40$	---	355	---	490-610	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				$40 < t \leq 75$	---	335	---	490-610	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				$75 < t \leq 100$	---	325	---	490-610	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				$100 < t \leq 160$	---	305	---	490-610	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				$160 < t \leq 200$	---	295	---	490-610	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
	Symbol SMA490BP	---	---	$t \leq 16$	---	365	---	490-610	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				$16 < t \leq 40$	---	355	---	490-610	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				$40 < t \leq 75$	---	335	---	490-610	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				$75 < t \leq 100$	---	325	---	490-610	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				$100 < t \leq 160$	---	305	---	490-610	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
				$160 < t \leq 200$	---	295	---	490-610	---	see standard	N, QT, T or TMCP	L: 27 J @ 0°C
	Symbol SMA490CW	---	---	$t \leq 16$	---	365	---	490-610	---	see standard	N, QT, T or TMCP	L: 47 J @ 0°C
				$16 < t \leq 40$	---	355	---	490-610	---	see standard	N, QT, T or TMCP	L: 47 J @ 0°C
				$40 < t \leq 75$	---	335	---	490-610	---	see standard	N, QT, T or TMCP	L: 47 J @ 0°C
				$75 < t \leq 100$	---	325	---	490-610	---	see standard	N, QT, T or TMCP	L: 47 J @ 0°C
	Symbol SMA490CP	---	---	$t \leq 16$	---	365	---	490-610	---	see standard	N, QT, T or TMCP	L: 47 J @ 0°C
				$16 < t \leq 40$	---	355	---	490-610	---	see standard	N, QT, T or TMCP	L: 47 J @ 0°C
				$40 < t \leq 75$	---	335	---	490-610	---	see standard	N, QT, T or TMCP	L: 47 J @ 0°C
				$75 < t \leq 100$	---	325	---	490-610	---	see standard	N, QT, T or TMCP	L: 47 J @ 0°C
JIS G 3125:2010	Symbol SPA-H	---	---	$t \leq 6.0$	---	355	---	490	---	22	HR	---
				$6.0 < t \leq 16$	---	355	---	490	---	15	HR	---

3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

3.3A Mechanical Properties of Structural Steels with Improved Atmospheric Corrosion-Resistance (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A871/A871M-14	Grade 60, Type I	---	---	---	---	415	60	520	75	18	AR, N or QT	see standard for impact data
	Grade 60, Type II	---	---	---	---	415	60	520	75	18	AR, N or QT	
	Grade 60, Type IV	---	---	---	---	415	60	520	75	18	AR, N or QT	
CSA G40.21-13	Grade 400A (60A)	---	---	---	---	400	60	520-690	75-100	21	AR, N or CtR	---
				---	---	400	60	520-690	75-100	20	SR, A or N	---
				$t \leq 65$	$t \leq 2.5$	400	60	520-690	75-100	21 L, 18 T	AR, N or CtR	---
	Grade 400AT (60AT)	---	---	---	---	400	60	520-690	75-100	21	AR, N or CtR	see standard for impact data
				---	---	400	60	520-690	75-100	20	SR, A or N	
				$t \leq 65$	$t \leq 2.5$	400	60	520-690	75-100	21 L, 18 T	AR, N or CtR	
ISO 5952:2005	Grade HSA 355W1, Class A	---	---	$t < 3$	---	355	---	510-680	---	15	HR	---
				$3 \leq t \leq 6$	---	355	---	490-630	---	20	HR	---
				$t > 6$	---	355	---	490-630	---	24	HR	---
	Grade HSA 355W1, Class D	---	---	$t < 3$	---	355	---	510-680	---	15	HR	---
				$3 \leq t \leq 6$	---	355	---	490-630	---	20	HR	---
				$t > 6$	---	355	---	490-630	---	24	HR	---
	Grade HSA 355W2, Class C	---	---	$t < 3$	---	355	---	510-680	---	18	HR	---
				$3 \leq t \leq 6$	---	355	---	490-630	---	20	HR	---
				$t > 6$	---	355	---	490-630	---	24	HR	---
	Grade HSA 355W2, Class D	---	---	$t < 3$	---	355	---	510-680	---	18	HR	---
				$3 \leq t \leq 6$	---	355	---	490-630	---	20	HR	---
				$t > 6$	---	355	---	490-630	---	24	HR	---

3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

3.3A Mechanical Properties of Structural Steels with Improved Atmospheric Corrosion-Resistance (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A871/A871M-14	Grade 65, Type I	---	---	---	---	450	65	550	80	17	AR, N or QT	see standard for impact data
	Grade 65, Type II	---	---	---	---	450	65	550	80	17	AR, N or QT	
	Grade 65, Type IV	---	---	---	---	450	65	550	80	17	AR, N or QT	
JIS G 3114:2008	Symbol SMA570W	---	---	$t \leq 16$	---	460	---	570-720	---	see standard	N, QT, T or TMCP	L: 47 J @ -5°C
				$16 < t \leq 40$	---	450	---	570-720	---	see standard	N, QT, T or TMCP	L: 47 J @ -5°C
				$40 < t \leq 75$	---	430	---	570-720	---	see standard	N, QT, T or TMCP	L: 47 J @ -5°C
				$75 < t \leq 100$	---	420	---	570-720	---	see standard	N, QT, T or TMCP	L: 47 J @ -5°C
	Symbol SMA570P	---	---	$t \leq 16$	---	460	---	570-720	---	see standard	N, QT, T or TMCP	L: 47 J @ -5°C
				$16 < t \leq 40$	---	450	---	570-720	---	see standard	N, QT, T or TMCP	L: 47 J @ -5°C
				$40 < t \leq 75$	---	430	---	570-720	---	see standard	N, QT, T or TMCP	L: 47 J @ -5°C
				$75 < t \leq 100$	---	420	---	570-720	---	see standard	N, QT, T or TMCP	L: 47 J @ -5°C
CSA G40.21-13	Grade 480A (70A)	---	---	---	---	480	70	590-790	85-115	17	SR, A or N	---
				$t \leq 65$	$t \leq 2.5$	480	70	590-790	85-115	17 L, 14 T	AR, N or CtR	---
	Grade 480AT (70AT)	---	---	---	---	480	70	590-790	85-115	17	SR, A or N	see standard for impact data
				$t \leq 65$	$t \leq 2.5$	480	70	590-790	85-115	17 L, 14 T	AR, N or CtR	
	Grade 550A (80A)	---	---	---	---	550	80	620-860	90-125	15	SR, A or N	---
				$t \leq 65$	$t \leq 2.5$	550	80	620-860	90-125	15 L, 12 T	AR, N or CtR	---
	Grade 550AT (80AT)	---	---	---	---	550	80	620-860	90-125	15	SR, A or N	see standard for impact data
				$t \leq 65$	$t \leq 2.5$	550	80	620-860	90-125	15 L, 12 T	AR, N or CtR	

3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

3.3B Chemical Composition of Structural Steels with Improved Atmospheric Corrosion-Resistance

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 4952:2006	Grade S235W, Quality B	---	---	---	---	0.13	0.20-0.60	0.10-0.40	0.040	0.035	0.40-0.80	0.65	---	V 0.02-0.15; Al 0.020 min.; Cu 0.25-0.55; Ti 0.02-0.10; Nb 0.015-0.060
	Grade S235W, Quality C	---	---	---	---	0.13	0.20-0.60	0.10-0.40	0.040	0.035	0.40-0.80	0.65	---	V 0.02-0.15; Al 0.020 min.; Cu 0.25-0.55; Ti 0.02-0.10; Nb 0.015-0.060
	Grade S235W, Quality D	---	---	---	---	0.13	0.20-0.60	0.10-0.40	0.040	0.035	0.40-0.80	0.65	---	V 0.02-0.15; Al 0.020 min.; Cu 0.25-0.55; Ti 0.02-0.10; Nb 0.015-0.060
ISO 5952:2005	Grade HSA 235W, Class B	---	---	---	---	0.13	0.20-0.60	0.100-0.40	0.040	0.035	0.40-0.80	0.65	---	Cu 0.25-0.55
	Grade HSA 235W, Class D	---	---	---	---	0.13	0.20-0.60	0.100-0.40	0.040	0.035	0.40-0.80	0.65	---	Al 0.020 min.; Cu 0.25-0.55
GB/T 18982-2003	Grade Q295GNHJ	---	---	---	---	0.12	0.25-0.55	0.20-0.40	0.07-0.12	0.030	---	---	---	Cu 0.25-0.50; Ti 0.030
ISO 5952:2005	Grade HSA 245W, Class B	---	---	---	---	0.18	1.25	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Cu 0.30-0.50; (Mo+Nb+Ti+V+Zr) 0.15
	Grade HSA 245W, Class D	---	---	---	---	0.18	1.25	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Al 0.020 min.; Cu 0.30-0.50; (Mo+Nb+Ti+V+Zr) 0.15
JIS G 3114:2008	Symbol SMA400AW	---	---	t ≤ 200	---	0.18	1.25	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Cu 0.30-0.50
	Symbol SMA400BW	---	---	t ≤ 200	---	0.18	1.25	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Cu 0.30-0.50
	Symbol SMA400CW	---	---	t ≤ 100	---	0.18	1.25	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Cu 0.30-0.50
	Symbol SMA400AP	---	---	t ≤ 200	---	0.18	1.25	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35
	Symbol SMA400BP	---	---	t ≤ 200	---	0.18	1.25	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35
	Symbol SMA400CP	---	---	t ≤ 100	---	0.18	1.25	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35
GB/T 18982-2003	Grade Q245NHJ	---	---	---	---	0.14	1.50	0.55	0.030	0.030	0.80-1.30	---	0.30	Cu 0.15-0.40
	Grade Q310GNHJ	---	---	---	---	0.12	0.15-0.70	0.10-0.50	0.06-0.12	0.030	---	---	---	Cu 0.20-0.50; Ti 0.030
	Grade Q310GNHLJ	---	---	---	---	0.12	0.20-0.50	0.25-0.75	0.07-0.12	0.030	0.30-1.25	0.65	---	Cu 0.25-0.50

3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

3.3B Chemical Composition of Structural Steels with Improved Atmospheric Corrosion-Resistance (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3125:2010	Symbol SPA-C	---	---	$0.6 \leq t \leq 2.3$	---	0.12	0.60	0.20-0.75	0.070-0.150	0.035	0.30-1.25	0.65	---	Cu 0.25-0.55
ISO 4952:2006	Grade S355WP, Quality A	---	---	---	---	0.12	1.00	0.20-0.75	0.06-0.15	0.035	0.30-1.25	0.65	---	V 0.02-0.15; Al 0.020 min.; Cu 0.25-0.55; Ti 0.02-0.10; Nb 0.015-0.060
	Grade S355WP, Quality D	---	---	---	---	0.12	1.00	0.20-0.75	0.06-0.15	0.035	0.30-1.25	0.65	---	V 0.02-0.15; Al 0.020 min.; Cu 0.25-0.55; Ti 0.02-0.10; Nb 0.015-0.060
	Grade S355W, Quality B	---	---	---	---	0.19	0.50-1.50	0.50	0.040	0.035	0.40-0.80	0.65	0.30	V 0.02-0.15; Al 0.020 min.; Cu 0.25-0.55; Ti 0.02-0.10; Nb 0.015-0.060; Zr 0.15
	Grade S355W, Quality C	---	---	---	---	0.19	0.50-1.50	0.50	0.040	0.035	0.40-0.80	0.65	0.30	V 0.02-0.15; Al 0.020 min.; Cu 0.25-0.55; Ti 0.02-0.10; Nb 0.015-0.060; Zr 0.15
	Grade S355W, Quality D	---	---	---	---	0.19	0.50-1.50	0.50	0.040	0.035	0.40-0.80	0.65	0.30	V 0.02-0.15; Al 0.020 min.; Cu 0.25-0.55; Ti 0.02-0.10; Nb 0.015-0.060; Zr 0.15
ASTM A606/A606M-09a	Type 2	---	---	---	---	0.22	1.25	---	---	0.04	---	---	---	Cu 0.20 min.
	Type 4	---	---	---	---	0.22	1.25	---	---	0.04	---	---	---	---
CSA G40.21-13	Grade 350A (50A)	---	---	---	---	0.20	0.75-1.35	0.15-0.50	0.03	0.04	0.70	0.90	---	Cu 0.20-0.60; (Cr+Ni) 0.40
	Grade 350AT (50AT)	---	---	---	---	0.20	0.75-1.35	0.15-0.50	0.03	0.04	0.70	0.90	---	Cu 0.20-0.60; (Cr+Ni) 0.40
	Grade 350R (50R)	---	---	---	---	0.16	0.75	0.75	0.05-0.15	0.04	0.30-1.25	0.90	---	Cu 0.20-0.60; (Cr+Ni+Cu) 1.00
GB/T 18982-2003	Grade Q325NHYJ	---	---	---	---	0.14	1.50	0.55	0.030	0.030	0.80-1.30	---	---	Nb 0.10
	Grade Q345GNHJ	---	---	---	---	0.12	0.20-0.70	0.20-0.50	0.07-0.12	0.030	---	---	---	Cu 0.25-0.50; Ti 0.030
	Grade Q345GNHLJ	---	---	---	---	0.12	0.20-0.50	0.25-0.75	0.07-0.12	0.030	0.30-1.25	0.65	---	Cu 0.25-0.50
ISO 5952:2005	Grade HSA 365W, Class B	---	---	---	---	0.18	1.40	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Cu 0.30-0.50; (Mo+Nb+Ti+V+Zr) 0.15
	Grade HSA 365W, Class D	---	---	---	---	0.18	1.40	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Al 0.020 min.; Cu 0.30-0.50; (Mo+Nb+Ti+V+Zr) 0.15

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3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

3.3B Chemical Composition of Structural Steels with Improved Atmospheric Corrosion-Resistance (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3114:2008	Symbol SMA490AW	---	---	$t \leq 200$	---	0.18	1.40	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Cu 0.30-0.50
	Symbol SMA490AP	---	---	$t \leq 200$	---	0.18	1.40	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35
	Symbol SMA490BW	---	---	$t \leq 200$	---	0.18	1.40	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Cu 0.30-0.50
	Symbol SMA490BP	---	---	$t \leq 200$	---	0.18	1.40	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35
	Symbol SMA490CW	---	---	$t \leq 100$	---	0.18	1.40	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Cu 0.30-0.50
	Symbol SMA490CP	---	---	$t \leq 100$	---	0.18	1.40	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35
JIS G 3125:2010	Symbol SPA-H	---	---	$t \leq 16$	---	0.12	0.60	0.20-0.75	0.070-0.150	0.035	0.30-1.25	0.65	---	Cu 0.25-0.55
ASTM A871/A871M-14	Grade 60, Type I	---	---	---	---	0.19	0.80-1.35	0.30-0.65	0.030	0.030	0.40-0.70	0.40	---	V 0.02-0.10; Cu 0.25-0.40
	Grade 60, Type II	---	---	---	---	0.20	0.75-1.35	0.15-0.50	0.030	0.030	0.40-0.70	0.50	---	V 0.01-0.10; Cu 0.20-0.40
	Grade 60, Type IV	---	---	---	---	0.17	0.50-1.20	0.25-0.50	0.030	0.030	0.40-0.70	0.40	0.10	Cu 0.30-0.50; Cb 0.005-0.05
CSA G40.21-13	Grade 400A (60A)	---	---	---	---	0.20	0.75-1.35	0.15-0.50	0.03	0.04	0.70	0.90	---	Cu 0.20-0.60; (Cr+Ni) 0.40
	Grade 400AT (60AT)	---	---	---	---	0.20	0.75-1.35	0.15-0.50	0.03	0.04	0.70	0.90	---	Cu 0.20-0.60; (Cr+Ni) 0.40
ISO 5952:2005	Grade HSA 355W1, Class A	---	---	---	---	0.12	1.00	0.20-0.75	0.06-0.15	0.035	0.30-1.25	0.65	---	Cu 0.25-0.55
	Grade HSA 355W1, Class D	---	---	---	---	0.12	1.00	0.20-0.75	0.06-0.15	0.035	0.30-1.25	0.65	---	Al 0.020 min.; Cu 0.25-0.55
	Grade HSA 355W2, Class C	---	---	---	---	0.16	0.50-1.50	0.50	0.035	0.035	0.40-0.80	0.65	0.3	Cu 0.25-0.55; Zr 0.15
	Grade HSA 355W2, Class D	---	---	---	---	0.16	0.50-1.50	0.50	0.035	0.035	0.40-0.80	0.65	0.3	Al 0.020 min.; Cu 0.25-0.55; Zr 0.15

3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

3.3B Chemical Composition of Structural Steels with Improved Atmospheric Corrosion-Resistance (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A871/A871M-14	Grade 65, Type I	---	---	---	---	0.19	0.80-1.35	0.30-0.65	0.030	0.030	0.40-0.70	0.40	---	V 0.02-0.10; Cu 0.25-0.40
	Grade 65, Type II	---	---	---	---	0.20	0.75-1.35	0.15-0.50	0.030	0.030	0.40-0.70	0.50	---	V 0.01-0.10; Cu 0.20-0.40
	Grade 65, Type IV	---	---	---	---	0.17	0.50-1.20	0.25-0.50	0.030	0.030	0.40-0.70	0.40	0.10	Cu 0.30-0.50; Cb 0.005-0.05
JIS G 3114:2008	Symbol SMA570W	---	---	$t \leq 100$	---	0.18	1.40	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Cu 0.30-0.50
	Symbol SMA570P	---	---	$t \leq 100$	---	0.18	1.40	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35
CSA G40.21-13	Grade 480A (70A)	---	---	---	---	0.20	1.00-1.60	0.15-0.50	0.025	0.035	0.70	0.25-0.50	---	Cu 0.20-0.60; (Cr+Ni) 0.40
	Grade 480AT (70AT)	---	---	---	---	0.20	1.00-1.60	0.15-0.50	0.025	0.035	0.70	0.25-0.50	---	Cu 0.20-0.60; (Cr+Ni) 0.40
	Grade 550A (80A)	---	---	---	---	0.15	1.75	0.15-0.50	0.025	0.035	0.70	0.25-0.50	---	Cu 0.20-0.60; (Cr+Ni) 0.40
	Grade 550AT (80AT)	---	---	---	---	0.15	1.75	0.15-0.40	0.025	0.035	0.70	0.25-0.50	---	Cu 0.20-0.60; (Cr+Ni) 0.40

Chapter

4

PRESSURE VESSEL STEEL PLATES

ASME Standards

ASME SA-203/SA-203M	Pressure Vessel Plates, Alloy Steel, Nickel
ASME SA-204/SA-204M	Pressure Vessel Plates, Alloy Steel, Molybdenum
ASME SA-240/SA-240M	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASME SA-302/SA-302M	Pressure Vessel Plates, Alloy Steel, Manganese-Molybdenum and Manganese-Molybdenum-Nickel
ASME SA-353/SA-353M	Pressure Vessel Plates, Alloy Steel, Double-Normalized and Tempered 9 Percent Nickel
ASME SA-387/SA-387M	Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
ASME SA-414/SA-414M	Steel, Sheet, Carbon, for Pressure Vessels
ASME SA-479/SA-479M	Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
ASME SA-515/SA-515M	Pressure Vessel Plates, Carbon Steel, for Intermediate-and-Higher-Temperature Service
ASME SA-516/SA-516M	Pressure Vessel Plates, Carbon Steel, for Moderate-and-Lower-Temperature Service
ASME SA-533/SA-533M	Pressure Vessel Plates, Alloy Steel, Quenched and Tempered, Manganese-Molybdenum and Manganese-Molybdenum-Nickel
ASME SA-537/SA-537M	Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel
ASME SA-553/SA-553M	Pressure Vessel Plates, Alloy Steel, Quenched and Tempered 8 and 9 Percent Nickel
ASME SA-612/SA-612M	Pressure Vessel Plates, Carbon Steel, High Strength, for Moderate and Lower Temperature Service
ASME SA-662/SA-662M	Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service
ASME SA-666	Annealed or Cold-Worked Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar
ASME SA-737/SA-737M	Pressure Vessel Plates, High-Strength Low-Alloy Steel
ASME SA-738/SA-738M	Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service
ASME SA-841/SA-841M	Steel Plates for Pressure Vessels, Produced by Thermo-Mechanical Control Process (TMCP)

ASTM Standards

ASTM A203/A203M-12	Pressure Vessel Plates, Alloy Steel, Nickel
ASTM A204/A204M-12	Pressure Vessel Plates, Alloy Steel, Molybdenum
ASTM A240/A240M-15a	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A302/A302M-12	Pressure Vessel Plates, Alloy Steel, Manganese-Molybdenum and Manganese-Molybdenum-Nickel
ASTM A353/A353M-09 (2014)	Pressure Vessel Plates, Alloy Steel, Double-Normalized and Tempered 9 Percent Nickel
ASTM A387/A387M-11	Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
ASTM A414/A414M-14	Steel, Sheet, Carbon, and High-Strength, Low-Alloy for Pressure Vessels
ASTM A479/A479M-14	Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
ASTM A515/A515M-10	Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A516/A516M-10	Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A533/A533M-09 (2014)	Pressure Vessel Plates, Alloy Steel, Quenched and Tempered, Manganese-Molybdenum and Manganese-Molybdenum-Nickel
ASTM A537/A537M-13	Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel
ASTM A553/A553M-14	Pressure Vessel Plates, Alloy Steel, Quenched and Tempered 7, 8, and 9 Percent Nickel
ASTM A612/A612M-12	Pressure Vessel Plates, Carbon Steel, High Strength, for Moderate and Lower Temperature Service
ASTM A662/A662M-12	Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service
ASTM A666-15	Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A737/A737M-09 (2013)	Pressure Vessel Plates, High-Strength, Low-Alloy Steel
ASTM A738/A738M-12a	Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service
ASTM A841/A841M-13	Steel Plates for Pressure Vessels, Produced by Thermo-Mechanical Control Process (TMCP)
ASTM A844/A844M-09	Steel Plates, 9 Percent Nickel Alloy, for Pressure Vessels, Produced by the Direct-Quenching Process

EN Standards

EN 10028-2:2009	Flat products made of steels for pressure purposes - Part 2: Non-alloy and alloy steels with specified elevated temperature properties
EN 10028-3:2009	Flat products made of steels for pressure purposes - Part 3: Weldable fine grain steels, normalized
EN 10028-4:2009	Flat products made of steels for pressure purposes - Part 4: Nickel alloy steels with specified low temperature properties
EN 10028-7:2007	Flat products made of steels for pressure purposes - Part 7: Stainless steels
EN 10088-2:2014	Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes
EN 10088-3:2014	Stainless steels - Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes
EN 10120:2008	Steel sheet and strip for welded gas cylinders

GB Standards

GB 713-1997	Steel Plates for Boilers
GB 3280-92	Cold Rolled Stainless Steel Sheets and Plates
GB 3531-1996	Low Alloy Steel Plates for Low Temperature Pressure Vessels
GB 4237-92	Hot Rolled Stainless Steel Sheets and Plates
GB 4238-92	Heat-Resisting Steel Sheets and Plates
GB 6653-94	Steel Plates for Welded Gas Cylinders
GB 6654-1996	Steel Plates for Pressure Vessels

ISO Standards

ISO 4706:1989	Refillable Welded Steel Gas Cylinders
ISO 4978:1983	Flat Rolled Steel Products for Welded Gas Cylinders
ISO 9328-2:2004	Steel Plates and Strips for Pressure Purposes - Technical Delivery Conditions - Part 2: Unalloyed and Low-Alloyed Steels With Specified Room Temperature and Elevated Temperature Properties
ISO 9328-4:2004	Steel Plates and Strips for Pressure Purposes - Technical Delivery Conditions - Part 4: Weldable Fine Grain Steels With High Proof Stress Supplied In The Normalized or Quenched and Tempered Condition
ISO 9328-7:2004	Steel Flat Products for Pressure Purposes - Technical Delivery Conditions - Part 7: Stainless Steels

JIS Standards

JIS G 3103:2012	Carbon steel and molybdenum alloy steel plates for boilers and pressure vessels
JIS G 3115:2010	Steel plates for pressure vessels for intermediate temperature service
JIS G 3116:2013	Steel sheet, plates and strip for gas cylinders
JIS G 3118:2010	Carbon steel plates for pressure vessels for intermediate and moderate temperature service
JIS G 3119:2013	Manganese-molybdenum and manganese-molybdenum-nickel alloy steel plates for boilers and pressure vessels
JIS G 3120:2014	Manganese-molybdenum and manganese-molybdenum-nickel alloy steel plates quenched and tempered for pressure vessels
JIS G 3124:2009	High strength steel plates for pressure vessel for intermediate and moderate temperature service
JIS G 3126:2009	Carbon steel plates for pressure vessels for low temperature service
JIS G 3127:2013	Nickel steel plates for pressure vessels for low temperature services
JIS G 4109:2013	Chromium-molybdenum alloy steel plates for boilers and pressure vessels
JIS G 4110:2008	High strength chromium-molybdenum and chromium-molybdenum-vanadium alloy steel plates for pressure vessels under high-temperature service
JIS G 4304:2012	Hot-rolled stainless steel plates, sheets and strip
JIS G 4305:2012	Cold-rolled stainless steel plates, sheets and strip
JIS G 4312:2011	Heat-resisting steel plate, sheet and strip

Heat Treatment Terms Applicable to this Chapter

Standard	Heat Treatment Terms
ASME SA-203/SA-203M	N: normalized; Q+T: quenched and tempered
ASME SA-204/SA-204M	AR: as-rolled; SR: stress relieved; N: normalized; SR+N: stress relieved and normalized
ASME SA-240/SA-240M	See standard; Q+SA: quenched in water and solution annealed
ASME SA-302/SA-302M	AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved
ASME SA-353/SA-353M	NN+T: double-normalized and tempered
ASME SA-387/SA-387M	A: annealed; N+T: normalized and tempered; SR: stress relieved; Q+T: quenched and tempered
ASME SA-414/SA-414M	HR: hot-rolled
ASME SA-479/SA-479M	A: annealed
ASME SA-515/SA-515M	AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved
ASME SA-516/SA-516M	AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved
ASME SA-533/SA-533M	Q+T: quenched and tempered
ASME SA-537/SA-537M	N: normalized; Q+T: quenched and tempered
ASME SA-553/SA-553M	Q+T: quenched and tempered
ASME SA-612/SA-612M	AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved
ASME SA-662/SA-662M	AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved
ASME SA-666	A: annealed
ASME SA-737/SA-737M	N: normalized
ASME SA-738/SA-738M	N: normalized; Q+T: quenched and tempered
ASME SA-841/SA-841M	TMCP: thermo-mechanical control process
ASTM A203/A203M-12	N: normalized; Q+T: quenched and tempered
ASTM A204/A204M-12	AR: as-rolled; N: normalized; SR: stress relieved; SR+N: stress relieved and normalized
ASTM A240/A240M-15a	See standard; SA: solution annealed
ASTM A302/A302M-12	AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved
ASTM A353/A353M-09(2014)	NN+T: double-normalized and tempered
ASTM A387/A387M-11	A: annealed; N+T: normalized and tempered; Q+T: quenched and tempered; SR: stress relieved
ASTM A414/A414M-14	HR: hot-rolled
ASTM A479/A479M-14	SA: solution annealed
ASTM A515/A515M-10	AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved
ASTM A516/A516M-10	AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved
ASTM A533/A533M-09(2014)	Q+T: quenched and tempered
ASTM A537/A537M-13	N: normalized; Q+T: quenched and tempered
ASTM A553/A553M-14	Q+T: quenched and tempered
ASTM A612/A612M-12	AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved
ASTM A662/A662M-12	AR: as-rolled; N: normalized; SR: stress relieved; N+SR: normalized and stress relieved
ASTM A666-15	A: annealed
ASTM A737/A737M-09(2013)	N: normalized
ASTM A738/A738M-12a	N: normalized; Q+T: quenched and tempered
ASTM A841/A841M-13	TMCP: thermo-mechanical control processed
ASTM A844/A844M-09	Q+T: quenched and tempered
EN 10028-2:2009	AR: as-rolled; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered;
EN 10028-3:2009	AR: as-rolled; N: normalized
EN 10028-4:2009	N+T: normalized and tempered; N: normalized; Q+T: quenched and tempered;
EN 10028-7:2007	A: annealed; Q+T: quenched and tempered; SA: solution annealed
EN 10088-2:2014	A: annealed; SA: solution annealed
EN 10088-3:2014	SA: solution annealed
EN 10120:2008	HR or HR+N: hot-rolled or hot-rolled and normalized

Heat Treatment Terms Applicable to this Chapter (continued)

Standard	Heat Treatment Terms
GB 713-1997	HR: hot-rolled; CtR: controlled-rolled; N or N+T: normalized or normalized and tempered
GB 3280-92	A: annealed; ST: solution treated
GB 3531-1996	N or N+T: normalized or normalized and tempered
GB 4237-92	A: annealed; ST: solution treated
GB 4238-92	A: annealed; ST: solution treated
GB 6653-94	HR: hot-rolled; CtR: control-rolled; A: annealed
GB 6654-1996	N: normalized; N+T: normalized and tempered
ISO 4706:1989	N or SR: normalized or stress relieved
ISO 4978:1983	N+C(A): normalized and air cooled
ISO 9328-2:2004	N: normalized; BA: as rolled if agreed upon at the time of enquiry
ISO 9328-4:2004	N: normalized; N+T: normalized and (if appropriate) tempered; Q+T: quenched and tempered
ISO 9328-7:2004	SA: solution annealed; A: annealed; Q+T: quenched and tempered
JIS G 3103:2012	AR: as-rolled; N: normalized; SR: stress relieved
JIS G 3115:2010	AR: as-rolled; N: normalized; Q+T: quenched and tempered; TMCP: thermo-mechanical control processed
JIS G 3116:2013	HR: hot-rolled
JIS G 3118:2010	AR: as-rolled; N: normalized; Q+T: quenched and tempered; TMCP: thermo-mechanical control processed
JIS G 3119:2013	AR: as-rolled; N: normalized; A: annealed; Q+T: quenched and tempered; N+A: normalized and annealed
JIS G 3120:2014	AR: as-rolled; A: annealed; Q+T: quenched and tempered
JIS G 3124:2009	AR: as-rolled; N: normalized; N+T: normalized and tempered; A: annealed
JIS G 3126:2009	N: normalized; Q+T: quench hardened and tempered; TMCP: thermo-mechanical control process
JIS G 3127:2013	N: normalized; NNT: double normalized and tempered; N+T: normalized and tempered; TMCP: thermo-mechanical control processed; Q+T: quenched and tempered
JIS G 4109:2013	A: annealed; N+T: normalized and tempered
JIS G 4110:2008	N+T: normalized and tempered; Q+T: quench and tempered
JIS G 4304:2012	A: annealed; ST: solution treated
JIS G 4305:2012	A: annealed; ST: solution treated
JIS G 4312:2011	A: annealed

Impact Testing Notes Applicable to this Chapter

see standard for supplementary impact testing: the standard includes impact testing as a supplementary requirement (optional to the purchaser).
 see standard for impact data: impact testing requirements are listed in the standard for multiple test temperatures.

4.1 Carbon Steels for Pressure Vessel Plates

4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10028-2:2009	P235GH	---	1.0345	$t \leq 16$	---	235	---	360-480	---	24	AR, N	see standard for impact data
				$16 < t \leq 40$	---	225	---	360-480	---	24	AR, N	
				$40 < t \leq 60$	---	215	---	360-480	---	24	AR, N	
				$60 < t \leq 100$	---	200	---	360-480	---	24	AR, N	
				$100 < t \leq 150$	---	185	---	350-480	---	24	AR, N	
				$150 < t \leq 250$	---	170	---	340-480	---	24	AR, N	
ISO 4978:1983	Grade 2	---	---	$t < 3$	---	235	---	360-460	---	22	N+C(A)	---
				$3 \leq t \leq 6$	---	235	---	360-460	---	30	N+C(A)	---
ISO 9328-2:2004	Grade P235GH	---	---	$t \leq 16$	---	235	---	360-480	---	24	N or BA	see standard for impact data
				$16 < t \leq 40$	---	225	---	360-480	---	24	N or BA	
				$40 < t \leq 60$	---	215	---	360-480	---	24	N or BA	
				$60 < t \leq 100$	---	200	---	360-480	---	24	N or BA	
				$100 < t \leq 150$	---	185	---	350-480	---	24	N or BA	
				$150 < t \leq 250$	---	170	---	340-480	---	24	N or BA	
EN 10120:2008	P245NB	---	1.0111	$t \leq 5$	---	245	---	360-450 T	---	34 T	HR or HR+N	---
ASME SA-414/SA-414M	Grade C	K02503	---	$1.5 \leq t < 2.2$	$0.057 \leq t < 0.089$	230	33	380-485 T	55-70 T	19 T	HR	---
				$2.2 \leq t < 3.8$	$0.089 \leq t < 0.145$	230	33	380-485 T	55-70 T	20 T	HR	---
				$3.8 \leq t < 7.0$	$0.145 \leq t < 0.270$	230	33	380-485 T	55-70 T	22 T	HR	---
ASTM A414/A414M-14	Grade C	K02503	---	$1.5 \leq t < 2.2$	$0.057 \leq t < 0.089$	230	33	380-485 T	55-70 T	19 T	HR	---
				$2.2 \leq t < 3.8$	$0.089 \leq t < 0.145$	230	33	380-485 T	55-70 T	20 T	HR	---
				$3.8 \leq t < 7.0$	$0.145 \leq t < 0.270$	230	33	380-485 T	55-70 T	22 T	HR	---
GB 6653-94	Grade HP245	---	---	---	---	245	---	390 T	---	28 T	HR, CtR or A	see standard for impact data
EN 10028-3:2009	P275NH	---	1.0487	$t \leq 16$	---	275	---	390-510	---	24	AR, N	see standard for impact data
				$16 < t \leq 40$	---	265	---	390-510	---	24	AR, N	
				$40 < t \leq 60$	---	255	---	390-510	---	24	AR, N	
				$60 < t \leq 100$	---	235	---	370-490	---	23	AR, N	
				$100 < t \leq 150$	---	225	---	360-480	---	23	AR, N	
				$150 < t \leq 250$	---	215	---	350-470	---	23	AR, N	
JIS G 3116:2013	Symbol SG255	---	---	$1.6 \leq t \leq 6.0$	---	255	---	400 L	---	28 L	HR	---

Note: This section continued on next page.

4.1 Carbon Steels for Pressure Vessel Plates

4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 3115:2010	Symbol SPV235	---	---	6 < t ≤ 16	---	235	---	400-510	---	17	AR or N	see standard for impact data
				16 < t ≤ 40	---	235	---	400-510	---	21	AR or N	L: 47 J @ 0°C
				40 < t ≤ 50	---	235	---	400-510	---	24	AR or N	L: 47 J @ 0°C
				50 < t ≤ 100	---	215	---	400-510	---	24	AR or N	L: 47 J @ 0°C
				100 < t ≤ 200	---	195	---	400-510	---	24	AR or N	L: 47 J @ 0°C
GB 6654-1996	Grade 20R	---	---	6 < t ≤ 16	---	245	---	400-520	---	25	N	T: 31 J @ 20°C
				16 < t ≤ 36	---	235	---	400-520	---	25	N	T: 31 J @ 20°C
				36 < t ≤ 60	---	225	---	400-520	---	25	N	T: 31 J @ 20°C
				60 < t ≤ 100	---	205	---	390-510	---	24	N	T: 31 J @ 20°C
GB 713-1997	Grade 20g	---	---	6 ≤ t ≤ 16	---	245	---	400-530	---	26	HR, CtR, N or N+T	see standard for impact data
				16 < t ≤ 25	---	235	---	400-520	---	25	HR, CtR, N or N+T	
				25 < t ≤ 36	---	225	---	400-520	---	24	HR, CtR, N or N+T	
				36 < t ≤ 60	---	225	---	400-520	---	23	HR, CtR, N or N+T	
				60 < t ≤ 100	---	205	---	390-510	---	22	HR, CtR, N or N+T	
				100 < t ≤ 150	---	185	---	380-500	---	22	HR, CtR, N or N+T	
EN 10028-2:2009	P265GH	---	1.0425	t ≤ 16	---	265	---	410-530	---	22	AR, N	see standard for impact data
				16 < t ≤ 40	---	255	---	410-530	---	22	AR, N	
				40 < t ≤ 60	---	245	---	410-530	---	22	AR, N	
				60 < t ≤ 100	---	215	---	410-530	---	22	AR, N	
				100 < t ≤ 150	---	200	---	400-530	---	22	AR, N	
				150 < t ≤ 250	---	185	---	390-530	---	22	AR, N	
EN 10120:2008	P265NB	---	1.0423	t ≤ 5	---	265	---	410-500 T	---	32 T	HR or HR+N	---
GB 6653-94	Grade HP265	---	---	---	---	265	---	410 T	---	27 T	HR, CtR or A	see standard for impact data
ISO 4978:1983	Grade 3	---	---	t < 3	---	265	---	410-510	---	20	N+C(A)	---
				3 ≤ t ≤ 6	---	265	---	410-510	---	28	N+C(A)	---
ISO 9328-2:2004	Grade P265GH	---	---	t ≤ 16	---	265	---	410-530	---	22	N or BA	see standard for impact data
				16 < t ≤ 40	---	255	---	410-530	---	22	N or BA	
				40 < t ≤ 60	---	245	---	410-530	---	22	N or BA	
				60 < t ≤ 100	---	215	---	410-530	---	22	N or BA	
				100 < t ≤ 150	---	200	---	400-530	---	22	N or BA	
				150 < t ≤ 250	---	185	---	390-530	---	22	N or BA	
JIS G 3103:2012	Symbol SB410	---	---	6 ≤ t ≤ 50	---	225	---	410-550	---	21	AR, N or SR	---
				50 < t ≤ 200	---	225	---	410-550	---	25	N	---

Note: This section continued on next page.

4.1 Carbon Steels for Pressure Vessel Plates

4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 3118:2010	Symbol SGV410	---	---	6 ≤ t ≤ 50	---	225	---	410-490 T	---	21	AR, N, Q+T or TMCP	---
				50 < t ≤ 200	---	225	---	410-490 T	---	25	N, Q+T, TMCP	---
ASME SA-515/SA-515M	Grade 60 [415]	K02401	---	t ≤ 50	t ≤ 2	220	32	415-550	60-80	25	AR or N or SR or N+SR	---
				t > 50	t > 2	220	32	415-550	60-80	25	N	---
ASME SA-516/SA-516M	Grade 60 [415]	K02100	---	t ≤ 40	t ≤ 1.50	220	32	415-550	60-80	25	AR or N or SR or N+SR	---
				t > 40	t > 1.50	220	32	415-550	60-80	25	N	---
ASTM A515/A515M-10	Grade 60 [415]	K02401	---	t ≤ 50	t ≤ 2	220	32	415-550	60-80	25	AR, N, SR or N+SR	---
				t > 50	t > 2	220	32	415-550	60-80	25	N	---
ASTM A516/A516M-10	Grade 60 [415]	K02100	---	t ≤ 40	t ≤ 1.50	220	32	415-550	60-80	25	AR, N, SR or N+SR	---
				t > 40	t > 1.50	220	32	415-550	60-80	25	N	---
ASME SA-414/SA-414M	Grade D	K02505	---	1.5 ≤ t < 2.2	0.057 ≤ t < 0.089	240	35	415-515 T	60-75 T	17 T	HR	---
				2.2 ≤ t < 3.8	0.089 ≤ t < 0.145	240	35	415-515 T	60-75 T	18 T	HR	---
				3.8 ≤ t < 7.0	0.145 ≤ t < 0.270	240	35	415-515 T	60-75 T	20 T	HR	---
ASTM A414/A414M-14	Grade D	K02505	---	1.5 ≤ t < 2.2	0.057 ≤ t < 0.089	240	35	415-515 T	60-75 T	17 T	HR	---
				2.2 ≤ t < 3.8	0.089 ≤ t < 0.145	240	35	415-515 T	60-75 T	18 T	HR	---
				3.8 ≤ t < 7.0	0.145 ≤ t < 0.270	240	35	415-515 T	60-75 T	20 T	HR	---
GB 6653-94	Grade HP295	---	---	---	---	295	---	440 T	---	26 T	HR, CtR or A	see standard for impact data
JIS G 3116:2013	Symbol SG295	---	---	1.6 ≤ t ≤ 6.0	---	295	---	440 L	---	26 L	HR	---
ASME SA-515/SA-515M	Grade 65 [450]	K02800	---	t ≤ 50	t ≤ 2	240	35	450-585	65-85	23	AR or N or SR or N+SR	---
				t > 50	t > 2	240	35	450-585	65-85	23	N	---
ASME SA-516/SA-516M	Grade 65 [450]	K02403	---	t ≤ 40	t ≤ 1.50	240	35	450-585	65-85	23	AR or N or SR or N+SR	---
				t > 40	t > 1.50	240	35	450-585	65-85	23	N	---
ASTM A515/A515M-10	Grade 65 [450]	K02800	---	t ≤ 50	t ≤ 2	240	35	450-585	65-85	23	AR, N, SR or N+SR	---
				t > 50	t > 2	240	35	450-585	65-85	23	N	---
ASTM A516/A516M-10	Grade 65 [450]	K02403	---	t ≤ 40	t ≤ 1.50	240	35	450-585	65-85	23	AR, N, SR or N+SR	---
				t > 40	t > 1.50	240	35	450-585	65-85	23	N	---
JIS G 3103:2012	Symbol SB450	---	---	6 ≤ t ≤ 50	---	245	---	450-590	---	19	AR, N or SR	---
				50 < t ≤ 200	---	245	---	450-590	---	23	N	---
JIS G 3118:2010	Symbol SGV450	---	---	6 ≤ t ≤ 50	---	245	---	450-540 T	---	19	AR, N, Q+T or TMCP	---
				50 < t ≤ 200	---	245	---	450-540 T	---	23	N, Q+T, TMCP	---
ASME SA-414/SA-414M	Grade E	K02704	---	1.5 ≤ t < 2.2	0.057 ≤ t < 0.089	260	38	450-585 T	65-85 T	15 T	HR	---
				2.2 ≤ t < 3.8	0.089 ≤ t < 0.145	260	38	450-585 T	65-85 T	16 T	HR	---
				3.8 ≤ t < 7.0	0.145 ≤ t < 0.270	260	38	450-585 T	65-85 T	18 T	HR	---
ASTM A414/A414M-14	Grade E	K02704	---	1.5 ≤ t < 2.2	0.057 ≤ t < 0.089	260	38	450-585 T	65-85 T	15 T	HR	---
				2.2 ≤ t < 3.8	0.089 ≤ t < 0.145	260	38	450-585 T	65-85 T	16 T	HR	---
				3.8 ≤ t < 7.0	0.145 ≤ t < 0.270	260	38	450-585 T	65-85 T	18 T	HR	---

4.1 Carbon Steels for Pressure Vessel Plates

4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10028-2:2009	P295GH	---	1.0481	$t \leq 16$	---	295	---	460-580	---	21	AR, N	see standard for impact data
				$16 < t \leq 40$	---	290	---	460-580	---	21	AR, N	
				$40 < t \leq 60$	---	285	---	460-580	---	21	AR, N	
				$60 < t \leq 100$	---	260	---	460-580	---	21	AR, N	
				$100 < t \leq 150$	---	235	---	440-570	---	21	AR, N	
				$150 < t \leq 250$	---	220	---	430-570	---	21	AR, N	
EN 10120:2008	P310NB	---	1.0437	$t \leq 5$	---	310	---	460-550 T	---	28 T	HR or HR+N	---
JIS G 3103:2012	Symbol SB480	---	---	$6 \leq t \leq 50$	---	265	---	480-620	---	17	AR, N or SR	---
JIS G 3118:2010	Symbol SGV480	---	---	$50 < t \leq 200$	---	265	---	480-620	---	21	N	---
				$6 \leq t \leq 50$	---	265	---	480-590 T	---	17	AR, N, Q+T or TMCP	---
				$50 < t \leq 200$	---	265	---	480-590 T	---	21	N, Q+T, TMCP	---
ASME SA-515/SA-515M	Grade 70 [485]	K03101	---	$t \leq 50$	$t \leq 2$	260	38	485-620	70-90	21	AR or N or SR or N+SR	---
				$t > 50$	$t > 2$	260	38	485-620	70-90	21	N	---
ASME SA-516/SA-516M	Grade 70 [485]	K02700	---	$t \leq 40$	$t \leq 1.50$	260	38	485-620	70-90	21	AR or N or SR or N+SR	---
				$t > 40$	$t > 1.50$	260	38	485-620	70-90	21	N	---
ASME SA-537/SA-537M	Class 1	K12437	---	$t \leq 65$	$t \leq 2.5$	345	50	485-620	70-90	22	N	---
				$65 < t \leq 100$	$2.5 < t \leq 4$	310	45	450-585	65-85	22	N	---
ASME SA-737/SA-737M	Grade B	K12001	---	---	---	345	50	485-620	70-90	23	N	---
ASTM A515/A515M-10	Grade 70 [485]	K03101	---	$t \leq 50$	$t \leq 2$	260	38	485-620	70-90	21	AR, N, SR or N+SR	---
				$t > 50$	$t > 2$	260	38	485-620	70-90	21	N	---
ASTM A516/A516M-10	Grade 70 [485]	K02700	---	$t \leq 40$	$t \leq 1.50$	260	38	485-620	70-90	21	AR, N, SR or N+SR	---
				$t > 40$	$t > 1.50$	260	38	485-620	70-90	21	N	---
ASME SA-414/SA-414M	Grade F	K03102	---	$1.5 \leq t < 2.2$	$0.057 \leq t < 0.089$	290	42	485-620 T	70-90 T	13 T	HR	---
				$2.2 \leq t < 3.8$	$0.089 \leq t < 0.145$	290	42	485-620 T	70-90 T	14 T	HR	---
				$3.8 \leq t < 7.0$	$0.145 \leq t < 0.270$	290	42	485-620 T	70-90 T	16 T	HR	---
ASTM A414/A414M-14	Grade F	K03102	---	$1.5 \leq t < 2.2$	$0.057 \leq t < 0.089$	290	42	485-620 T	70-90 T	13 T	HR	---
				$2.2 \leq t < 3.8$	$0.089 \leq t < 0.145$	290	42	485-620 T	70-90 T	14 T	HR	---
				$3.8 \leq t < 7.0$	$0.145 \leq t < 0.270$	290	42	485-620 T	70-90 T	16 T	HR	---
ASTM A537/A537M-13	Class 1	K12437	---	$t \leq 65$	$t \leq 2.5$	345	50	485-620	70-90	22	N	---
				$65 < t \leq 100$	$2.5 < t \leq 4$	310	45	450-585	65-85	22	N	---
ASTM A737/A737M-09 (2013)	Grade B	K12001	---	---	---	345	50	485-620	70-90	23	N	---

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4.1 Carbon Steels for Pressure Vessel Plates

4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ISO 4706:1989	carbon steel	---	---	$t < 3$	---	---	---	490 max.	---	22	N or SR	---
				$t \geq 3$	---	---	---	490 max.	---	29	N or SR	---
	alloy steel	---	---	$t < 3$	---	---	---	490	---	15	N or SR	---
				$t \geq 3$	---	---	---	490	---	20	N or SR	---
GB 3531-1996	Grade 16MnDR	---	---	$6 \leq t \leq 16$	---	315	---	490-620	---	21	N or N+T	---
				$16 < t \leq 36$	---	295	---	470-600	---	21	N or N+T	---
				$36 < t \leq 60$	---	275	---	450-580	---	21	N or N+T	---
				$60 < t \leq 100$	---	255	---	450-580	---	21	N or N+T	---
JIS G 3115:2010	Symbol SPV315	---	---	$6 < t \leq 16$	---	315	---	490-610	---	16	AR, N, Q+T or TMCP	see standard for impact data
				$16 < t \leq 40$	---	315	---	490-610	---	20	AR, N, Q+T or TMCP	L: 47 J @ 0°C
				$40 < t \leq 50$	---	315	---	490-610	---	23	AR, N, Q+T or TMCP	L: 47 J @ 0°C
				$50 < t \leq 100$	---	295	---	490-610	---	23	AR, N, Q+T or TMCP	L: 47 J @ 0°C
				$100 < t \leq 150$	---	275	---	490-610	---	23	AR, N, Q+T or TMCP	L: 47 J @ 0°C
GB 6653-94	Grade HP325	---	---	---	---	325	---	490 T	---	21 T	HR, CtR or A	see standard for impact data
JIS G 3116:2013	Symbol SG325	---	---	$1.6 \leq t \leq 6.0$	---	325	---	490 L	---	22 L	HR	---
ISO 4978:1983	Grade 4	---	---	$t < 3$	---	345	---	490-610	---	17	N+C(A)	---
				$3 \leq t \leq 6$	---	345	---	490-610	---	24	N+C(A)	---
EN 10028-3:2009	P355N	---	1.0562	$t \leq 16$	---	355	---	490-630	---	22	AR, N	see standard for impact data
				$16 < t \leq 40$	---	345	---	490-630	---	22	AR, N	
				$40 < t \leq 60$	---	335	---	490-630	---	22	AR, N	
				$60 < t \leq 100$	---	315	---	470-610	---	21	AR, N	
				$100 < t \leq 150$	---	305	---	460-600	---	21	AR, N	
				$150 < t \leq 250$	---	295	---	450-590	---	21	AR, N	
	P355NH	---	1.0565	$t \leq 16$	---	355	---	490-630	---	22	AR, N	see standard for impact data
				$16 < t \leq 40$	---	345	---	490-630	---	22	AR, N	
				$40 < t \leq 60$	---	335	---	490-630	---	22	AR, N	
				$60 < t \leq 100$	---	315	---	470-610	---	21	AR, N	
				$100 < t \leq 150$	---	305	---	460-600	---	21	AR, N	
				$150 < t \leq 250$	---	295	---	450-590	---	21	AR, N	

4.1 Carbon Steels for Pressure Vessel Plates

4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 6654-1996	Grade 16MnR	---	---	6 < t ≤ 16	---	345	---	510-640	---	21	N	T: 31 J @ 20°C
				16 < t ≤ 36	---	325	---	490-620	---	21	N	T: 31 J @ 20°C
				36 < t ≤ 60	---	305	---	470-600	---	21	N	T: 31 J @ 20°C
				60 < t ≤ 100	---	285	---	460-590	---	20	N	T: 31 J @ 20°C
				100 < t ≤ 120	---	275	---	450-580	---	20	N	T: 31 J @ 20°C
GB 713-1997	Grade 16Mng	---	---	6 ≤ t ≤ 16	---	345	---	510-655	---	21	HR, CtR, N or N+T	see standard for impact data
				16 < t ≤ 25	---	325	---	490-635	---	19	HR, CtR, N or N+T	
				25 < t ≤ 36	---	305	---	470-620	---	19	HR, CtR, N or N+T	
				36 < t ≤ 60	---	285	---	470-620	---	19	HR, CtR, N or N+T	
				60 < t ≤ 100	---	265	---	440-590	---	18	HR, CtR, N or N+T	
	Grade 19Mng	---	---	100 < t ≤ 150	---	245	---	440-590	---	18	HR, CtR, N or N+T	
				6 ≤ t ≤ 16	---	355	---	510-650	---	20	HR, CtR, N or N+T	T: 31 J @ 0°C
				16 < t ≤ 40	---	345	---	510-650	---	20	HR, CtR, N or N+T	T: 31 J @ 0°C
				40 < t ≤ 60	---	335	---	510-650	---	20	HR, CtR, N or N+T	T: 31 J @ 0°C
				60 < t ≤ 100	---	315	---	490-630	---	20	HR, CtR, N or N+T	T: 31 J @ 0°C
				100 < t ≤ 150	---	295	---	480-630	---	20	HR, CtR, N or N+T	T: 31 J @ 0°C
GB 6653-94	Grade HP345	---	---	---	---	345	---	510 T	---	20 T	HR, CtR or A	see standard for impact data
EN 10028-2:2009	P355GH	---	1.0473	t ≤ 16	---	355	---	510-650	---	20	AR, N	see standard for impact data
				16 < t ≤ 40	---	345	---	510-650	---	20	AR, N	
				40 < t ≤ 60	---	335	---	510-650	---	20	AR, N	
				60 < t ≤ 100	---	315	---	490-630	---	20	AR, N	
				100 < t ≤ 150	---	295	---	480-630	---	20	AR, N	
EN 10120:2008 JIS G 3124:2009	P355NB Symbol SEV 245	---	1.0557	150 < t ≤ 250	---	280	---	470-630	---	20	AR, N	
				t ≤ 5	---	355	---	510-620 T	---	24 T	HR or HR+N	---
				6 ≤ t ≤ 50	---	370	---	510-650 T	---	16	AR, N, N+T or A	T: 31 J @ 0°C
				50 < t ≤ 100	---	355	---	510-650 T	---	20	AR, N, N+T or A	T: 31 J @ 0°C
				100 < t ≤ 125	---	345	---	500-640 T	---	20	AR, N, N+T or A	T: 31 J @ 0°C
GB 713-1997 ASME SA-414/SA-414M	Grade 22Mng Grade G	---	---	125 < t ≤ 150	---	335	---	490-630 T	---	20	AR, N, N+T or A	T: 31 J @ 0°C
				t > 25	---	275	---	515-655	---	19	HR, CtR, N or N+T	T: 27 J @ RT
				1.5 ≤ t < 2.2	0.057 ≤ t < 0.089	310	45	515-655 T	75-95 T	13 T	HR	---
				2.2 ≤ t < 3.8	0.089 ≤ t < 0.145	310	45	515-655 T	75-95 T	14 T	HR	---
				3.8 ≤ t < 7.0	0.145 ≤ t < 0.270	310	45	515-655 T	75-95 T	16 T	HR	---

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4.1 Carbon Steels for Pressure Vessel Plates

4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A414/A414M-14	Grade G	K03103	---	$1.5 \leq t < 2.2$	$0.057 \leq t < 0.089$	310	45	515-655	75-95	13	HR	---
				$2.2 \leq t < 3.8$	$0.089 \leq t < 0.145$	310	45	515-655	75-95	14	HR	---
				$3.8 \leq t < 7.0$	$0.145 \leq t < 0.270$	310	45	515-655	75-95	16	HR	---
ASME SA-738/SA-738M	Grade A	K12447	---	$t \leq 65$	$t \leq 2.5$	310	45	515-655	75-95	20	N or Q+T	---
				$t > 65$	$t > 2.5$	310	45	515-655	75-95	20	Q+T	---
ASTM A738/A738M-12a	Grade A	K12447	---	$t \leq 65$	$t \leq 2.5$	310	45	515-655	75-95	20	N or Q+T	---
				$t > 65$	$t > 2.5$	310	45	515-655	75-95	20	Q+T	---
JIS G 3115:2010	Symbol SPV355	---	---	$6 < t \leq 16$	---	355	---	520-640	---	14	AR, N, Q+T or TMCP	see standard for impact data
				$16 < t \leq 40$	---	355	---	520-640	---	18	AR, N, Q+T or TMCP	L: 47 J @ 0°C
				$40 < t \leq 50$	---	355	---	520-640	---	21	AR, N, Q+T or TMCP	L: 47 J @ 0°C
				$50 < t \leq 100$	---	335	---	520-640	---	21	AR, N, Q+T or TMCP	L: 47 J @ 0°C
				$100 < t \leq 150$	---	315	---	520-640	---	21	AR, N, Q+T or TMCP	L: 47 J @ 0°C
GB 6654-1996	Grade 15MnVR	---	---	$6 < t \leq 16$	---	390	---	530-665	---	19	N	T: 31 J @ 20°C
				$16 < t \leq 36$	---	370	---	510-645	---	19	N	T: 31 J @ 20°C
				$36 < t \leq 60$	---	350	---	490-625	---	19	N	T: 31 J @ 20°C
GB 6653-94	Grade HP365	---	---	---	---	365	---	540 T	---	20 T	HR, CTR or A	see standard for impact data
JIS G 3116:2013	Symbol SG365	---	---	$1.6 \leq t \leq 6.0$	---	365	---	540 L	---	20 L	HR	---
ASME SA-537/SA-537M	Class 3	K12437	---	$t \leq 65$	$t \leq 2.5$	380	55	550-690	80-100	22	Q+T	---
				$65 < t \leq 100$	$2.5 < t \leq 4$	345	50	515-655	75-95	22	Q+T	---
				$100 < t \leq 150$	$4 < t \leq 6$	275	40	485-620	70-90	20	Q+T	---
	Class 2	K12437	---	$t \leq 65$	$t \leq 2.5$	415	60	550-690	80-100	22	Q+T	---
				$65 < t \leq 100$	$2.5 < t \leq 4$	380	55	515-655	75-95	22	Q+T	---
				$100 < t \leq 150$	$4 < t \leq 6$	315	46	485-620	70-90	20	Q+T	---
ASTM A537/A537M-13	Class 3	K12437	---	$t \leq 65$	$t \leq 2.5$	380	55	550-690	80-100	22	Q+T	---
				$65 < t \leq 100$	$2.5 < t \leq 4$	345	50	515-655	75-95	22	Q+T	---
				$100 < t \leq 150$	$4 < t \leq 6$	275	40	485-620	70-90	20	Q+T	---
	Class 2	K12437	---	$t \leq 65$	$t \leq 2.5$	415	60	550-690	80-100	22	Q+T	---
				$65 < t \leq 100$	$2.5 < t \leq 4$	380	55	515-655	75-95	22	Q+T	---
				$100 < t \leq 150$	$4 < t \leq 6$	315	46	485-620	70-90	20	Q+T	---

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4.1 Carbon Steels for Pressure Vessel Plates

4.1A Mechanical Properties of Carbon Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 3115:2010	Symbol SPV410	---	---	6 < t ≤ 16	---	410	---	550-670	---	12	N, Q+T or TMCP	see standard for impact data
				16 < t ≤ 40	---	410	---	550-670	---	16	N, Q+T or TMCP	L: 47 J @ -10°C
				40 < t ≤ 50	---	410	---	550-670	---	18	N, Q+T or TMCP	L: 47 J @ -10°C
				50 < t ≤ 100	---	390	---	550-670	---	18	N, Q+T or TMCP	L: 47 J @ -10°C
				100 < t ≤ 150	---	370	---	550-670	---	18	N, Q+T or TMCP	L: 47 J @ -10°C
ASME SA-737/SA-737M	Grade C	K12202	---	---	---	415	60	550-690	80-100	23	N	---
ASTM A737/A737M-09 (2013)	Grade C	K12202	---	---	---	415	60	550-690	80-100	23	N	---
ASME SA-738/SA-738M	Grade C	K02008	---	t ≤ 65	t ≤ 2.5	415	60	550-690	80-100	22	Q+T	---
				65 < t ≤ 100	2.5 < t ≤ 4	380	55	515-655	75-95	22	Q+T	---
				t > 100	t > 4	315	46	485-620	70-90	20	Q+T	---
ASTM A738/A738M-12a	Grade C	K02008	---	t ≤ 65	t ≤ 2.5	415	60	550-690	80-100	22	Q+T	---
				65 < t ≤ 100	2.5 < t ≤ 4	380	55	515-655	75-95	22	Q+T	---
				t > 100	t > 4	315	46	485-620	70-90	20	Q+T	---
ASME SA-612/SA-612M	---	---	---	t ≤ 12.5	t ≤ 0.5	345	50	570-725	83-105	22	AR or N or SR or N+SR	---
				12.5 < t ≤ 25	0.5 < t ≤ 1	345	50	560-695	81-101	22	AR or N or SR or N+SR	---
ASTM A612/A612M-12	---	---	---	t ≤ 12.5	t ≤ 0.5	345	50	570-725	83-105	22	AR, N, SR or N+SR	---
				12.5 < t ≤ 25	0.5 < t ≤ 1	345	50	560-695	81-101	22	AR, N, SR or N+SR	---
JIS G 3115:2010	Symbol SPV450	---	---	6 < t ≤ 16	---	450	---	570-700	---	19	N or Q+T	see standard for impact data
				16 < t ≤ 20	---	450	---	570-700	---	26	N or Q+T	L: 47 J @ -10°C
				20 < t ≤ 50	---	450	---	570-700	---	20	N or Q+T	L: 47 J @ -10°C
				50 < t ≤ 100	---	430	---	570-700	---	20	N or Q+T	L: 47 J @ -10°C
				100 < t ≤ 150	---	410	---	570-700	---	20	N or Q+T	L: 47 J @ -10°C
ASME SA-738/SA-738M	Grade B	---	---	---	---	415	60	585-705	85-102	20	Q+T	---
ASTM A738/A738M-12a	Grade B	---	---	---	---	415	60	585-705	85-102	20	Q+T	---

4.1 Carbon Steels for Pressure Vessel Plates

4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10028-2:2009	P235GH	---	1.0345	---	---	0.16	0.60-1.20	0.35	0.025	0.010	0.30	0.30	0.08	V 0.02; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.020; N 0.012; (Cr+Cu+Mo+Ni) 0.70
ISO 4978:1983	Grade 2	---	---	---	---	0.16	0.25 min.	0.15	0.035	0.035	---	---	---	Al 0.015 min.
ISO 9328-2:2004	Grade P235GH	---	---	---	---	0.16	0.60-1.20	0.30	0.025	0.015	0.30	0.30	0.08	V 0.02; Al 0.02; Cu 0.30; Ti 0.03; Nb 0.02; (Cr+Cu+Mo+Ni) 0.70
EN 10120:2008	P245NB	---	1.0111	---	---	0.16	0.30 min.	0.25	0.025	0.015	---	---	---	Al 0.020 min.; Ti 0.03; Nb 0.050; N 0.009
ASME SA-414/SA-414M	Grade C	K02503	---	---	---	0.25	0.90	0.30	0.035	0.035	---	---	---	Al 0.02-0.08
ASTM A414/A414M-14	Grade C	K02503	---	---	---	0.25	0.90	0.30	0.035	0.035	0.30	0.40	0.12	Cu 0.40; Al 0.02-0.08; V 0.03; Ti 0.025; Cb 0.02
GB 6653-94	Grade HP245	---	---	---	---	0.16	0.60	0.35	0.035	0.035	0.30	0.30	0.30	V 0.12; Al 0.020 min.; Cu 0.20; Ti 0.20; Nb 0.060; (P+S) 0.060
EN 10028-3:2009	P275NH	---	1.0487	---	---	0.16	0.80-1.50	0.40	0.025	0.010	0.30	0.50	0.08	V 0.05; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.012; (Nb+Ti+V) 0.05; (Cr+Cu+Mo) 0.45
JIS G 3116:2013	Symbol SG255	---	---	1.6 ≤ t ≤ 6.0	---	0.20	0.30	---	0.020	0.020	---	---	---	---
JIS G 3115:2010	Symbol SPV235	---	---	6 ≤ t ≤ 100	---	0.18	1.40	0.35	0.030	0.030	---	---	---	---
				100 < t ≤ 200	---	0.20	1.40	0.35	0.030	0.030	---	---	---	---
GB 6654-1996	Grade 20R	---	---	---	---	0.20	0.40-0.90	0.15-0.30	0.035	0.030	0.30	0.30	---	Cu 0.30
GB 713-1997	Grade 20g	---	---	---	---	0.20	0.50-0.90	0.15-0.30	0.035	0.035	0.30	0.30	0.10	V 0.010; Cu 0.30

4.1 Carbon Steels for Pressure Vessel Plates

4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10028-2:2009	P265GH	---	1.0425	---	---	0.20	0.80-1.40	0.40	0.025	0.010	0.30	0.30	0.08	V 0.02; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.020; N 0.012; (Cr+Cu+Mo+Ni) 0.70
EN 10120:2008	P265NB	---	1.0423	---	---	0.19	0.40 min.	0.25	0.025	0.015	---	---	---	Al 0.020 min.; Ti 0.03; Nb 0.050; N 0.009
GB 6653-94	Grade HP265	---	---	---	---	0.19	0.80	0.35	0.035	0.035	0.30	0.30	0.30	V 0.12; Al 0.020 min.; Cu 0.20; Ti 0.20; Nb 0.060; (P+S) 0.060
ISO 4978:1983	Grade 3	---	---	---	---	0.19	0.40 min.	0.20	0.035	0.035	---	---	---	Al 0.015 min.
ISO 9328-2:2004	Grade P265GH	---	---	---	---	0.20	0.80-1.40	0.40	0.025	0.015	0.30	0.30	0.08	V 0.02; Al 0.02; Cu 0.30; Ti 0.03; Nb 0.02; (Cr+Cu+Mo+Ni) 0.70
JIS G 3103:2012	Symbol SB410	---	---	6 ≤ t ≤ 25	---	0.24	0.90	0.15-0.40	0.020	0.020	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32
				25 < t ≤ 50	---	0.27	0.90	0.15-0.40	0.020	0.020	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32
				50 < t ≤ 100	---	0.29	0.90	0.15-0.40	0.020	0.020	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32
				100 < t ≤ 200	---	0.30	0.90	0.15-0.40	0.020	0.020	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32
JIS G 3118:2010	Symbol SGV410	---	---	6 ≤ t ≤ 12.5	---	0.21	0.85-1.20	0.15-0.40	0.030	0.030	---	---	---	---
				12.5 < t ≤ 50	---	0.23	0.85-1.20	0.15-0.40	0.030	0.030	---	---	---	---
				50 < t ≤ 100	---	0.25	0.85-1.20	0.15-0.40	0.030	0.030	---	---	---	---
				100 < t ≤ 200	---	0.27	0.85-1.20	0.15-0.40	0.030	0.030	---	---	---	---
ASME SA-515/SA-515M*	Grade 60 [415]	K02401	---	t ≤ 25	t ≤ 1	0.24	0.90	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.27	0.90	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.29	0.90	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 100	t > 4	0.31	0.90	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010

Note: This section continued on next page.

4.1 Carbon Steels for Pressure Vessel Plates

4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-516/SA-516M*	Grade 60 [415]	K02100	---	t ≤ 12.5	t ≤ 0.5	0.21	0.60-0.90	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				12.5 < t ≤ 50	0.5 < t ≤ 2	0.23	0.85-1.20	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.25	0.85-1.20	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 100	t > 4	0.27	0.85-1.20	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A515/A515M-10*	Grade 60 [415]	K02401	---	t ≤ 25	t ≤ 1	0.24	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.27	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.29	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 100	t > 4	0.31	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A516/A516M-10*	Grade 60 [415]	K02100	---	t ≤ 12.5	t ≤ 0.5	0.21	0.60-0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				12.5 < t ≤ 50	0.5 < t ≤ 2	0.23	0.85-1.20	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.25	0.85-1.20	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 100	t > 4	0.27	0.85-1.20	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASME SA-414/SA-414M	Grade D	K02505	---	---	---	0.25	1.20	0.30	0.035	0.035	---	---	---	Al 0.02-0.08
ASTM A414/A414M-14	Grade D	K02505	---	---	---	0.25	1.20	0.30	0.035	0.035	0.30	0.40	0.12	Cu 0.40; Al 0.02-0.08; V 0.03; Ti 0.025; Cb 0.02
GB 6653-94	Grade HP295	---	---	---	---	0.20	1.00	0.35	0.035	0.035	0.30	0.30	0.30	V 0.12; Al 0.020 min.; Cu 0.20; Ti 0.20; Nb 0.060; (P+S) 0.060
JIS G 3116:2013	Symbol SG295	---	---	1.6 ≤ t ≤ 6.0	---	0.20	1.00	0.35	0.020	0.020	---	---	---	---
ASME SA-515/SA-515M*	Grade 65 [450]	K02800	---	t ≤ 25	t ≤ 1	0.28	0.90	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.31	0.90	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 50	t > 2	0.33	0.90	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010

*: See ASTM A20/A20M-14 for additional information.

Note: This section continued on next page.

4.1 Carbon Steels for Pressure Vessel Plates

4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-516/SA-516M*	Grade 65 [450]	K02403	---	t ≤ 12.5	t ≤ 0.5	0.24	0.85-1.20	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				12.5 < t ≤ 50	0.5 < t ≤ 2	0.26	0.85-1.20	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.28	0.85-1.20	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 100	t > 4	0.29	0.85-1.20	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A515/A515M-10*	Grade 65 [450]	K02800	---	t ≤ 25	t ≤ 1	0.28	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.31	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 50	t > 2	0.33	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A516/A516M-10*	Grade 65 [450]	K02403	---	t ≤ 12.5	t ≤ 0.5	0.24	0.85-1.20	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				12.5 < t ≤ 50	0.5 < t ≤ 2	0.26	0.85-1.20	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.28	0.85-1.20	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 100	t > 4	0.29	0.85-1.20	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
JIS G 3103:2012	Symbol SB450	---	---	6 ≤ t ≤ 25	---	0.28	0.90	0.15-0.40	0.020	0.020	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32
				25 < t ≤ 50	---	0.31	0.90	0.15-0.40	0.020	0.020	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32
				50 < t ≤ 200	---	0.33	0.90	0.15-0.40	0.020	0.020	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32
JIS G 3118:2010	Symbol SGV450	---	---	6 ≤ t ≤ 12.5	---	0.24	0.85-1.20	0.15-0.40	0.030	0.030	---	---	---	---
				12.5 < t ≤ 50	---	0.26	0.85-1.20	0.15-0.40	0.030	0.030	---	---	---	---
				50 < t ≤ 100	---	0.28	0.85-1.20	0.15-0.40	0.030	0.030	---	---	---	---
				100 < t ≤ 200	---	0.29	0.85-1.20	0.15-0.40	0.030	0.030	---	---	---	---
ASME SA-414/SA-414M	Grade E	K02704	---	---	---	0.27	1.20	0.30	0.035	0.035	---	---	---	Al 0.02-0.08
ASTM A414/A414M-14	Grade E	K02704	---	---	---	0.27	1.20	0.30	0.035	0.035	0.30	0.40	0.12	Cu 0.40; Al 0.02-0.08; V 0.03; Ti 0.025; Cb 0.02

*: See ASTM A20/A20M-14 for additional information.

4.1 Carbon Steels for Pressure Vessel Plates

4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10028-2:2009	P295GH	---	1.0481	---	---	0.08-0.20	0.90-1.50	0.40	0.025	0.010	0.30	0.30	0.08	V 0.02; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.020; N 0.012; (Cr+Cu+Mo+Ni) 0.70
EN 10120:2008	P310NB	---	1.0437	---	---	0.20	0.70 min.	0.50	0.025	0.015	---	---	---	Al 0.020 min.; Ti 0.03; Nb 0.050; N 0.009
JIS G 3103:2012	Symbol SB480	---	---	6 ≤ t ≤ 25	---	0.31	1.20	0.15-0.40	0.020	0.020	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32
				25 < t ≤ 50	---	0.33	1.20	0.15-0.40	0.020	0.020	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32
				50 < t ≤ 200	---	0.35	1.20	0.15-0.40	0.020	0.020	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010; (Cu+Ni+Mo+Cr) 1.00; (Cr+Mo) 0.32
JIS G 3118:2010	Symbol SGV480	---	---	6 ≤ t ≤ 12.5	---	0.27	0.85-1.20	0.15-0.40	0.030	0.030	---	---	---	---
				12.5 < t ≤ 50	---	0.28	0.85-1.20	0.15-0.40	0.030	0.030	---	---	---	---
				50 < t ≤ 100	---	0.30	0.85-1.20	0.15-0.40	0.030	0.030	---	---	---	---
				100 < t ≤ 200	---	0.31	0.85-1.20	0.15-0.40	0.030	0.030	---	---	---	---
ASME SA-515/SA-515M*	Grade 70 [485]	K03101	---	t ≤ 25	t ≤ 1	0.31	1.20	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.33	1.20	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 50	t > 2	0.35	1.20	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASME SA-516/SA-516M*	Grade 70 [485]	K02700	---	t ≤ 12.5	t ≤ 0.5	0.27	0.85-1.20	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				12.5 < t ≤ 50	0.5 < t ≤ 2	0.28	0.85-1.20	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.30	0.85-1.20	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 100	t > 4	0.31	0.85-1.20	0.15-0.40	0.035	0.035	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASME SA-537/SA-537M*	Class 1	K12437	---	t ≤ 40	t ≤ 1.5	0.24	0.70-1.35	0.15-0.50	0.035	0.035	0.25	0.25	0.08	V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010
				40 < t ≤ 100	1.5 < t ≤ 4	0.24	1.00-1.60	0.15-0.50	0.035	0.035	0.25	0.25	0.08	V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010
ASME SA-737/SA-737M*	Grade B	K12001	---	---	---	0.20	1.15-1.50	0.15-0.50	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.05; B 0.0010

*: See ASTM A20/A20M-14 for additional information.

Note: This section continued on next page.

4.1 Carbon Steels for Pressure Vessel Plates

4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A515/A515M-10*	Grade 70 [485]	K03101	---	t ≤ 25	t ≤ 1	0.31	1.20	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.33	1.20	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 50	t > 2	0.35	1.20	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A516/A516M-10*	Grade 70 [485]	K02700	---	t ≤ 25	t ≤ 1	0.27	0.85-1.20	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.28	0.85-1.20	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.30	0.85-1.20	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 100	t > 4	0.31	0.85-1.20	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASME SA-414/SA-414M	Grade F	K03102	---	---	---	0.31	1.20	0.30	0.035	0.035	---	---	---	Al 0.02-0.08
ASTM A414/A414M-14	Grade F	K03102	---	---	---	0.31	1.20	0.30	0.035	0.035	0.30	0.40	0.12	Cu 0.40; Al 0.02-0.08; V 0.03; Ti 0.025; Cb 0.02
ASTM A537/A537M-13*	Class 1	K12437	---	t ≤ 40	t ≤ 1.5	0.24	0.70-1.35	0.15-0.50	0.025	0.025	0.25	0.25	0.08	V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010
				t > 40	t > 1.5	0.24	1.00-1.60	0.15-0.50	0.025	0.025	0.25	0.25	0.08	V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010
ASTM A737/A737M-09 (2013)*	Grade B	K12001	---	---	---	0.20	1.15-1.50	0.15-0.50	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.05; B 0.0010
ISO 4706:1989	carbon steel	---	---	---	---	0.22	1.60	0.45	0.04	0.04	---	---	---	(P+S) 0.07
	alloy steel	---	---	---	---	0.22	1.60	0.45	0.04	0.04	---	---	---	V 0.20; Ti 0.20; Nb 0.08; (P+S) 0.07; (Nb+V) 0.20
GB 3531-1996	Grade 16MnDR	---	---	---	---	0.20	1.20-1.60	0.15-0.50	0.030	0.025	0.25	0.40	0.08	Al 0.020 min.; Cu 0.25
JIS G 3115:2010	Symbol SPV315	---	---	6 ≤ t ≤ 150	---	0.18	1.60	0.55	0.030	0.030	---	---	---	---
GB 6653-94	Grade HP325	---	---	---	---	0.20	1.50	0.35	0.035	0.035	0.30	0.30	0.30	V 0.12; Al 0.020 min.; Cu 0.20; Ti 0.20; Nb 0.060; (P+S) 0.060
JIS G 3116:2013	Symbol SG325	---	---	1.6 ≤ t ≤ 6.0	---	0.20	1.50	0.55	0.020	0.020	---	---	---	---
ISO 4978:1983	Grade 4	---	---	---	---	0.20	0.70 min.	0.45	0.035	0.035	---	---	---	Al 0.015 min.
EN 10028-3:2009	P355N	---	1.0562	---	---	0.18	1.10-1.70	0.50	0.025	0.010	0.30	0.50	0.08	V 0.10; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.012; (Nb+Ti+V) 0.12; (Cr+Cu+Mo) 0.45
	P355NH	---	1.0565	---	---	0.18	1.10-1.70	0.50	0.025	0.010	0.30	0.50	0.08	V 0.10; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.012; (Nb+Ti+V) 0.12; (Cr+Cu+Mo) 0.45

*: See ASTM A20/A20M-14 for additional information.

4.1 Carbon Steels for Pressure Vessel Plates

4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB 6654-1996	Grade 16MnR	---	---	---	---	0.20	1.20-1.60	0.20-0.55	0.035	0.030	0.30	0.30	---	Cu 0.30
GB 713-1997	Grade 16Mng	---	---	---	---	0.20	1.20-1.60	0.20-0.55	0.035	0.030	0.30	0.30	0.10	V 0.010; Cu 0.30
	Grade 19Mng	---	---	---	---	0.15-0.22	1.00-1.60	0.30-0.60	0.030	0.025	0.30	0.30	0.10	V 0.010; Cu 0.30
GB 6653-94	Grade HP345	---	---	---	---	0.20	1.50	0.35	0.035	0.035	0.30	0.30	0.30	V 0.12; Al 0.020 min.; Cu 0.20; Ti 0.20; Nb 0.060; (P+S) 0.060
EN 10028-2:2009	P355GH	---	1.0473	---	---	0.10-0.22	1.10-1.70	0.60	0.025	0.010	0.30	0.30	0.08	V 0.02; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.040; N 0.012; (Cr+Cu+Mo+Ni) 0.70
EN 10120:2008	P355NB	---	1.0557	---	---	0.20	0.70 min.	0.50	0.025	0.015	---	---	---	Al 0.020 min.; Ti 0.03; Nb 0.050; N 0.009
JIS G 3124:2009	Symbol SEV245	---	---	$6 \leq t \leq 150$	---	0.20	0.80-1.60	0.15-0.60	0.030	0.030	---	---	0.35	V 0.10; Cu 0.40; Nb 0.05
GB 713-1997	Grade 22Mng	---	---	---	---	0.30	0.90-1.50	0.15-0.40	0.025	0.025	0.30	0.30	0.10	V 0.010; Cu 0.30
ASME SA-414/SA-414M	Grade G	K03103	---	---	---	0.31	1.35	0.30	0.035	0.035	---	---	---	Al 0.02-0.08
ASTM A414/A414M-14	Grade G	K03103	---	---	---	0.31	1.35	0.30	0.035	0.035	0.30	0.40	0.12	Cu 0.40; Al 0.02-0.08; V 0.03; Ti 0.025; Cb 0.02
ASME SA-738/SA-738M	Grade A	K12447	---	$t \leq 65$	$t \leq 2.5$	0.24	1.50	0.15-0.50	0.035	0.035	0.25	0.50	0.08	V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08
				$65 < t \leq 150$	$2.5 < t \leq 6$	0.24	1.60	0.15-0.50	0.035	0.035	0.25	0.50	0.08	V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08
ASTM A738/A738M-12a	Grade A	K12447	---	$t \leq 65$	$t \leq 2.5$	0.24	1.50	0.15-0.50	0.025	0.025	0.25	0.50	0.08	V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08
				$65 < t \leq 150$	$2.5 < t \leq 6$	0.24	1.60	0.15-0.50	0.025	0.025	0.25	0.50	0.08	V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08
JIS G 3115:2010	Symbol SPV355	---	---	$6 \leq t \leq 150$	---	0.20	1.60	0.55	0.030	0.030	---	---	---	---
GB 6654-1996	Grade 15MnVR	---	---	---	---	0.18	1.20-1.60	0.20-0.55	0.035	0.030	0.30	0.30	---	V 0.04-0.12; Cu 0.30
GB 6653-94	Grade HP365	---	---	---	---	0.20	1.50	0.35	0.035	0.035	0.30	0.30	0.30	V 0.12; Al 0.020 min.; Cu 0.20; Ti 0.20; Nb 0.060; (P+S) 0.060
JIS G 3116:2013	Symbol SG365	---	---	$1.6 \leq t \leq 6.0$	---	0.20	1.50	0.55	0.020	0.020	---	---	---	---

Note: This section continued on next page.

4.1 Carbon Steels for Pressure Vessel Plates

4.1B Chemical Composition of Carbon Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-537/SA-537M*	Class 3	K12437	---	t ≤ 40	t ≤ 1.5	0.24	0.70-1.35	0.15-0.50	0.035	0.035	0.25	0.25	0.08	V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010
				40 < t ≤ 150	1.5 < t ≤ 6	0.24	1.00-1.60	0.15-0.50	0.035	0.035	0.25	0.25	0.08	V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010
	Class 2	K12437	---	t ≤ 40	t ≤ 1.5	0.24	0.70-1.35	0.15-0.50	0.035	0.035	0.25	0.25	0.08	V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010
				40 < t ≤ 150	1.5 < t ≤ 6	0.24	1.00-1.60	0.15-0.50	0.035	0.035	0.25	0.25	0.08	V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010
ASTM A537/A537M-13*	Class 3	K12437	---	t ≤ 40	t ≤ 1.5	0.24	0.70-1.35	0.15-0.50	0.025	0.025	0.25	0.25	0.08	V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010
				40 < t ≤ 150	1.5 < t ≤ 6	0.24	1.00-1.60	0.15-0.50	0.025	0.025	0.25	0.25	0.08	V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010
	Class 2	K12437	---	t ≤ 40	t ≤ 1.5	0.24	0.70-1.35	0.15-0.50	0.025	0.025	0.25	0.25	0.08	V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010
				40 < t ≤ 150	1.5 < t ≤ 6	0.24	1.00-1.60	0.15-0.50	0.025	0.025	0.25	0.25	0.08	V 0.03; Cu 0.35; Ti 0.03; Cb 0.02; B 0.0010
JIS G 3115:2010	Symbol SPV410	---	---	6 ≤ t ≤ 150	---	0.18	1.60	0.75	0.030	0.030	---	---	---	---
ASME SA-737/SA-737M*	Grade C	K12202	---	---	---	0.22	1.15-1.50	0.15-0.50	0.025	0.025	0.30	0.40	0.12	V 0.04-0.11; Cu 0.40; Ti 0.03; Cb 0.05; N 0.03; B 0.0010
ASTM A737/A737M-09 (2013)*	Grade C	K12202	---	---	---	0.22	1.15-1.50	0.15-0.50	0.025	0.025	0.30	0.40	0.12	V 0.04-0.11; Cu 0.40; Ti 0.03; Cb 0.05; N 0.03; B 0.0010
ASME SA-738/SA-738M	Grade C	K02008	---	t ≤ 65	t ≤ 2.5	0.20	1.50	0.15-0.50	0.025	0.025	0.25	0.50	0.08	V 0.05; Cu 0.35
				65 < t ≤ 150	2.5 < t ≤ 6	0.20	1.60	0.15-0.50	0.025	0.025	0.25	0.50	0.08	V 0.05; Cu 0.35
ASTM A738/A738M-12a	Grade C	K02008	---	t ≤ 65	t ≤ 2.5	0.20	1.50	0.15-0.50	0.025	0.025	0.25	0.50	0.08	V 0.05; Cu 0.35
				65 < t ≤ 150	2.5 < t ≤ 6	0.20	1.60	0.15-0.50	0.025	0.025	0.25	0.50	0.08	V 0.05; Cu 0.35
ASME SA-612/SA-612M	---	---	---	---	---	0.25	1.00-1.50	0.15-0.50	0.025	0.025	0.25	0.25	0.08	V 0.08; Cu 0.35
ASTM A612/A612M-12	---	---	---	---	---	0.25	1.00-1.50	0.15-0.50	0.025	0.025	0.25	0.25	0.08	V 0.08; Cu 0.35
JIS G 3115:2010	Symbol SPV450	---	---	6 ≤ t ≤ 150	---	0.18	1.60	0.75	0.030	0.030	---	---	---	---
ASME SA-738/SA-738M	Grade B	---	---	t ≤ 40	t ≤ 1.5	0.20	0.90-1.50	0.15-0.55	0.030	0.030	0.30	0.60	0.20	V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08
				40 < t ≤ 65	1.5 < t ≤ 2.5	0.20	0.90-1.50	0.15-0.55	0.030	0.030	0.30	0.60	0.20	V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08
				65 < t ≤ 100	2.5 < t ≤ 4	0.20	0.90-1.60	0.15-0.55	0.030	0.030	0.30	0.60	0.20	V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08
ASTM A738/A738M-12a	Grade B	---	---	t ≤ 40	t ≤ 1.5	0.20	0.90-1.50	0.15-0.55	0.025	0.025	0.30	0.60	0.20	V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08
				40 < t ≤ 65	1.5 < t ≤ 2.5	0.20	0.90-1.50	0.15-0.55	0.025	0.025	0.30	0.60	0.20	V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08
				65 < t ≤ 100	2.5 < t ≤ 4	0.20	0.90-1.60	0.15-0.55	0.025	0.025	0.30	0.60	0.20	V 0.07; Cu 0.35; Cb 0.04; (Cb+V) 0.08

*: See ASTM A20/A20M-14 for additional information.

4.2 Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C

4.2A Mechanical Properties of Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10028-3:2009	P275NL1	---	1.0488	t ≤ 16	---	275	---	390-510	---	24	AR, N	see standard for impact data
				16 < t ≤ 40	---	265	---	390-510	---	24	AR, N	
				40 < t ≤ 60	---	255	---	390-510	---	24	AR, N	
				60 < t ≤ 100	---	235	---	370-490	---	23	AR, N	
				100 < t ≤ 150	---	225	---	360-480	---	23	AR, N	
				150 < t ≤ 250	---	215	---	350-470	---	23	AR, N	
	P275NL2	---	1.1104	t ≤ 16	---	275	---	390-510	---	24	AR, N	see standard for impact data
				16 < t ≤ 40	---	265	---	390-510	---	24	AR, N	
				40 < t ≤ 60	---	255	---	390-510	---	24	AR, N	
				60 < t ≤ 100	---	235	---	370-490	---	23	AR, N	
				100 < t ≤ 150	---	225	---	360-480	---	23	AR, N	
				150 < t ≤ 250	---	215	---	350-470	---	23	AR, N	
ASME SA-662/SA-662M	Grade A	K01701	---	---	---	275	40	400-540	58-78	23	N	---
ASTM A662/A662M-12	Grade A	K01701	---	---	---	275	40	400-540	58-78	23	N	---
JIS G 3126:2009	Symbol SLA235A	---	---	6 ≤ t ≤ 16	---	235	---	400-510 T	---	18	N or TMCP	see standard for impact data
				16 < t ≤ 40	---	235	---	400-510 T	---	22	N or TMCP	
				40 < t ≤ 50	---	215	---	400-510 T	---	24	N or TMCP	
	Symbol SLA235B	---	---	6 ≤ t ≤ 16	---	235	---	400-510 T	---	18	N or TMCP	see standard for impact data
				16 < t ≤ 40	---	235	---	400-510 T	---	22	N or TMCP	
				40 < t ≤ 50	---	215	---	400-510 T	---	24	N or TMCP	
	Symbol SLA325A	---	---	6 ≤ t ≤ 16	---	325	---	440-560 T	---	22	N or TMCP	see standard for impact data
				16 < t ≤ 20	---	325	---	440-560 T	---	30	N or TMCP	
				20 < t ≤ 38	---	325	---	440-560 T	---	22	N or TMCP	
	Symbol SLA325B	---	---	6 ≤ t ≤ 16	---	325	---	440-560 T	---	22	Q+T or TMCP	see standard for impact data
				16 < t ≤ 20	---	325	---	440-560 T	---	30	Q+T or TMCP	
				20 < t ≤ 38	---	325	---	440-560 T	---	22	Q+T or TMCP	

4.2 Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C

4.2A Mechanical Properties of Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-662/SA-662M	Grade B	K02203	---	$t \leq 40$	$t \leq 1.5$	275	40	450-585	65-85	23	AR, N, SR or N+SR	---
				$t > 40$	$t > 1.5$	275	40	450-585	65-85	23	N	---
	Grade C	K02007	---	$t \leq 40$	$t \leq 1.5$	295	43	485-620	70-90	22	AR, N, SR or N+SR	---
				$t > 40$	$t > 1.5$	295	43	485-620	70-90	22	N	---
ASTM A662/A662M-12	Grade B	K02203	---	$t \leq 40$	$t \leq 1.5$	275	40	450-585	65-85	23	AR, N, SR or N+SR	---
				$t > 40$	$t > 1.5$	275	40	450-585	65-85	23	N	---
	Grade C	K02007	---	$t \leq 40$	$t \leq 1.5$	295	43	485-620	70-90	22	AR, N, SR or N+SR	---
				$t > 40$	$t > 1.5$	295	43	485-620	70-90	22	N	---
ASME SA-841/SA-841M	Grade A, Class 1	K02010	---	$t \leq 65$	$t \leq 2.5$	345	50	480-620	70-90	22	TMCP	L: 20 J @ -40°C
				$65 < t \leq 100$	$2.5 < t \leq 4$	315	45	450-585	65-85	22	TMCP	L: 20 J @ -40°C
	Grade B, Class 1	---	---	$t \leq 65$	$t \leq 2.5$	345	50	480-620	70-90	22	TMCP	L: 20 J @ -40°C
				$65 < t \leq 100$	$2.5 < t \leq 4$	315	45	450-585	65-85	22	TMCP	L: 20 J @ -40°C
	Grade C, Class 1	---	---	$t \leq 65$	$t \leq 2.5$	345	50	480-620	70-90	22	TMCP	L: 20 J @ -40°C
				$65 < t \leq 100$	$2.5 < t \leq 4$	315	45	450-585	65-85	22	TMCP	L: 20 J @ -40°C
ASTM A841/A841M-13	Grade A, Class 1	K02010	---	$t \leq 65$	$t \leq 2.5$	345	50	480-620	70-90	22	TMCP	L: 20 J @ -40°C
				$65 < t \leq 100$	$2.5 < t \leq 4$	315	45	450-585	65-85	22	TMCP	L: 20 J @ -40°C
	Grade B, Class 1	---	---	$t \leq 65$	$t \leq 2.5$	345	50	480-620	70-90	22	TMCP	L: 20 J @ -40°C
				$65 < t \leq 100$	$2.5 < t \leq 4$	315	45	450-585	65-85	22	TMCP	L: 20 J @ -40°C
	Grade C, Class 1	---	---	$t \leq 65$	$t \leq 2.5$	345	50	480-620	70-90	22	TMCP	L: 20 J @ -40°C
				$65 < t \leq 100$	$2.5 < t \leq 4$	315	45	450-585	65-85	22	TMCP	L: 20 J @ -40°C
EN 10028-3:2009	P355NL1	---	1.0566	$t \leq 16$	---	355	---	490-630	---	22	AR, N	see standard for impact data
				$16 < t \leq 40$	---	345	---	490-630	---	22	AR, N	
				$40 < t \leq 60$	---	335	---	490-630	---	22	AR, N	
				$60 < t \leq 100$	---	315	---	470-610	---	21	AR, N	
				$100 < t \leq 150$	---	305	---	460-600	---	21	AR, N	
				$150 < t \leq 250$	---	295	---	450-590	---	21	AR, N	
	P355NL2	---	1.1106	$t \leq 16$	---	355	---	490-630	---	22	AR, N	see standard for impact data
				$16 < t \leq 40$	---	345	---	490-630	---	22	AR, N	
				$40 < t \leq 60$	---	335	---	490-630	---	22	AR, N	
				$60 < t \leq 100$	---	315	---	470-610	---	21	AR, N	
				$100 < t \leq 150$	---	305	---	460-600	---	21	AR, N	
				$150 < t \leq 250$	---	295	---	450-590	---	21	AR, N	
JIS G 3126:2009	Symbol SLA365	---	---	$6 \leq t \leq 16$	---	365	---	490-610 T	---	20	Q+T or TMCP	see standard for impact data
				$16 < t \leq 20$	---	365	---	490-610 T	---	28	Q+T or TMCP	
				$20 < t \leq 38$	---	365	---	490-610 T	---	20	Q+T or TMCP	

4.2 Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C

4.2A Mechanical Properties of Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 3126:2009	Symbol SLA410	---	---	6 ≤ t ≤ 16	---	410	---	520-640 T	---	18	Q+T or TMCP	see standard for impact data
				16 < t ≤ 20	---	410	---	520-640 T	---	26	Q+T or TMCP	
				20 < t ≤ 38	---	410	---	520-640 T	---	18	Q+T or TMCP	
ASME SA-841/SA-841M	Grade A, Class 2	K02010	---	t ≤ 65	t ≤ 2.5	415	60	550-690	80-100	22	TMCP	L: 20 J @ -40°C
				65 < t ≤ 100	2.5 < t ≤ 4	380	55	515-655	75-95	22	TMCP	L: 20 J @ -40°C
	Grade B, Class 2	---	---	t ≤ 65	t ≤ 2.5	415	60	550-690	80-100	22	TMCP	L: 20 J @ -40°C
				65 < t ≤ 100	2.5 < t ≤ 4	380	55	515-655	75-95	22	TMCP	L: 20 J @ -40°C
	Grade C, Class 2	---	---	t ≤ 65	t ≤ 2.5	415	60	550-690	80-100	22	TMCP	L: 20 J @ -40°C
				65 < t ≤ 100	2.5 < t ≤ 4	380	55	515-655	75-95	22	TMCP	L: 20 J @ -40°C
ASTM A841/A841M-13	Grade A, Class 2	K02010	---	t ≤ 65	t ≤ 2.5	415	60	550-690	80-100	22	TMCP	L: 20 J @ -40°C
				65 < t ≤ 100	2.5 < t ≤ 4	380	55	515-655	75-95	22	TMCP	L: 20 J @ -40°C
	Grade B, Class 2	---	---	t ≤ 65	t ≤ 2.5	415	60	550-690	80-100	22	TMCP	L: 20 J @ -40°C
				65 < t ≤ 100	2.5 < t ≤ 4	380	55	515-655	75-95	22	TMCP	L: 20 J @ -40°C
	Grade C, Class 2	---	---	t ≤ 65	t ≤ 2.5	415	60	550-690	80-100	22	TMCP	L: 20 J @ -40°C
				65 < t ≤ 100	2.5 < t ≤ 4	380	55	515-655	75-95	22	TMCP	L: 20 J @ -40°C

4.2 Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C

4.2B Chemical Composition of Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10028-3:2009	P275NL1	---	1.0488	---	---	0.16	0.80-1.50	0.40	0.025	0.008	0.30	0.50	0.08	V 0.05; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.012; (Nb+Ti+V) 0.05; (Cr+Cu+Mo) 0.45
	P275NL2	---	1.1104	---	---	0.16	0.80-1.50	0.40	0.020	0.005	0.30	0.50	0.08	V 0.05; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.012; (Nb+Ti+V) 0.05; (Cr+Cu+Mo) 0.45
ASME SA-662/SA-662M*	Grade A	K01701	---	---	---	0.14	0.90-1.35	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A662/A662M-12*	Grade A	K01701	---	---	---	0.14	0.90-1.35	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
JIS G 3126:2009	Symbol SLA235A	---	---	6 ≤ t ≤ 50	---	0.15	0.70-1.50	0.30	0.025	0.020	---	---	---	---
	Symbol SLA235B	---	---	6 ≤ t ≤ 50	---	0.15	0.70-1.50	0.30	0.025	0.020	---	---	---	---
	Symbol SLA325A	---	---	6 ≤ t ≤ 38	---	0.16	0.80-1.60	0.55	0.025	0.020	---	---	---	---
	Symbol SLA325B	---	---	6 ≤ t ≤ 38	---	0.16	0.80-1.60	0.55	0.025	0.020	---	---	---	---

*: See ASTM A20/A20M-14 for additional information.

4.2 Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C

4.2B Chemical Composition of Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-662/SA-662M*	Grade B	K02203	---	---	---	0.19	0.85-1.50	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade C	K02007	---	---	---	0.20	1.00-1.60	0.15-0.50	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A662/A662M-12*	Grade B	K02203	---	---	---	0.19	0.85-1.50	0.15-0.40	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade C	K02007	---	---	---	0.20	1.00-1.60	0.15-0.50	0.025	0.025	0.30	0.40	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASME SA-841/SA-841M*	Grade A, Class 1	K02010	---	t ≤ 40	t ≤ 1.5	0.20	0.70-1.35	0.15-0.50	0.030	0.030	0.25	0.25	0.08	V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010
				40 < t ≤ 100	1.5 < t ≤ 4	0.20	1.00-1.60	0.15-0.50	0.030	0.030	0.25	0.25	0.08	V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010
	Grade B, Class 1	---	---	t ≤ 40	t ≤ 1.5	0.15	0.70-1.35	0.15-0.50	0.030	0.025	0.25	0.60	0.30	V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010
				40 < t ≤ 100	1.5 < t ≤ 4	0.15	1.00-1.60	0.15-0.50	0.030	0.025	0.25	0.60	0.30	V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010
	Grade C, Class 1	---	---	t ≤ 40	t ≤ 1.5	0.10	0.70-1.60	0.15-0.50	0.030	0.015	0.25	0.25	0.08	V 0.06; Cu 0.35; Ti 0.006-0.02; Cb 0.06; B 0.0010
				40 < t ≤ 100	1.5 < t ≤ 4	0.10	1.00-1.60	0.15-0.50	0.030	0.015	0.25	0.25	0.08	V 0.06; Cu 0.35; Ti 0.006-0.02; Cb 0.06; B 0.0010
ASTM A841/A841M-13*	Grade A, Class 1	K02010	---	t ≤ 40	t ≤ 1.5	0.20	0.70-1.35	0.15-0.50	0.030	0.030	0.25	0.25	0.08	V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010
				40 < t ≤ 100	1.5 < t ≤ 4	0.20	1.00-1.60	0.15-0.50	0.030	0.030	0.25	0.25	0.08	V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010
	Grade B, Class 1	---	---	t ≤ 40	t ≤ 1.5	0.15	0.70-1.35	0.15-0.50	0.030	0.025	0.25	0.60	0.30	V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010
				40 < t ≤ 100	1.5 < t ≤ 4	0.15	1.00-1.60	0.15-0.50	0.030	0.025	0.25	0.60	0.30	V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010
	Grade C, Class 1	---	---	t ≤ 40	t ≤ 1.5	0.10	0.70-1.60	0.15-0.50	0.030	0.015	0.25	0.25	0.08	V 0.06; Cu 0.35; Ti 0.006-0.02; Cb 0.06; B 0.0010
				40 < t ≤ 100	1.5 < t ≤ 4	0.10	1.00-1.60	0.15-0.50	0.030	0.015	0.25	0.25	0.08	V 0.06; Cu 0.35; Ti 0.006-0.02; Cb 0.06; B 0.0010
EN 10028-3:2009	P355NL1	---	1.0566	---	---	0.18	1.10-1.70	0.50	0.025	0.008	0.30	0.50	0.08	V 0.10; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.012; (Nb+Ti+V) 0.12; (Cr+Cu+Mo) 0.45
	P355NL2	---	1.1106	---	---	0.18	1.10-1.70	0.50	0.020	0.005	0.30	0.50	0.08	V 0.10; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.012; (Nb+Ti+V) 0.12; (Cr+Cu+Mo) 0.45
JIS G 3126:2009	Symbol SLA365	---	---	6 ≤ t ≤ 38	---	0.18	0.80-1.60	0.55	0.025	0.020	---	---	---	---

*: See ASTM A20/A20M-14 for additional information.

4.2 Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C

4.2B Chemical Composition of Carbon Steels for Pressure Vessel Plates – With Impact Testing Below -20°C (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3126:2009	Symbol SLA410	---	---	$6 \leq t \leq 38$	---	0.18	0.80-1.60	0.55	0.025	0.020	---	---	---	---
ASME SA-841/SA-841M*	Grade A, Class 2	K02010	---	$t \leq 40$	$t \leq 1.5$	0.20	0.70-1.35	0.15-0.50	0.030	0.030	0.25	0.25	0.08	V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010
				$40 < t \leq 100$	$1.5 < t \leq 4$	0.20	1.00-1.60	0.15-0.50	0.030	0.030	0.25	0.25	0.08	V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010
	Grade B, Class 2	---	---	$t \leq 40$	$t \leq 1.5$	0.15	0.70-1.35	0.15-0.50	0.030	0.025	0.25	0.60	0.30	V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010
				$40 < t \leq 100$	$1.5 < t \leq 4$	0.15	1.00-1.60	0.15-0.50	0.030	0.025	0.25	0.60	0.30	V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010
	Grade C, Class 2	---	---	$t \leq 40$	$t \leq 1.5$	0.10	0.70-1.60	0.15-0.50	0.030	0.015	0.25	0.25	0.08	V 0.06; Cu 0.35; Ti 0.006-0.02; Cb 0.06; B 0.0010
				$40 < t \leq 100$	$1.5 < t \leq 4$	0.10	1.00-1.60	0.15-0.50	0.030	0.015	0.25	0.25	0.08	V 0.06; Cu 0.35; Ti 0.006-0.02; Cb 0.06; B 0.0010
ASTM A841/A841M-13*	Grade A, Class 2	K02010	---	$t \leq 40$	$t \leq 1.5$	0.20	0.70-1.35	0.15-0.50	0.030	0.030	0.25	0.25	0.08	V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010
				$40 < t \leq 100$	$1.5 < t \leq 4$	0.20	1.00-1.60	0.15-0.50	0.030	0.030	0.25	0.25	0.08	V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010
	Grade B, Class 2	---	---	$t \leq 40$	$t \leq 1.5$	0.15	0.70-1.35	0.15-0.50	0.030	0.025	0.25	0.60	0.30	V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010
				$40 < t \leq 100$	$1.5 < t \leq 4$	0.15	1.00-1.60	0.15-0.50	0.030	0.025	0.25	0.60	0.30	V 0.06; Al 0.020 min.; Cu 0.35; Ti 0.03; Cb 0.03; B 0.0010
	Grade C, Class 2	---	---	$t \leq 40$	$t \leq 1.5$	0.10	0.70-1.60	0.15-0.50	0.030	0.015	0.25	0.25	0.08	V 0.06; Cu 0.35; Ti 0.006-0.02; Cb 0.06; B 0.0010
				$40 < t \leq 100$	$1.5 < t \leq 4$	0.10	1.00-1.60	0.15-0.50	0.030	0.015	0.25	0.25	0.08	V 0.06; Cu 0.35; Ti 0.006-0.02; Cb 0.06; B 0.0010

*: See ASTM A20/A20M-14 for additional information.

4.3 ½ Mo Alloy Steels for Pressure Vessel Plates

4.3A Chemical Composition of ½Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10028-2:2009	18MnMo4-5	---	1.5414	---	---	0.20	0.90-1.50	0.40	0.015	0.005	0.30	0.30	0.45-0.60	Cu 0.30; N 0.012
	16Mo3	---	1.5415	---	---	0.12-0.20	0.40-0.90	0.35	0.025	0.010	0.30	0.30	0.25-0.35	Cu 0.30; N 0.012
GB 713-1997	Grade 13MnNiMoNbg	---	---	---	---	0.15	1.00-1.60	0.10-0.50	0.025	0.025	0.20-0.40	0.60-1.00	0.20-0.40	V 0.010; Cu 0.30; Nb 0.005-0.020
ISO 9328-2:2004	Grade 16Mo3	---	---	---	---	0.12-0.20	0.40-0.90	0.35	0.025	0.010	0.30	0.30	0.25-0.35	Cu 0.30
ASME SA-204/SA-204M*	Grade A	K11820	---	t ≤ 25	t ≤ 1	0.18	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.21	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.23	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 100	t > 4	0.25	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade B	K12020	---	t ≤ 25	t ≤ 1	0.20	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.23	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.25	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 100	t > 4	0.27	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade C	K12320	---	t ≤ 25	t ≤ 1	0.23	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.26	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 50	t > 2	0.28	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A204/A204M-12*	Grade A	K11820	---	t ≤ 25	t ≤ 1	0.18	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.21	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.23	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 100	t > 4	0.25	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010

*: See ASTM A20/A20M-14 for additional information.

Note: This section continued on next page.

4.3 ½ Mo Alloy Steels for Pressure Vessel Plates

4.3A Chemical Composition of ½Mo Alloy Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A204/A204M-12*	Grade B	K12020	---	t ≤ 25	t ≤ 1	0.20	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.23	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.25	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 100	t > 4	0.27	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade C	K12320	---	t ≤ 25	t ≤ 1	0.23	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.26	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 50	t > 2	0.28	0.90	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
JIS G 3103:2012	Symbol SB450M	---	---	6 ≤ t ≤ 25	---	0.18	0.90	0.15-0.40	0.020	0.020	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
				25 < t ≤ 50	---	0.21	0.90	0.15-0.40	0.020	0.020	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
				50 < t ≤ 100	---	0.23	0.90	0.15-0.40	0.020	0.020	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
				100 < t ≤ 150	---	0.25	0.90	0.15-0.40	0.020	0.020	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
	Symbol SB480M	---	---	6 ≤ t ≤ 25	---	0.20	0.90	0.15-0.40	0.020	0.020	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
				25 < t ≤ 50	---	0.23	0.90	0.15-0.40	0.020	0.020	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
				50 < t ≤ 100	---	0.25	0.90	0.15-0.40	0.020	0.020	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
				100 < t ≤ 150	---	0.27	0.90	0.15-0.40	0.020	0.020	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010

4.3 ½ Mo Alloy Steels for Pressure Vessel Plates

4.3A Chemical Composition of ½Mo Alloy Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-302/SA-302M*	Grade A	K12021	---	t ≤ 25	t ≤ 1	0.20	0.95-1.30	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.23	0.95-1.30	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 50	t > 2	0.25	0.95-1.30	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A302/A302M-12*	Grade A	K12021	---	t ≤ 25	t ≤ 1	0.20	0.95-1.30	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.23	0.95-1.30	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 50	t > 2	0.25	0.95-1.30	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
JIS G 3119:2013	Symbol SBV1A	---	---	6 ≤ t ≤ 25	---	0.20	0.95-1.30	0.15-0.40	0.020	0.020	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
				25 < t ≤ 50	---	0.23	0.95-1.30	0.15-0.40	0.020	0.020	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
				50 < t ≤ 150	---	0.25	0.95-1.30	0.15-0.40	0.020	0.020	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
JIS G 3124:2009	Symbol SEV295	---	---	6 ≤ t ≤ 150	---	0.19	0.80-1.60	0.15-0.60	0.030	0.030	---	---	0.10-0.40	V 0.10; Cu 0.70; Nb 0.05

*: See ASTM A20/A20M-14 for additional information.

4.3 ½ Mo Alloy Steels for Pressure Vessel Plates

4.3A Chemical Composition of ½Mo Alloy Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-302/SA-302M*	Grade B	K12022	---	t ≤ 25	t ≤ 1	0.20	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.23	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 50	t > 2	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASME SA-533/SA-533M*	Type A, Class 1	K12521	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Type A, Class 2	K12521	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Type A, Class 3	K12521	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A302/A302M-12*	Grade B	K12022	---	t ≤ 25	t ≤ 1	0.20	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.23	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 50	t > 2	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A533/A533M-09 (2014)*	Type A, Class 1	K12521	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Type A, Class 2	K12521	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Type A, Class 3	K12521	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
GB 6654-1996	Grade 18MnMoNbR	---	---	---	---	0.22	1.20-1.60	0.15-0.50	0.035	0.030	0.30	0.30	0.45-0.65	Cu 0.30; Nb 0.025-0.050
JIS G 3119:2013	Symbol SBV1B	---	---	6 ≤ t ≤ 25	---	0.20	1.15-1.50	0.15-0.40	0.020	0.020	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
				25 < t ≤ 50	---	0.23	1.15-1.50	0.15-0.40	0.020	0.020	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
				50 < t ≤ 150	---	0.25	1.15-1.50	0.15-0.40	0.020	0.020	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
JIS G 3120:2014	Symbol SQV1A	---	---	---	---	0.25	1.15-1.50	0.15-0.40	0.020	0.020	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
	Symbol SQV1B	---	---	---	---	0.25	1.15-1.50	0.15-0.40	0.020	0.020	0.30	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
JIS G 3124:2009	Symbol SEV345	---	---	6 ≤ t ≤ 150	---	0.19	0.80-1.70	0.15-0.60	0.030	0.030	---	---	0.15-0.50	V 0.10; Cu 0.70; Nb 0.05

*: See ASTM A20/A20M-14 for additional information.

4.3 ½Mo Alloy Steels for Pressure Vessel Plates

4.3B Mechanical Properties of ½Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10028-2:2009	18MnMo4-5	---	1.5414	t ≤ 60	---	345	---	510-650	---	20	N+T	see standard for impact data
				60 < t ≤ 150	---	325	---	510-650	---	20	N+T	
				150 < t ≤ 250	---	310	---	480-620	---	20	Q+T	
	16Mo3	---	1.5415	t ≤ 16	---	275	---	440-590	---	22	AR, N or N+T	see standard for impact data
				16 < t ≤ 40	---	270	---	440-590	---	22	AR, N or N+T	
				40 < t ≤ 60	---	260	---	440-590	---	22	AR, N or N+T	
				60 < t ≤ 100	---	240	---	430-580	---	22	AR, N or N+T	
				100 < t ≤ 150	---	220	---	420-570	---	22	AR, N or N+T	
				150 < t ≤ 250	---	210	---	410-570	---	22	AR, N or N+T	
GB 713-1997	Grade 13MnNiMoNbg	---	---	t ≤ 100	---	390	---	570-740	---	18	HR, Ctr, N or N+T	T: 31 J @ 0°C
				100 < t ≤ 120	---	380	---	570-740	---	18	HR, Ctr, N or N+T	T: 31 J @ 0°C
				120 < t ≤ 150	---	375	---	570-740	---	18	HR, Ctr, N or N+T	T: 31 J @ 0°C
ISO 9328-2:2004	Grade 16Mo3	---	---	t ≤ 16	---	275	---	440-590	---	22	N or BA	see standard for impact data
				16 < t ≤ 40	---	270	---	440-590	---	22	N or BA	
				40 < t ≤ 60	---	260	---	440-590	---	22	N or BA	
				60 < t ≤ 100	---	240	---	430-580	---	22	N or BA	
				100 < t ≤ 150	---	220	---	420-570	---	22	N or BA	
				150 < t ≤ 250	---	210	---	410-570	---	22	N or BA	
ASME SA-204/SA-204M	Grade A	K11820	---	t ≤ 40	t ≤ 1.5	255	37	450-585	65-85	23	AR or SR or N or SR+N	---
				t > 40	t > 1.5	255	37	450-585	65-85	23	N	---
	Grade B	K12020	---	t ≤ 40	t ≤ 1.5	275	40	485-620	70-90	21	AR or SR or N or SR+N	---
				t > 40	t > 1.5	275	40	485-620	70-90	21	N	---
	Grade C	K12320	---	t ≤ 40	t ≤ 1.5	295	43	515-655	75-95	20	AR or SR or N or SR+N	---
				t > 40	t > 1.5	295	43	515-655	75-95	20	N	---
ASTM A204/A204M-12	Grade A	K11820	---	t ≤ 40	t ≤ 1.5	255	37	450-585	65-85	23	AR, SR, N or SR+N	---
				t > 40	t > 1.5	255	37	450-585	65-85	23	N	---
	Grade B	K12020	---	t ≤ 40	t ≤ 1.5	275	40	485-620	70-90	21	AR, SR, N or SR+N	---
				t > 40	t > 1.5	275	40	485-620	70-90	21	N	---
	Grade C	K12320	---	t ≤ 40	t ≤ 1.5	295	43	515-655	75-95	20	AR, SR, N or SR+N	---
				t > 40	t > 1.5	295	43	515-655	75-95	20	N	---
JIS G 3103:2012	Symbol SB450M	---	---	6 ≤ t ≤ 50	---	255	---	450-590	---	19	AR, N or SR	---
				50 < t ≤ 150	---	255	---	450-590	---	23	N	---
	Symbol SB480M	---	---	6 ≤ t ≤ 50	---	275	---	480-620	---	17	AR, N or SR	---
				50 < t ≤ 150	---	275	---	480-620	---	21	N	---

4.3 ½Mo Alloy Steels for Pressure Vessel Plates

4.3B Mechanical Properties of ½Mo Alloy Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-302/SA-302M	Grade A	K12021	---	t ≤ 50	t ≤ 2	310	45	515-655	75-95	19	AR or N or SR or N+SR	---
				t > 50	t > 2	310	45	515-655	75-95	19	N	---
ASTM A302/A302M-12	Grade A	K12021	---	t ≤ 50	t ≤ 2	310	45	515-655	75-95	19	AR, N, SR or N+SR	---
				t > 50	t > 2	310	45	515-655	75-95	19	N	---
JIS G 3119:2013	Symbol SBV1A	---	---	6 ≤ t ≤ 50	---	315	---	520-660	---	15	AR, N, A, Q+T or N+A	---
				50 < t ≤ 150	---	315	---	520-660	---	19	N or Q+T	---
JIS G 3124:2009	Symbol SEV295	---	---	6 ≤ t ≤ 50	---	420	---	540-690 T	---	15	AR, N, N+T or A	T: 31 J @ 0°C
				50 < t ≤ 100	---	400	---	540-690 T	---	19	AR, N, N+T or A	T: 31 J @ 0°C
				100 < t ≤ 125	---	390	---	530-680 T	---	19	AR, N, N+T or A	T: 31 J @ 0°C
				125 < t ≤ 150	---	380	---	520-670 T	---	19	AR, N, N+T or A	T: 31 J @ 0°C
ASME SA-302/SA-302M	Grade B	K12022	---	t ≤ 50	t ≤ 2	345	50	550-690	80-100	18	AR or N or SR or N+SR	---
				t > 50	t > 2	345	50	550-690	80-100	18	N	---
ASME SA-533/SA-533M	Type A, Class 1	K12521	---	t ≥ 6.5	t ≥ 0.25	345	50	550-690	80-100	18	Q+T	---
	Type A, Class 2	K12521	---	t ≥ 6.5	t ≥ 0.25	485	70	620-795	90-115	16	Q+T	---
	Type A, Class 3	K12521	---	6.5 ≤ t ≤ 65	0.25 ≤ t ≤ 2.5	570	83	690-860	100-125	16	Q+T	---
ASTM A302/A302M-12	Grade B	K12022	---	t ≤ 50	t ≤ 2	345	50	550-690	80-100	18	AR, N, SR or N+SR	---
				t > 50	t > 2	345	50	550-690	80-100	18	N	---
ASTM A533/A533M-09 (2014)	Type A, Class 1	K12521	---	t ≥ 6.5	t ≥ 0.25	345	50	550-690	80-100	18	Q+T	---
	Type A, Class 2	K12521	---	t ≥ 6.5	t ≥ 0.25	485	70	620-795	90-115	16	Q+T	---
	Type A, Class 3	K12521	---	6.5 ≤ t ≤ 65	0.25 ≤ t ≤ 2.5	570	83	690-860	100-125	16	Q+T	---
GB 6654-1996	Grade 18MnMoNbR	---	---	30 < t ≤ 60	---	440	---	590-740	---	17	N+T	T: 34 J @ 20°C
				60 < t ≤ 100	---	410	---	570-720	---	17	N+T	T: 34 J @ 20°C
JIS G 3119:2013	Symbol SBV1B	---	---	6 ≤ t ≤ 50	---	345	---	550-690	---	15	AR, N, A, Q+T or N+A	---
				50 < t ≤ 150	---	345	---	550-690	---	18	N or Q+T	---
JIS G 3120:2014	Symbol SQV1A	---	---	---	---	345	---	550-690 T	---	18	AR, A or Q+T	L: 40 J @ BA°C
	Symbol SQV1B	---	---	---	---	480	---	620-790 T	---	16	AR, A or Q+T	L: 47 J @ BA°C
JIS G 3124:2009	Symbol SEV345	---	---	6 ≤ t ≤ 50	---	430	---	590-740 T	---	14	AR, N, N+T or A	T: 31 J @ 0°C
				50 < t ≤ 100	---	430	---	590-740 T	---	18	AR, N, N+T or A	T: 31 J @ 0°C
				100 < t ≤ 125	---	420	---	580-730 T	---	18	AR, N, N+T or A	T: 31 J @ 0°C
				125 < t ≤ 150	---	410	---	570-720 T	---	18	AR, N, N+T or A	T: 31 J @ 0°C

4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

4.4.1A Chemical Composition of $\frac{3}{4}\text{Cr}-\frac{1}{2}\text{Mo}$ Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-387/SA-387M*	Grade 2, Class 1	S50460	---	---	---	0.05-0.21	0.55-0.80	0.15-0.40	0.025	0.025	0.50-0.80	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade 2, Class 2	S50460	---	---	---	0.05-0.21	0.55-0.80	0.15-0.40	0.025	0.025	0.50-0.80	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A387/A387M-11*	Grade 2, Class 1	S50460	---	---	---	0.05-0.21	0.55-0.80	0.15-0.40	0.025	0.025	0.50-0.80	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade 2, Class 2	S50460	---	---	---	0.05-0.21	0.55-0.80	0.15-0.40	0.025	0.025	0.50-0.80	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
JIS G 4109:2013	Symbol SCM V1-1	---	---	$6 \leq t \leq 200$	---	0.21	0.55-0.80	0.40	0.020	0.020	0.50-0.80	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003
	Symbol SCM V1-2	---	---	$6 \leq t \leq 200$	---	0.21	0.55-0.80	0.40	0.020	0.020	0.50-0.80	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003

*: See ASTM A20/A20M-14 for additional information.

4.4.1B Mechanical Properties of $\frac{3}{4}\text{Cr}-\frac{1}{2}\text{Mo}$ Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-387/SA-387M	Grade 2, Class 1	S50460	---	---	---	230	33	380-550	55-80	22	A, N+T or Q+T	---
	Grade 2, Class 2	S50460	---	---	---	310	45	485-620	70-90	22	A, N+T or Q+T	---
ASTM A387/A387M-11	Grade 2, Class 1	S50460	---	---	---	230	33	380-550	55-80	22	A, N+T or Q+T	---
	Grade 2, Class 2	S50460	---	---	---	310	45	485-620	70-90	22	A, N+T or Q+T	---
JIS G 4109:2013	Symbol SCM V1-1	---	---	$6 \leq t \leq 50$	---	225	---	380-550 T	---	18	A or N+T	---
				$50 < t \leq 200$	---	225	---	380-550 T	---	22	A or N+T	---
	Symbol SCM V1-2	---	---	$6 \leq t \leq 50$	---	315	---	480-620 T	---	18	N+T	---
				$50 < t \leq 200$	---	315	---	480-620 T	---	22	N+T	---

4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

4.4.2A Chemical Composition of 1Cr-½Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-387/SA-387M*	Grade 12, Class 1	K11757	---	---	---	0.05-0.17	0.40-0.65	0.15-0.40	0.025	0.025	0.80-1.15	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade 12, Class 2	K11757	---	---	---	0.05-0.17	0.40-0.65	0.15-0.40	0.025	0.025	0.80-1.15	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A387/A387M-11*	Grade 12, Class 1	K11757	---	---	---	0.05-0.17	0.40-0.65	0.15-0.40	0.025	0.025	0.80-1.15	0.40	0.45-0.65	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade 12, Class 2	K11757	---	---	---	0.05-0.17	0.40-0.65	0.15-0.40	0.025	0.025	0.80-1.15	0.40	0.45-0.65	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
EN 10028-2:2009	13 CrMo 4-5	---	1.7335	---	---	0.08-0.18	0.40-1.00	0.35	0.025	0.010	0.70-1.15	---	0.40-0.60	Cu 0.30; N 0.012
GB 6654-1996	Grade 15CrMoR	---	---	---	---	0.12-0.18	0.40-0.70	0.15-0.40	0.030	0.030	0.80-1.20	0.30	0.45-0.60	Cu 0.30
GB 713-1997	Grade 15CrMog	---	---	---	---	0.12-0.18	0.40-0.70	0.15-0.40	0.030	0.030	0.80-1.20	0.30	0.45-0.60	V 0.010; Cu 0.30
JIS G 4109:2013	Symbol SCM V2-1	---	---	6 ≤ t ≤ 200	---	0.17	0.40-0.65	0.40	0.020	0.020	0.80-1.15	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003
	Symbol SCM V2-2	---	---	6 ≤ t ≤ 200	---	0.17	0.40-0.65	0.40	0.020	0.020	0.80-1.15	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003

*: See ASTM A20/A20M-14 for additional information.

4.4.2B Mechanical Properties of 1Cr-½Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-387/SA-387M	Grade 12, Class 1	K11757	---	---	---	230	33	380-550	55-80	22	A, N+T or Q+T	---
	Grade 12, Class 2	K11757	---	---	---	275	40	450-585	65-85	22	A, N+T or Q+T	---
ASTM A387/A387M-11	Grade 12, Class 1	K11757	---	---	---	230	33	380-550	55-80	22	A, N+T or Q+T	---
	Grade 12, Class 2	K11757	---	---	---	275	40	450-585	65-85	22	A, N+T or Q+T	---
EN 10028-2:2009	13 CrMo 4-5	---	1.7335	t ≤ 16	---	300	---	450-600	---	19	N+T	see standard for impact data
				15 < t ≤ 60	---	290	---	450-600	---	19	N+T	
				60 < t ≤ 100	---	270	---	440-590	---	19	N+T	
				100 < t ≤ 150	---	255	---	430-580	---	19	N+T or Q+T	
				150 < t ≤ 250	---	245	---	420-570	---	19	Q+T	
GB 6654-1996	Grade 15CrMoR	---	---	6 < t ≤ 60	---	295	---	450-590	---	19	N+T	T: 31 J @ 20°C
				60 < t ≤ 100	---	275	---	450-590	---	18	N+T	T: 31 J @ 20°C
GB 713-1997	Grade 15CrMog	---	---	t ≤ 60	---	295	---	450-590	---	19	HR, CtR, N or N+T	T: 31 J @ RT
				60 < t ≤ 100	---	275	---	450-590	---	18	HR, CtR, N or N+T	T: 31 J @ RT
JIS G 4109:2013	Symbol SCM V2-1	---	---	6 ≤ t ≤ 50	---	225	---	380-550 T	---	18	A or N+T	---
				50 < t ≤ 200	---	225	---	380-550 T	---	22	A or N+T	---
	Symbol SCM V2-2	---	---	6 ≤ t ≤ 50	---	275	---	450-590 T	---	19	N+T	---
				50 < t ≤ 200	---	275	---	450-590 T	---	22	N+T	---

4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

4.4.3A Chemical Composition of 1¼Cr-½Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-387/SA-387M*	Grade 11, Class 1	K11789	---	---	---	0.05-0.17	0.40-0.65	0.50-0.80	0.025	0.025	1.00-1.50	0.40	0.45-0.65	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade 11, Class 2	K11789	---	---	---	0.05-0.17	0.40-0.65	0.50-0.80	0.025	0.025	1.00-1.50	0.40	0.45-0.65	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A387/A387M-11*	Grade 11, Class 1	K11789	---	---	---	0.05-0.17	0.40-0.65	0.50-0.80	0.025	0.025	1.00-1.50	0.40	0.45-0.65	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade 11, Class 2	K11789	---	---	---	0.05-0.17	0.40-0.65	0.50-0.80	0.025	0.025	1.00-1.50	0.40	0.45-0.65	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
EN 10028-2:2009	13CrMoSi5-5	---	1.7336	---	---	0.17	0.40-0.65	0.50-0.80	0.015	0.005	1.00-1.50	0.30	0.45-0.65	Cu 0.30; N 0.012
JIS G 4109:2013	Symbol SCM V3-1	---	---	6 ≤ t ≤ 200	---	0.17	0.40-0.65	0.50-0.80	0.020	0.020	1.00-1.50	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003
	Symbol SCM V3-2	---	---	6 ≤ t ≤ 200	---	0.17	0.40-0.65	0.50-0.80	0.020	0.020	1.00-1.50	0.40	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003

*: See ASTM A20/A20M-14 for additional information.

4.4.3B Mechanical Properties of 1¼Cr-½Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-387/SA-387M	Grade 11, Class 1	K11789	---	---	---	240	35	415-585	60-85	22	A, N+T or Q+T	---
	Grade 11, Class 2	K11789	---	---	---	310	45	515-690	75-100	22	A, N+T or Q+T	---
ASTM A387/A387M-11	Grade 11, Class 1	K11789	---	---	---	240	35	415-585	60-85	22	A, N+T or Q+T	---
	Grade 11, Class 2	K11789	---	---	---	310	45	515-690	75-100	22	A, N+T or Q+T	---
EN 10028-2:2009	13CrMoSi5-5	---	1.7336	t ≤ 60	---	310	---	510-690	---	20	N+T	see standard for impact data
				t ≤ 60	---	400	---	510-690	---	20	Q+T	
				60 < t ≤ 100	---	300	---	480-660	---	20	N+T	
				60 < t ≤ 100	---	390	---	500-680	---	20	Q+T	
				100 < t ≤ 250	---	380	---	490-670	---	20	Q+T	
JIS G 4109:2013	Symbol SCM V3-1	---	---	6 ≤ t ≤ 50	---	235	---	410-590 T	---	19	A or N+T	---
				50 < t ≤ 200	---	235	---	410-590 T	---	22	A or N+T	---
	Symbol SCM V3-2	---	---	6 ≤ t ≤ 50	---	315	---	520-690 T	---	18	N+T	---
				50 < t ≤ 200	---	315	---	520-690 T	---	22	N+T	---

4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

4.4.4A Chemical Composition of 2½Cr-1Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-387/SA-387M*	Grade 22, Class 1	K21590	---	---	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.00-2.50	0.40	0.90-1.10	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade 22, Class 2	K21590	---	---	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.00-2.50	0.40	0.90-1.10	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade 22L, Class 1	K21590	---	---	---	0.10	0.30-0.60	0.50	0.025	0.025	2.00-2.50	0.40	0.90-1.10	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A387/A387M-11*	Grade 22, Class 1	K21590	---	---	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.00-2.50	0.40	0.90-1.10	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade 22, Class 2	K21590	---	---	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.00-2.50	0.40	0.90-1.10	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade 22L, Class 1	K21590	---	---	---	0.10	0.30-0.60	0.50	0.025	0.025	2.00-2.50	0.40	0.90-1.10	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
EN 10028-2:2009	10CrMo9-10	---	1.7380	---	---	0.08-0.14	0.40-0.80	0.50	0.020	0.010	2.00-2.50	---	0.90-1.10	Cu 0.30; N 0.012
JIS G 4109:2013	Symbol SCMV4-1	---	---	6 ≤ t ≤ 300	---	0.17	0.30-0.60	0.50	0.020	0.020	2.00-2.50	0.40	0.90-1.10	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003
	Symbol SCMV4-2	---	---	6 ≤ t ≤ 300	---	0.17	0.30-0.60	0.50	0.020	0.020	2.00-2.50	0.40	0.90-1.10	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003
JIS G 4110:2008	Symbol SCM4E	---	---	6 ≤ t ≤ 300	---	0.17	0.30-0.60	0.50	0.015	0.015	2.00-2.50	0.40	0.90-1.10	V 0.03; Cu 0.40; Nb 0.02

*: See ASTM A20/A20M-14 for additional information.

4.4.4B Mechanical Properties of 2½Cr-1Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-387/SA-387M	Grade 22, Class 1	K21590	---	---	---	205	30	415-585	60-85	18	A, SR, N+T or Q+T	---
	Grade 22, Class 2	K21590	---	---	---	310	45	515-690	75-100	18	A, SR, N+T or Q+T	---
	Grade 22L, Class 1	K21590	---	---	---	205	30	415-585	60-85	18	A, SR, N+T or Q+T	---
ASTM A387/A387M-11	Grade 22, Class 1	K21590	---	---	---	205	30	415-585	60-85	18	A, SR, N+T or Q+T	---
	Grade 22, Class 2	K21590	---	---	---	310	45	515-690	75-100	18	A, SR, N+T or Q+T	---
	Grade 22L, Class 1	K21590	---	---	---	205	30	415-585	60-85	18	A, SR, N+T or Q+T	---
EN 10028-2:2009	10CrMo9-10	---	1.7380	t ≤ 16	---	310	---	480-630	---	18	N+T	see standard for impact data
				16 < t ≤ 40	---	300	---	480-630	---	18	N+T	
				40 < t ≤ 60	---	290	---	480-630	---	18	N+T	
				60 < t ≤ 100	---	280	---	470-620	---	17	N+T or Q+T	
				100 < t ≤ 150	---	260	---	460-610	---	17	Q+T	
				150 < t ≤ 250	---	250	---	450-600	---	17	Q+T	
JIS G 4109:2013	Symbol SCMV4-1	---	---	6 ≤ t ≤ 300	---	205	---	410-590 T	---	18	A or N+T	---
	Symbol SCMV4-2	---	---	6 ≤ t ≤ 300	---	315	---	520-690 T	---	18	N+T	---
JIS G 4110:2008	Symbol SCM4E	---	---	6 ≤ t ≤ 300	---	380	---	580-760 T	---	18	Q+T or N+T	T: 54 J @ -18°C

4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

4.4.5A Chemical Composition of 3Cr-1Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-387/SA-387M*	Grade 21, Class 1	K31545	---	---	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.75-3.25	0.40	0.90-1.10	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade 21, Class 2	K31545	---	---	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.75-3.25	0.40	0.90-1.10	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade 21L, Class 1	K31545	---	---	---	0.10	0.30-0.60	0.50	0.025	0.025	2.75-3.25	0.40	0.90-1.10	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A387/A387M-11*	Grade 21, Class 1	K31545	---	---	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.75-3.25	0.40	0.90-1.10	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade 21, Class 2	K31545	---	---	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.75-3.25	0.40	0.90-1.10	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade 21L, Class 1	K31545	---	---	---	0.10	0.30-0.60	0.50	0.025	0.025	2.75-3.25	0.40	0.90-1.10	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
JIS G 4109:2013	Symbol SCM5-1	---	---	$6 \leq t \leq 300$	---	0.17	0.30-0.60	0.50	0.020	0.020	2.75-3.25	0.40	0.90-1.10	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003
	Symbol SCM5-2	---	---	$6 \leq t \leq 300$	---	0.17	0.30-0.60	0.50	0.020	0.020	2.75-3.25	0.40	0.90-1.10	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003

*: See ASTM A20/A20M-14 for additional information.

4.4.5B Mechanical Properties of 3Cr-1Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-387/SA-387M	Grade 21, Class 1	K31545	---	---	---	205	30	415-585	60-85	18	A, SR, N+T or Q+T	---
	Grade 21, Class 2	K31545	---	---	---	310	45	515-690	75-100	18	A, SR, N+T or Q+T	---
	Grade 21L, Class 1	K31545	---	---	---	205	30	415-585	60-85	18	A, SR, N+T or Q+T	---
ASTM A387/A387M-11	Grade 21, Class 1	K31545	---	---	---	205	30	415-585	60-85	18	A, SR, N+T or Q+T	---
	Grade 21, Class 2	K31545	---	---	---	310	45	515-690	75-100	18	A, SR, N+T or Q+T	---
	Grade 21L, Class 1	K31545	---	---	---	205	30	415-585	60-85	18	A, SR, N+T or Q+T	---
JIS G 4109:2013	Symbol SCM5-1	---	---	$6 \leq t \leq 300$	---	205	---	410-590 T	---	18	A or N+T	---
	Symbol SCM5-2	---	---	$6 \leq t \leq 300$	---	315	---	520-690 T	---	18	N+T	---

4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

4.4.6A Chemical Composition of 5Cr-½Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-387/SA-387M*	Grade 5, Class 1	S50200	---	---	---	0.15	0.30-0.60	0.50	0.025	0.025	4.00-6.00	0.40	0.45-0.65	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade 5, Class 2	S50200	---	---	---	0.15	0.30-0.60	0.50	0.025	0.025	4.00-6.00	0.40	0.45-0.65	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A387/A387M-11*	Grade 5, Class 1	S50200	---	---	---	0.15	0.30-0.60	0.50	0.025	0.025	4.00-6.00	0.40	0.45-0.65	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade 5, Class 2	S50200	---	---	---	0.15	0.30-0.60	0.50	0.025	0.025	4.00-6.00	0.40	0.45-0.65	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
EN 10028-2:2009	X12CrMo5	---	1.7362	---	---	0.10-0.15	0.30-0.60	0.50	0.020	0.005	4.0-6.0	0.30	0.45-0.65	Cu 0.30; N 0.012
JIS G 4109:2013	Symbol SCM V6-1	---	---	6 ≤ t ≤ 300	---	0.15	0.30-0.60	0.50	0.020	0.020	4.00-6.00	0.40	0.45-0.65	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003
	Symbol SCM V6-2	---	---	6 ≤ t ≤ 300	---	0.15	0.30-0.60	0.50	0.020	0.020	4.00-6.00	0.40	0.45-0.65	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.003

*: See ASTM A20/A20M-14 for additional information.

4.4.6B Mechanical Properties of 5Cr-½Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-387/SA-387M	Grade 5, Class 1	S50200	---	---	---	205	30	415-585	60-85	18	A, SR, N+T or Q+T	---
	Grade 5, Class 2	S50200	---	---	---	310	45	515-690	75-100	18	A, SR, N+T or Q+T	---
ASTM A387/A387M-11	Grade 5, Class 1	S50200	---	---	---	205	30	415-585	60-85	18	A, SR, N+T or Q+T	---
	Grade 5, Class 2	S50200	---	---	---	310	45	515-690	75-100	18	A, SR, N+T or Q+T	---
EN 10028-2:2009	X12CrMo5	---	1.7362	t ≤ 60	---	320	---	510-690	---	20	N+T	see standard for impact data
				60 < t ≤ 150	---	300	---	480-660	---	20	N+T	
				150 < t ≤ 250	---	300	---	450-630	---	20	Q+T	
JIS G 4109:2013	Symbol SCM V6-1	---	---	6 ≤ t ≤ 300	---	205	---	410-590 T	---	18	A or N+T	---
	Symbol SCM V6-2	---	---	6 ≤ t ≤ 300	---	315	---	520-690 T	---	18	N+T	---

4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

4.4.7A Chemical Composition of 9Cr-1Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-387/SA-387M*	Grade 91, Class 2	K90901	---	---	---	0.08-0.12	0.30-0.60	0.20-0.50	0.020	0.010	8.00-9.50	0.40	0.85-1.05	V 0.18-0.25; Al 0.02; Cu 0.40; Ti 0.01; Cb 0.06-0.10; N 0.030-0.070; Zr 0.01; B 0.0010
ASTM A387/A387M-11*	Grade 91, Class 2	K91560	---	---	---	0.08-0.12	0.30-0.60	0.20-0.50	0.020	0.010	8.00-9.50	0.40	0.85-1.05	V 0.18-0.25; Al 0.02; Cu 0.40; Ti 0.01; Cb 0.06-0.10; N 0.030-0.070; Zr 0.01; B 0.0010
EN 10028-2:2009	X10CrMoVNb9-1	---	1.4903	---	---	0.08-0.12	0.30-0.60	0.50	0.020	0.005	8.0-9.5	0.30	0.85-1.05	V 0.18-0.25; Al 0.040; Cu 0.30; Nb 0.06-0.10; N 0.030-0.070

*: See ASTM A20/A20M-14 for additional information.

4.4.7B Mechanical Properties of 9Cr-1Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-387/SA-387M	Grade 91, Class 2	K90901	---	---	---	415	60	585-760	85-110	18	N+T, A or SR	---
ASTM A387/A387M-11	Grade 91, Class 2	K91560	---	---	---	415	60	585-760	85-110	18	N+T, A or SR	---
EN 10028-2:2009	X10CrMoVNb9-1	---	1.4903	t ≤ 60	---	445	---	580-760	---	18	N+T	see standard for impact data
				60 < t ≤ 150	---	435	---	550-730	---	18	N+T	
				150 < t ≤ 250	---	435	---	520-700	---	18	Q+T	

4.5 Ni Alloy Steels for Pressure Vessel Plates

4.5.1A Chemical Composition of ½Ni Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10028-4:2009	11MnNi5-3	---	1.6212	---	---	0.14	0.70-1.50	0.50	0.025	0.010	---	0.30-0.80	---	V 0.050; Al 0.020 min.; Nb 0.05; (Cr+Cu+Mo) 0.50
	13MnNi6-3	---	1.6217	---	---	0.16	0.85-1.70	0.50	0.025	0.010	---	0.30-0.85	---	V 0.050; Al 0.020 min.; Nb 0.05; (Cr+Cu+Mo) 0.50
GB 3531-1996	Grade 15MnNiDR	---	---	---	---	0.18	1.20-1.60	0.15-0.50	0.030	0.025	0.25	0.20-0.60	0.08	V 0.06; Al 0.020 min.; Cu 0.25
ISO 9328-4:2004	Grade 11MnNi5-3	---	---	---	---	0.14	0.70-1.50	0.50	0.025	0.015	---	0.30-0.80	---	V 0.05; Al 0.02-; Nb 0.05; (Cr+Cu+Mo) 0.50
	Grade 13MnNi6-3	---	---	---	---	0.16	0.85-1.70	0.50	0.025	0.015	---	0.30-0.80	---	V 0.05; Al 0.02-; Nb 0.05; (Cr+Cu+Mo) 0.50

4.5.1B Mechanical Properties of ½ Ni Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10028-4:2009	11MnNi5-3	---	1.6212	t ≤ 30	---	285	---	420-530	---	24	N+T	see standard for impact data
				30 < t ≤ 50	---	275	---	420-530	---	24	N+T	
				50 < t ≤ 80	---	265	---	420-530	---	24	N+T	
	13MnNi6-3	---	1.6217	t ≤ 30	---	355	---	490-610	---	22	N+T	see standard for impact data
				30 < t ≤ 50	---	345	---	490-610	---	22	N+T	
				50 < t ≤ 80	---	335	---	490-610	---	22	N+T	
GB 3531-1996	Grade 15MnNiDR	---	---	6 ≤ t ≤ 16	---	325	---	490-630	---	20	N or N+T	---
				16 < t ≤ 36	---	305	---	470-610	---	20	N or N+T	---
				36 < t ≤ 60	---	290	---	460-600	---	20	N or N+T	---
ISO 9328-4:2004	Grade 11MnNi5-3	---	---	t ≤ 30	---	285	---	550, 420-530 T	80	35, 24 T	N or N+T	see standard for impact data
				30 < t ≤ 50	---	275	---	420-530 T	---	24 T	N or N+T	
				50 < t ≤ 80	---	265	---	420-530 T	---	24 T	N or N+T	
	Grade 13MnNi6-3	---	---	t ≤ 30	---	355	---	490-610 T	---	22 T	N or N+T	see standard for impact data
				30 < t ≤ 50	---	345	---	490-610 T	---	22 T	N or N+T	
				50 < t ≤ 80	---	335	---	490-610 T	---	22 T	N or N+T	

4.5 Ni Alloy Steels for Pressure Vessel Plates

4.5.2A Chemical Composition of 1½ Ni Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10028-4:2009	15NiMn6	---	1.6228	---	---	0.18	0.80-1.50	0.35	0.025	0.010	---	1.30-1.70	---	V 0.05; (Cr+Cu+Mo) 0.50
ISO 9328-4:2004	Grade 15NiMn6	---	---	---	---	0.18	0.80-1.50	0.35	0.025	0.015	---	1.30-1.70	---	V 0.05; (Cr+Cu+Mo) 0.50

4.5.2B Mechanical Properties of 1½ Ni Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
EN 10028-4:2009	15NiMn6	---	1.6228	t ≤ 30	---	355	---	490-640	---	22	N or N+T or Q+T	see standard for impact data
				30 < t ≤ 50	---	345	---	490-640	---	22	N or N+T or Q+T	
				50 < t ≤ 80	---	335	---	490-640	---	22	N or N+T or Q+T	
ISO 9328-4:2004	Grade 15NiMn6	---	---	t ≤ 30	---	355	---	490-640 T	---	22 T	N or N+T or Q+T	see standard for impact data
				30 < t ≤ 50	---	345	---	490-640 T	---	22 T	N or N+T or Q+T	
				50 < t ≤ 80	---	335	---	490-640 T	---	22 T	N or N+T or Q+T	

4.5 Ni Alloy Steels for Pressure Vessel Plates

4.5.3A Chemical Composition of 2½Ni Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-203/SA-203M*	Grade A	K21703	---	t ≤ 50	t ≤ 2	0.17	0.70	0.15-0.40	0.025	0.025	0.30	2.10-2.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.20	0.80	0.15-0.40	0.025	0.025	0.30	2.10-2.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 100	t > 4	0.23	0.80	0.15-0.40	0.025	0.025	0.30	2.10-2.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade B	K22103	---	t ≤ 50	t ≤ 2	0.21	0.70	0.15-0.40	0.025	0.025	0.30	2.10-2.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.24	0.80	0.15-0.40	0.025	0.025	0.30	2.10-2.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 100	t > 4	0.25	0.80	0.15-0.40	0.025	0.025	0.30	2.10-2.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A203/A203M-12*	Grade A	K21703	---	t ≤ 50	t ≤ 2	0.17	0.70	0.15-0.40	0.025	0.025	0.30	2.10-2.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.20	0.80	0.15-0.40	0.025	0.025	0.30	2.10-2.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 100	t > 4	0.23	0.80	0.15-0.40	0.025	0.025	0.30	2.10-2.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade B	K22103	---	t ≤ 50	t ≤ 2	0.21	0.70	0.15-0.40	0.025	0.025	0.30	2.10-2.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.24	0.80	0.15-0.40	0.025	0.025	0.30	2.10-2.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 100	t > 4	0.25	0.80	0.15-0.40	0.025	0.025	0.30	2.10-2.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
JIS G 3127:2013	Symbol SL2N255	---	---	6 ≤ t ≤ 50	---	0.17	0.70	0.30	0.015	0.015	---	2.10-2.50	---	---

*: See ASTM A20/A20M-14 for additional information.

4.5 Ni Alloy Steels for Pressure Vessel Plates

4.5.3B Mechanical Properties of 2¼Ni Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-203/SA-203M	Grade A	K21703	---	t ≤ 50	t ≤ 2	255	37	450-585	65-85	23	N	27 J @ BA°C
				t > 50	t > 2	255	37	450-585	65-85	23	N	27 J @ BA°C
	Grade B	K22103	---	t ≤ 50	t ≤ 2	275	40	485-620	70-90	21	N	27 J @ BA°C
				t > 50	t > 2	275	40	485-620	70-90	21	N	27 J @ BA°C
ASTM A203/A203M-12	Grade A	K21703	---	t ≤ 50	t ≤ 2	255	37	450-585	65-85	23	N	27 J @ BA°C
				t > 50	t > 2	255	37	450-585	65-85	23	N	27 J @ BA°C
	Grade B	K22103	---	t ≤ 50	t ≤ 2	275	40	485-620	70-90	21	N	27 J @ BA°C
				t > 50	t > 2	275	40	485-620	70-90	21	N	27 J @ BA°C
JIS G 3127:2013	Symbol SL2N255	---	---	6 ≤ t ≤ 16	---	255	---	450-590 T	---	24	N, N+T or TMCP	see standard for impact data
				16 < t ≤ 20	---	255	---	450-590 T	---	29	N, N+T or TMCP	L: 21 J @ -70°C
				20 < t ≤ 50	---	255	---	450-590 T	---	24	N, N+T or TMCP	L: 21 J @ -70°C

4.5 Ni Alloy Steels for Pressure Vessel Plates

4.5.4A Chemical Composition of 3½Ni Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-203/SA-203M*	Grade D	K31718	---	t ≤ 50	t ≤ 2	0.17	0.70	0.15-0.40	0.025	0.025	0.30	3.25-3.75	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.20	0.80	0.15-0.40	0.025	0.025	0.30	3.25-3.75	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade E	K32018	---	t ≤ 50	t ≤ 2	0.20	0.70	0.15-0.40	0.025	0.025	0.30	3.25-3.75	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.23	0.80	0.15-0.40	0.025	0.025	0.30	3.25-3.75	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade F	---	---	t ≤ 50	t ≤ 2	0.20	0.70	0.15-0.40	0.025	0.025	0.30	3.25-3.75	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.23	0.80	0.15-0.40	0.025	0.025	0.30	3.25-3.75	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A203/A203M-12*	Grade D	K31718	---	t ≤ 50	t ≤ 2	0.17	0.70	0.15-0.40	0.025	0.025	0.30	3.25-3.75	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.20	0.80	0.15-0.40	0.025	0.025	0.30	3.25-3.75	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade E	K32018	---	t ≤ 50	t ≤ 2	0.20	0.70	0.15-0.40	0.025	0.025	0.30	3.25-3.75	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.23	0.80	0.15-0.40	0.025	0.025	0.30	3.25-3.75	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Grade F	---	---	t ≤ 50	t ≤ 2	0.20	0.70	0.15-0.40	0.025	0.025	0.30	3.25-3.75	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				50 < t ≤ 100	2 < t ≤ 4	0.23	0.80	0.15-0.40	0.025	0.025	0.30	3.25-3.75	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
EN 10028-4:2009	12Ni14	---	1.5637	---	---	0.15	0.30-0.80	0.35	0.020	0.005	---	3.25-3.75	---	V 0.05; (Cr+Cu+Mo) 0.50
JIS G 3127:2013	Symbol SL3N255	---	---	6 ≤ t ≤ 50	---	0.15	0.70	0.30	0.015	0.015	---	3.25-3.75	---	---
	Symbol SL3N275	---	---	6 ≤ t ≤ 50	---	0.17	0.70	0.30	0.015	0.015	---	3.25-3.75	---	---
	Symbol SL3N440	---	---	6 ≤ t ≤ 50	---	0.15	0.70	0.30	0.015	0.015	---	3.25-3.75	---	---

*: See ASTM A20/A20M-14 for additional information.

4.5 Ni Alloy Steels for Pressure Vessel Plates

4.5.4B Mechanical Properties of 3½Ni Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-203/SA-203M	Grade D	K31718	---	t ≤ 50	t ≤ 2	255	37	450-585	65-85	23	N	27 J @ BA°C
				t > 50	t > 2	255	37	450-585	65-85	23	N	27 J @ BA°C
	Grade E	K32018	---	t ≤ 50	t ≤ 2	275	40	485-620	70-90	21	N	27 J @ BA°C
				t > 50	t > 2	275	40	485-620	70-90	21	N	27 J @ BA°C
	Grade F	---	---	t ≤ 50	t ≤ 2	380	55	550-690	80-100	20	Q+T	---
				t > 50	t > 2	345	50	515-655	75-95	20	Q+T	---
ASTM A203/A203M-12	Grade D	K31718	---	t ≤ 50	t ≤ 2	255	37	450-585	65-85	23	N	27 J @ BA°C
				t > 50	t > 2	255	37	450-585	65-85	23	N	27 J @ BA°C
	Grade E	K32018	---	t ≤ 50	t ≤ 2	275	40	485-620	70-90	21	N	27 J @ BA°C
				t > 50	t > 2	275	40	485-620	70-90	21	N	27 J @ BA°C
	Grade F	---	---	t ≤ 50	t ≤ 2	380	55	550-690	80-100	20	Q+T	---
				t > 50	t > 2	345	50	515-655	75-95	20	Q+T	---
EN 10028-4:2009	12Ni14	---	1.5637	t ≤ 30	---	355	---	490-640	---	22	N or N+T or Q+T	see standard for impact data
				30 < t ≤ 50	---	345	---	490-640	---	22	N or N+T or Q+T	
				50 < t ≤ 80	---	335	---	490-640	---	22	N or N+T or Q+T	
JIS G 3127:2013	Symbol SL3N255	---	---	6 ≤ t ≤ 16	---	255	---	450-590 T	---	24	N, N+T or TMCP	see standard for impact data
				16 < t ≤ 20	---	255	---	450-590 T	---	29	N, N+T or TMCP	L: 21 J @ -101°C
				20 < t ≤ 50	---	255	---	450-590 T	---	24	N, N+T or TMCP	L: 21 J @ -101°C
	Symbol SL3N275	---	---	6 ≤ t ≤ 16	---	275	---	480-620 T	---	22	N, N+T or TMCP	see standard for impact data
				16 < t ≤ 20	---	275	---	480-620 T	---	26	N, N+T or TMCP	L: 21 J @ -101°C
				20 < t ≤ 50	---	275	---	480-620 T	---	22	N, N+T or TMCP	L: 21 J @ -101°C
	Symbol SL3N440	---	---	6 ≤ t ≤ 16	---	440	---	540-690 T	---	21	Q+T	see standard for impact data
				16 < t ≤ 20	---	440	---	540-690 T	---	25	Q+T	L: 27 J @ -110°C
				20 < t ≤ 50	---	440	---	540-690 T	---	21	Q+T	L: 27 J @ -110°C

4.5 Ni Alloy Steels for Pressure Vessel Plates

4.5.5A Chemical Composition of 5Ni Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10028-4:2009	X12Ni5	---	1.5680	---	---	0.15	0.30-0.80	0.35	0.020	0.005	---	4.75-5.25	---	V 0.05; (Cr+Cu+Mo) 0.50
JIS G 3127:2013	Symbol SL5N590	---	---	$6 \leq t \leq 50$	---	0.13	1.50	0.30	0.015	0.015	---	4.75-6.00	---	---

4.5.5B Mechanical Properties of 5Ni Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10028-4:2009	X12Ni5	---	1.5680	$t \leq 30$	---	390	---	530-710	---	20	N or N+T or Q+T	see standard for impact data
				$30 < t \leq 50$	---	380	---	530-710	---	20	N or N+T or Q+T	
JIS G 3127:2013	Symbol SL5N590	---	---	$6 \leq t \leq 16$	---	590	---	690-830 T	---	21	Q+T	see standard for impact data
				$16 < t \leq 20$	---	590	---	690-830 T	---	25	Q+T	
				$20 < t \leq 50$	---	590	---	690-830 T	---	21	Q+T	L: 41 J @ -130°C

4.5.6A Chemical Composition of 9Ni Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-353/SA-353M*	---	K81340	---	---	---	0.13	0.90	0.15-0.40	0.015	0.015	0.30	8.50-9.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASME SA-553/SA-553M*	Type II	K71340	---	---	---	0.13	0.90	0.15-0.40	0.035	0.035	0.30	7.50-8.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Type I	K81340	---	---	---	0.13	0.90	0.15-0.40	0.035	0.035	0.30	8.50-9.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A353/A353M-09 (2014)*	---	K81340	---	---	---	0.13	0.90	0.15-0.40	0.015	0.015	0.30	8.50-9.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A553/A553M-14*	Type II	K71340	---	---	---	0.13	0.90	0.15-0.40	0.015	0.015	0.30	7.50-8.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Type I	K81340	---	---	---	0.13	0.90	0.15-0.40	0.015	0.015	0.30	8.50-9.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A844/A844M-09*	---	K81340	---	---	---	0.13	0.90	0.15-0.40	0.015	0.015	0.30	8.50-9.50	0.12	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
EN 10028-4:2009	X8Ni9	---	1.5662	---	---	0.10	0.30-0.80	0.35	0.020	0.005	---	8.5-10.0	0.10	V 0.05; (Cr+Cu+Mo) 0.50
	X7Ni9	---	1.5663	---	---	0.10	0.30-0.80	0.35	0.015	0.005	---	8.5-10.0	0.10	V 0.01; (Cr+Cu+Mo) 0.50
JIS G 3127:2013	Symbol SL9N520	---	---	$6 \leq t \leq 50$	---	0.12	0.90	0.30	0.015	0.015	---	8.50-9.50	---	---
	Symbol SL9N590	---	---	$6 \leq t \leq 100$	---	0.12	0.90	0.30	0.015	0.015	---	8.50-9.50	---	---

*: See ASTM A20/A20M-14 for additional information.

4.5 Ni Alloy Steels for Pressure Vessel Plates

4.5.6B Mechanical Properties of 9Ni Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-353/SA-353M	---	K81340	---	---	---	515	75	690-825	100-120	20.0	NN+T	---
ASME SA-553/SA-553M	Type II	K71340	---	---	---	585	85	690-825	100-120	20.0	Q+T	---
	Type I	K81340	---	---	---	585	85	690-825	100-120	20.0	Q+T	---
ASTM A353/A353M-09 (2014)	---	K81340	---	---	---	515	75	690-825	100-120	20.0	NN+T	---
ASTM A553/A553M-14	Type II	K71340	---	---	---	585	85	690-825	100-120	20.0	Q+T	---
	Type I	K81340	---	---	---	585	85	690-825	100-120	20.0	Q+T	---
ASTM A844/A844M-09	---	K81340	---	t ≤ 50	t ≤ 2	585	85	690-825	100-120	20.0	Q+T	---
EN 10028-4:2009	X8Ni9	---	1.5662	t ≤ 30	---	490	---	640-840	---	18	N or N+T	see standard for impact data
				t ≤ 30	---	490	---	640-840	---	18	Q+T	
				t ≤ 30	---	585	---	680-820	---	18	Q+T	
				30 < t ≤ 50	---	480	---	640-840	---	18	N or N+T	
				30 < t ≤ 50	---	480	---	640-840	---	18	Q+T	
				30 < t ≤ 50	---	575	---	680-820	---	18	Q+T	
	X7Ni9	---	1.5663	t ≤ 15	---	585	---	680-820	---	18	N or N+T or Q+T	see standard for impact data
				15 < t ≤ 30	---	585	---	680-820	---	18	Q+T	
				30 < t ≤ 50	---	575	---	680-820	---	18	Q+T	
	JIS G 3127:2013	Symbol SL9N520	---	---	6 ≤ t ≤ 16	---	520	---	690-830 T	---	21	NN+T
16 < t ≤ 20					---	520	---	690-830 T	---	25	NN+T	L: 34 J @ -196°C
20 < t ≤ 50					---	520	---	690-830 T	---	21	NN+T	L: 34 J @ -196°C
Symbol SL9N590		---	---	6 ≤ t ≤ 16	---	590	---	690-830 T	---	21	Q+T	see standard for impact data
				16 < t ≤ 20	---	590	---	690-830 T	---	25	Q+T	L: 41 J @ -196°C
20 < t ≤ 100	---	590	---	690-830 T	---	21	Q+T	L: 41 J @ -196°C				

4.6 Ni-Mo Alloy Steels for Pressure Vessel Plates

4.6.1A Chemical Composition of ½Ni-½Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-302/SA-302M*	Grade C	K12039	---	t ≤ 25	t ≤ 1	0.20	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.23	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 50	t > 2	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASME SA-533/SA-533M*	Type B, Class 1	K12539	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Type B, Class 2	K12539	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Type B, Class 3	K12539	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A302/A302M-12*	Grade C	K12039	---	t ≤ 25	t ≤ 1	0.20	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.23	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 50	t > 2	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A533/A533M- 09 (2014)*	Type B, Class 1	K12539	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Type B, Class 2	K12539	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Type B, Class 3	K12539	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
EN 10028-2:2009	20MnMoNi4-5	---	1.6311	---	---	0.15-0.23	1.00-1.50	0.40	0.020	0.010	0.20	0.40-0.80	0.45-0.60	V 0.02; Cu 0.20; N 0.012
JIS G 3119:2013	Symbol SBV2	---	---	6 ≤ t ≤ 25	---	0.20	1.15-1.50	0.15-0.40	0.020	0.020	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
				25 < t ≤ 50	---	0.23	1.15-1.50	0.15-0.40	0.020	0.020	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
				50 < t ≤ 150	---	0.25	1.15-1.50	0.15-0.40	0.020	0.020	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
JIS G 3120:2014	Symbol SQV2A	---	---	---	---	0.25	1.15-1.50	0.15-0.40	0.020	0.020	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
	Symbol SQV2B	---	---	---	---	0.25	1.15-1.50	0.15-0.40	0.020	0.020	0.30	0.40-0.70	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010

*: See ASTM A20/A20M-14 for additional information.

4.6 Ni-Mo Alloy Steels for Pressure Vessel Plates

4.6.1B Mechanical Properties of ½Ni-½Mo Alloys Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-302/SA-302M	Grade C	K12039	---	$t \leq 50$	$t \leq 2$	345	50	550-690	80-100	20	AR or N or SR or N+SR	---
				$t > 50$	$t > 2$	345	50	550-690	80-100	20	N	---
ASME SA-533/SA-533M	Type B, Class 1	K12539	---	$t \geq 6.5$	$t \geq 0.25$	345	50	550-690	80-100	18	Q+T	---
	Type B, Class 2	K12539	---	$t \geq 6.5$	$t \geq 0.25$	485	70	620-795	90-115	16	Q+T	---
	Type B, Class 3	K12539	---	$6.5 \leq t \leq 65$	$0.25 \leq t \leq 2.5$	570	83	690-860	100-125	16	Q+T	---
ASTM A302/A302M-12	Grade C	K12039	---	$t \leq 50$	$t \leq 2$	345	50	550-690	80-100	20	AR, N, SR or N+SR	---
				$t > 50$	$t > 2$	345	50	550-690	80-100	20	N	---
ASTM A533/A533M-09 (2014)	Type B, Class 1	K12539	---	$t \geq 6.5$	$t \geq 0.25$	345	50	550-690	80-100	18	Q+T	---
	Type B, Class 2	K12539	---	$t \geq 6.5$	$t \geq 0.25$	485	70	620-795	90-115	16	Q+T	---
	Type B, Class 3	K12539	---	$6.5 \leq t \leq 65$	$0.25 \leq t \leq 2.5$	570	83	690-860	100-125	16	Q+T	---
EN 10028-2:2009	20MnMoNi4-5	---	1.6311	$t \leq 40$	---	470	---	590-750	---	18	Q+T	see standard for impact data
				$40 < t \leq 60$	---	460	---	590-730	---	18	Q+T	
				$60 < t \leq 100$	---	450	---	570-710	---	18	Q+T	
				$100 < t \leq 150$	---	440	---	570-710	---	18	Q+T	
				$150 < t \leq 250$	---	400	---	560-700	---	18	Q+T	
JIS G 3119:2013	Symbol SBV2	---	---	$6 \leq t \leq 50$	---	345	---	550-690	---	17	AR, N, A, Q+T or N+A	---
				$50 < t \leq 150$	---	345	---	550-690	---	20	N or Q+T	---
JIS G 3120:2014	Symbol SQV2A	---	---	---	---	345	---	550-690 T	---	18	AR, A or Q+T	L: 40 J @ BA°C
	Symbol SQV2B	---	---	---	---	480	---	620-790 T	---	16	AR, A or Q+T	L: 47 J @ BA°C

4.6 Ni Alloys Steels for Pressure Plates

4.6.2A Chemical Composition of ¼Ni-½Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness		Weight, %max, Unless Otherwise Specified								
				mm	in	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-302/SA-302M*	Grade D	K12054	---	t ≤ 25	t ≤ 1	0.20	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.23	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 50	t > 2	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASME SA-533/SA-533M*	Type C, Class 1	K12554	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Type C, Class 2	K12554	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Type C, Class 3	K12554	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A302/A302M-12*	Grade D	K12054	---	t ≤ 25	t ≤ 1	0.20	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				25 < t ≤ 50	1 < t ≤ 2	0.23	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
				t > 50	t > 2	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
ASTM A533/A533M-09 (2014)*	Type C, Class 1	K12554	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Type C, Class 2	K12554	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
	Type C, Class 3	K12554	---	---	---	0.25	1.15-1.50	0.15-0.40	0.025	0.025	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Cb 0.02; B 0.0010
EN 10028-2:2009	15NiCuMoNb5-6-4	---	1.6368	---	---	0.17	0.80-1.20	0.25-0.50	0.025	0.010	0.30	1.00-1.30	0.25-0.50	Al 0.015 min.; Cu 0.50-0.80; Nb 0.015-0.045; N 0.020
GB 6654-1996	Grade 13MnNiMoNbR	---	---	---	---	0.15	1.20-1.60	0.15-0.50	0.025	0.025	0.20-0.40	0.60-1.00	0.20-0.40	Cu 0.30; Nb 0.005-0.020
JIS G 3119:2013	Symbol SBV3	---	---	6 ≤ t ≤ 25	---	0.20	1.15-1.50	0.15-0.40	0.020	0.020	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
				25 < t ≤ 50	---	0.23	1.15-1.50	0.15-0.40	0.020	0.020	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
				50 < t ≤ 150	---	0.25	1.15-1.50	0.15-0.40	0.020	0.020	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
JIS G 3120:2014	Symbol SQV3A	---	---	---	---	0.25	1.15-1.50	0.15-0.40	0.020	0.020	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010
	Symbol SQV3B	---	---	---	---	0.25	1.15-1.50	0.15-0.40	0.020	0.020	0.30	0.70-1.00	0.45-0.60	V 0.03; Cu 0.40; Ti 0.03; Nb 0.02; B 0.0010

*: See ASTM A20/A20M-14 for additional information.

4.6 Ni-Mo Alloy Steels for Pressure Vessel Plates

4.6.2B Mechanical Properties of 3/4Ni-1/2Mo Alloy Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-302/SA-302M	Grade D	K12054	---	t ≤ 50	t ≤ 2	345	50	550-690	80-100	20	AR or N or SR or N+SR	---
				t > 50	t > 2	345	50	550-690	80-100	20	N	---
ASME SA-533/SA-533M	Type C, Class 1	K12554	---	t ≥ 6.5	t ≥ 0.25	345	50	550-690	80-100	18	Q+T	---
	Type C, Class 2	K12554	---	t ≥ 6.5	t ≥ 0.25	485	70	620-795	90-115	16	Q+T	---
	Type C, Class 3	K12554	---	6.5 ≤ t ≤ 65	0.25 ≤ t ≤ 2.5	570	83	690-860	100-125	16	Q+T	---
ASTM A302/A302M-12	Grade D	K12054	---	t ≤ 50	t ≤ 2	345	50	550-690	80-100	20	AR, N, SR or N+SR	---
				t > 50	t > 2	345	50	550-690	80-100	20	N	---
ASTM A533/A533M-09 (2014)	Type C, Class 1	K12554	---	t ≥ 6.5	t ≥ 0.25	345	50	550-690	80-100	18	Q+T	---
	Type C, Class 2	K12554	---	t ≥ 6.5	t ≥ 0.25	485	70	620-795	90-115	16	Q+T	---
	Type C, Class 3	K12554	---	6.5 ≤ t ≤ 65	0.25 ≤ t ≤ 2.5	570	83	690-860	100-125	16	Q+T	---
EN 10028-2:2009	15NiCuMoNb5-6-4	---	1.6368	t ≤ 40	---	460	---	610-780	---	16	N+T	see standard for impact data
				40 < t ≤ 60	---	440	---	610-780	---	16	N+T	
				60 < t ≤ 100	---	430	---	600-760	---	16	N+T	
				100 < t ≤ 150	---	420	---	590-740	---	16	N+T or Q+T	
				150 < t ≤ 200	---	410	---	580-740	---	16	Q+T	
GB 6654-1996	Grade 13MnNiMoNbR	---	---	t ≤ 100	---	390	---	570-720	---	18	N+T	T: 31 J @ 0°C
				100 < t ≤ 120	---	380	---	570-720	---	18	N+T	T: 31 J @ 0°C
JIS G 3119:2013	Symbol SBV3	---	---	6 ≤ t ≤ 50	---	345	---	550-690	---	17	AR, N, A, Q+T or N+A	---
				50 < t ≤ 150	---	345	---	550-690	---	20	N or Q+T	---
JIS G 3120:2014	Symbol SQV3A	---	---	---	---	345	---	550-690 T	---	18	AR, A or Q+T	L: 40 J @ BA°C
	Symbol SQV3B	---	---	---	---	480	---	620-790 T	---	16	AR, A or Q+T	L: 47 J @ BA°C

4.7 Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates

4.7A Chemical Composition of Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 405	S40500	---	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.60	---	Al 0.10-0.30
ASTM A240/A240M-15a	Type 405	S40500	---	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.60	---	Al 0.10-0.30
EN 10088-2:2014	X6CrAl13	---	1.4002	0.08	1.00	1.00	0.040	0.015	12.0-14.0	---	---	Al 0.10-0.30
GB 3280-92	Grade 0Cr13Al	---	---	0.08	1.00	1.00	0.035	0.030	11.50-14.50	0.60	---	Al 0.10-0.30
GB 4237-92	Grade 0Cr13Al	---	---	0.08	1.00	1.00	0.035	0.030	11.50-14.50	0.60	---	Al 0.10-0.30
GB 4238-92	Grade 0Cr13Al	---	---	0.08	1.00	1.00	0.035	0.030	11.50-14.50	0.60	---	Al 0.10-0.30
JIS G 4304:2012	Symbol SUS405	---	---	0.08	1.00	1.00	0.040	0.030	11.50-14.50	0.60	---	Al 0.10-0.30
JIS G 4305:2012	Symbol SUS405	---	---	0.08	1.00	1.00	0.040	0.030	11.50-14.50	0.60	---	Al 0.10-0.30
ASME SA-240/SA-240M	---	S40977	---	0.030	1.50	1.00	0.040	0.015	10.5-12.5	0.30-1.00	---	N 0.030
		S41050	---	0.04	1.00	1.00	0.045	0.030	10.5-12.5	0.60-1.10	---	N 0.10
ASTM A240/A240M-15a	---	S40977	---	0.030	1.50	1.00	0.040	0.015	10.5-12.5	0.30-1.00	---	N 0.030
		S41050	---	0.04	1.00	1.00	0.045	0.030	10.5-12.5	0.60-1.10	---	N 0.10
EN 10028-7:2007	X2CrNi12	---	1.4003	0.030	1.50	1.00	0.040	0.015	10.5-12.5	0.30-1.00	---	N 0.030
EN 10088-2:2014	X2CrNi12	---	1.4003	0.030	1.50	1.00	0.040	0.015	10.5-12.5	0.30-1.00	---	N 0.030
ISO 9328-7:2004	Grade X2CrNi12	---	---	0.030	1.50	1.00	0.040	0.015	10.5-12.5	0.30-1.10	---	N 0.030
JIS G 4312:2011	Symbol SUH409L	---	---	0.030	1.00	1.00	0.040	0.030	10.50-11.75	0.60	---	Ti 6xC to 0.75
ASME SA-240/SA-240M	---	S42035	---	0.08	1.00	1.00	0.045	0.030	13.5-15.5	1.0-2.5	0.2-1.2	Ti 0.30-0.50
ASTM A240/A240M-15a	---	S42035	---	0.08	1.00	1.00	0.045	0.030	13.5-15.5	1.0-2.5	0.2-1.2	Ti 0.30-0.50
EN 10028-7:2007	X6CrNiTi12	---	1.4516	0.08	1.50	0.70	0.040	0.015	10.5-12.5	0.50-1.50	---	Ti 0.05-0.35
EN 10088-2:2014	X6CrNiTi12	---	1.4516	0.08	1.50	0.70	0.040	0.015	10.5-12.5	0.50-1.50	---	Ti 0.05-0.35
	X5CrNiMoTi15-2	---	1.4589	0.08	1.00	1.00	0.040	0.015	13.5-15.5	1.00-2.50	0.20-1.20	Ti 0.30-0.50
ISO 9328-7:2004	Grade X6CrNiTi12	---	---	0.08	1.00	1.00	0.040	0.015	10.5-12.5	0.50-1.50	---	Ti 0.05-0.35
ASME SA-240/SA-240M	---	S41500	---	0.05	0.50-1.00	0.60	0.030	0.030	11.5-14.0	3.5-5.5	0.50-1.00	---
ASTM A240/A240M-15a	---	S41500	---	0.05	0.50-1.00	0.60	0.030	0.030	11.5-14.0	3.5-5.5	0.50-1.00	---
EN 10028-7:2007	X3CrNiMo13-4	---	1.4313	0.05	1.50	0.70	0.040	0.015	12.0-14.0	3.5-4.5	0.30-0.70	N 0.020 min.
ISO 9328-7:2004	Grade X3CrNiMo13-4	---	---	0.05	0.50-1.00	0.70	0.040	0.015	12.0-14.0	3.5-4.5	0.30-1.00	---

4.7 Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates

4.7A Chemical Composition of Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 439	S43035	---	0.030	1.00	1.00	0.040	0.030	17.0-19.0	0.50	---	Al 0.15; N 0.030; Ti [0.20+4(C+N)] to 1.10
	---	S43932	---	0.030	1.00	1.00	0.040	0.030	17.0-19.0	0.50	---	Al 0.15; N 0.030; Ti+Cb [0.20+4(C+N)] to 0.75
	---	S43940	---	0.030	1.00	1.00	0.040	0.015	17.5-18.5	---	---	Ti 0.10-0.60; Cb [0.30+(3xC)] min.
ASTM A240/A240M-15a	Type 439	S43035	---	0.030	1.00	1.00	0.040	0.030	17.0-19.0	0.50	---	Al 0.15; N 0.030; Ti [0.20+4(C+N)] to 1.10
	---	S43932	---	0.030	1.00	1.00	0.040	0.030	17.0-19.0	0.50	---	Al 0.15; N 0.030; Ti+Cb [0.20+4(C+N)] to 0.75
	---	S43940	---	0.030	1.00	1.00	0.040	0.015	17.5-18.5	---	---	Ti 0.10-0.60; Cb [0.30+(3xC)] min.
EN 10028-7:2007	X2CrTiNb18	---	1.4509	0.030	1.00	1.00	0.040	0.015	17.5-18.5	---	---	Ti 0.10-0.60; Nb [3xC+0.30] to 1.00
EN 10088-2:2014	X2CrTiNb18	---	1.4509	0.030	1.00	1.00	0.040	0.015	17.5-18.5	---	---	Ti 0.10-0.60; Nb [3xC+0.30] to 1.00
ISO 9328-7:2004	Grade X2CrTiNb18	---	---	0.030	1.00	1.00	0.040	0.015	17.5-18.5	---	---	Ti 0.10-0.60; Nb [(3xC)+0.30] to 1.00
EN 10028-7:2007	X3CrTi17	---	1.4510	0.05	1.00	1.00	0.040	0.015	16.0-18.0	---	---	Ti [4x(C+N)+0.15] to 0.80
	X2CrTi17	---	1.4520	0.025	0.50	0.50	0.040	0.015	16.0-18.0	---	---	Ti 0.30-0.60; N 0.015
EN 10088-2:2014	X3CrTi17	---	1.4510	0.05	1.00	1.00	0.040	0.015	16.0-18.0	---	---	Ti [4x(C+N)+0.15] to 0.80
	X3CrNb17	---	1.4511	0.05	1.00	1.00	0.040	0.015	16.0-18.0	---	---	Nb 12xC to 1.00
	X2CrTi17	---	1.4520	0.025	0.50	0.50	0.040	0.015	16.0-18.0	---	---	N 0.015; Ti [4x(C+N)+0.15] to 0.80
GB 3280-92	Grade 00Cr17	---	---	0.030	1.00	0.75	0.035	0.030	16.00-19.00	0.60	---	Ti 0.10-1.00; Nb 0.10-1.00
ISO 9328-7:2004	Grade X2CrTi17	---	---	0.025	0.50	0.50	0.040	0.015	16.0-18.0	---	---	Ti 0.30-0.60; N 0.015
	Grade X3CrTi17	---	---	0.05	1.00	1.00	0.040	0.015	16.0-19.0	---	---	Ti [4x(C+N)+0.15] to 0.75
JIS G 4304:2012	Symbol SUS430LX	---	---	0.030	1.00	0.75	0.040	0.030	16.00-19.00	0.60	---	Ti 0.10-1.00; Nb 0.10-1.00
JIS G 4305:2012	Symbol SUS430LX	---	---	0.030	1.00	0.75	0.040	0.030	16.00-19.00	0.60	---	Ti 0.10-1.00; Nb 0.10-1.00

4.7 Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates

4.7A Chemical Composition of Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 444	S44400	---	0.025	1.00	1.00	0.040	0.030	17.5-19.5	1.00	1.75-2.50	N 0.035; (Ti+Cb) [0.20+4(C+N)] to 0.80
ASTM A240/A240M-15a	Type 444	S44400	---	0.025	1.00	1.00	0.040	0.030	17.5-19.5	1.00	1.75-2.50	N 0.035; Ti+Cb [0.20+4(C+N)] to 0.80
EN 10028-7:2007	X2CrMoTi18-2	---	1.4521	0.025	1.00	1.00	0.040	0.015	17.0-20.0	---	1.80-2.50	N 0.030; Ti [4x(C+N)+0.15] to 0.80
EN 10088-2:2014	X2CrMoTi18-2	---	1.4521	0.025	1.00	1.00	0.040	0.015	17.0-20.0	---	1.80-2.50	N 0.030; Ti [4x(C+N)+0.15] to 0.80
GB 3280-92	Grade 00Cr18Mo2	---	---	0.025	1.00	1.00	0.035	0.030	17.00-20.00	0.60	1.75-2.50	Ti 8x(C+N) to 0.80; Nb 8x(C+N) to 0.80; Zr 8x(C+N) to 0.80; (Ti+Nb+Zr) 8x(C+N) to 0.80; N 0.025
GB 4237-92	Grade 00Cr18Mo2	---	---	0.025	1.00	1.00	0.035	0.030	17.00-20.00	0.60	1.75-2.50	Ti 8x(C+N) to 0.80; Nb 8x(C+N) to 0.80; Zr 8x(C+N) to 0.80; (Ti+Nb+Zr) 8x(C+N) to 0.80; N 0.025
ISO 9328-7:2004	Grade X2CrMoTi18-2	---	---	0.025	1.00	1.00	0.040	0.015	17.0-20.0	---	1.80-2.50	N 0.030; Ti [4x(C+N)+0.15] to 0.80
JIS G 4304:2012	Symbol SUS444	---	---	0.025	1.00	1.00	0.040	0.030	17.00-20.00	0.60	1.75-2.50	Ti, Nb, Zr or their combination 8x(C + N) to 0.80; N 0.025
JIS G 4305:2012	Symbol SUS444	---	---	0.025	1.00	1.00	0.040	0.030	17.00-20.00	0.60	1.75-2.50	Ti, Nb, Zr or their combination 8x(C + N) to 0.80; N 0.025

4.7 Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates

4.7B Mechanical Properties of Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 405	S40500	---	---	---	170	25	415	60	20	see standard	179 max. HB; 88 max. HRB
ASTM A240/A240M-15a	Type 405	S40500	---	---	---	170	25	415	60	20	see standard	179 max. HB; 88 max. HRBW
EN 10088-2:2014	X6CrAl13	---	1.4002	$t \leq 8$	---	230	---	400-600	---	17 L, 17 T	A	---
				$t \leq 13.5$	---	210	---	400-600	---	17 L, 17 T	A	---
				$t \leq 25$	---	210	---	400-600	---	17 L, 17 T	A	---
GB 3280-92	Grade 0Cr13Al	---	---	---	---	175	---	410	---	20	A	183 max. HB; 88 max. HRB
GB 4237-92	Grade 0Cr13Al	---	---	---	---	177	---	410	---	20	A	183 max. HB; 88 max. HRB
GB 4238-92	Grade 0Cr13Al	---	---	---	---	175	---	410	---	20	A	183 max. HB; 88 max. HRB
JIS G 4304:2012	Symbol SUS405	---	---	---	---	175	---	410	---	20	A	183 max. HBW; 88 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS405	---	---	---	---	175	---	410	---	20	A	183 max. HBW; 88 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	---	S40977	---	---	---	280	41	450	65	18	see standard	180 max. HB; 88 max. HRB
		S41050	---	---	---	205	30	415	60	22	see standard	183 max. HB; 89 max. HRB
ASTM A240/A240M-15a	---	S40977	---	---	---	280	41	450	65	18	see standard	180 max. HB; 88 max. HRBW
		S41050	---	---	---	205	30	415	60	22	see standard	183 max. HB; 89 max. HRBW
EN 10028-7:2007	X2CrNi12	---	1.4003	$t \leq 8$	---	280	---	450-650	---	20 L, 20 T	A	T: 50 J @ RT
				$t \leq 13.5$	---	280	---	450-650	---	20 L, 20 T	A	T: 50 J @ RT
				$t \leq 25$	---	250	---	450-650	---	18 L, 18 T	A	T: 50 J @ RT
EN 10088-2:2014	X2CrNi12	---	1.4003	$t \leq 8$	---	280	---	450-650	---	20 L, 20 T	A	---
				$t \leq 13.5$	---	280	---	450-650	---	20 L, 20 T	A	---
				$t \leq 25$	---	250	---	450-650	---	18 L, 18 T	A	---
ISO 9328-7:2004	Grade X2CrNi12	---	---	$t \leq 6$	---	280	---	450-650	---	20 L, 20 T	A	T: 50 J @ 20°C
				$t \leq 12$	---	280	---	450-650	---	20 L, 20 T	A	T: 50 J @ 20°C
				$t \leq 25$	---	250	---	450-650	---	18 L, 18 T	A	T: 50 J @ 20°C
JIS G 4312:2011	Symbol SUH409L	---	---	---	---	175	---	360	---	25	A	162 max. HBW; 80 max. HRBW; 175 max. HV

4.7 Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates

4.7B Mechanical Properties of Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	---	S42035	---	---	---	380	55	550	80	16	see standard	180 max. HB; 88 max. HRB
ASTM A240/A240M-15a	---	S42035	---	---	---	380	55	550	80	16	see standard	180 max. HB; 88 max. HRBW
EN 10028-7:2007	X6CrNiTi12	---	1.4516	$t \leq 8$	---	280	---	450-650	---	23 L, 23 T	A	T: 50 J @ RT
				$t \leq 13.5$	---	280	---	450-650	---	23 L, 23 T	A	T: 50 J @ RT
				$t \leq 25$	---	250	---	450-650	---	20 L, 20 T	A	T: 50 J @ RT
EN 10088-2:2014	X6CrNiTi12	---	1.4516	$t \leq 8$	---	280	---	450-650	---	23 L, 23 T	A	---
				$t \leq 13.5$	---	280	---	450-650	---	23 L, 23 T	A	---
				$t \leq 25$	---	250	---	450-650	---	20 L, 20 T	A	---
	X5CrNiMoTi15-2	---	1.4589	$t \leq 8$	---	400	---	550-750	---	16 L, 16 T	A	---
				$t \leq 13.5$	---	360	---	500-750	---	14 L, 14 T	A	---
ISO 9328-7:2004	Grade X6CrNiTi12	---	---	$t \leq 6$	---	280	---	450-650	---	23 L, 23 T	A	T: 50 J @ 20°C
				$t \leq 12$	---	280	---	450-650	---	23 L, 23 T	A	T: 50 J @ 20°C
				$t \leq 25$	---	250	---	450-650	---	20 L, 20 T	A	T: 50 J @ 20°C
ASME SA-240/SA-240M	---	S41500	---	---	---	620	90	795	115	15	see standard	302 max. HB; 32 max. HRC
ASTM A240/A240M-15a	---	S41500	---	---	---	620	90	795	115	15	see standard	302 max. HB; 32 max. HRC
EN 10028-7:2007	X3CrNiMo13-4	---	1.4313	$t \leq 75$	---	650	---	780-980	---	14 L, 14 T	Q+T	see standard for impact data
ISO 9328-7:2004	Grade X3CrNiMo13-4	---	---	$t \leq 75$	---	650	---	780-980	---	14 L, 14 T	Q+T	see standard for impact data
ASME SA-240/SA-240M	Type 439	S43035	---	---	---	205	30	415	60	22	see standard	183 max. HB; 89 max. HRB
	---	S43932	---	---	---	205	30	415	60	22	see standard	183 max. HB; 89 max. HRB
	---	S43940	---	---	---	250	36	430	62	18	see standard	180 max. HB; 88 max. HRB
ASTM A240/A240M-15a	Type 439	S43035	---	---	---	205	30	415	60	22	see standard	183 max. HB; 89 max. HRBW
	---	S43932	---	---	---	205	30	415	60	22	see standard	183 max. HB; 89 max. HRBW
	---	S43940	---	---	---	250	36	430	62	18	see standard	180 max. HB; 88 max. HRBW
EN 10028-7:2007	X2CrTiNb18	---	1.4509	$t \leq 4$	---	230	---	430-630	---	18 L, 18 T	A	---
EN 10088-2:2014	X2CrTiNb18	---	1.4509	$t \leq 8$	---	230	---	430-630	---	18 L, 18 T	A	---
ISO 9328-7:2004	Grade X2CrTiNb18	---	---	$t \leq 2.5$	---	230	---	430-630	---	18 L, 18 T	A	---

4.7 Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates

4.7B Mechanical Properties of Ferritic and Martensitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10028-7:2007	X3CrTi17	---	1.4510	$t \leq 4$	---	230	---	420-600	---	23 L, 23 T	A	---
	X2CrTi17	---	1.4520	$t \leq 4$	---	180	---	380-530	---	24 L, 24 T	A	---
EN 10088-2:2014	X3CrTi17	---	1.4510	$t \leq 8$	---	230	---	420-600	---	23 L, 23 T	A	---
				$t \leq 13.5$	---	230	---	420-600	---	23 L, 23 T	A	---
	X3CrNb17	---	1.4511	$t \leq 8$	---	230	---	420-600	---	23 L, 23 T	A	---
	X2CrTi17	---	1.4520	$t \leq 8$	---	180	---	380-530	---	24 L, 24 T	A	---
GB 3280-92	Grade 00Cr17	---	---	---	---	175	---	365	---	22	A	183 max. HB; 88 max. HRB
ISO 9328-7:2004	Grade X2CrTi17	---	---	$t \leq 2.5$	---	180	---	380-530	---	24 L, 24 T	A	---
	Grade X3CrTi17	---	---	$t \leq 3$	---	230	---	420-600	---	23 L, 23 T	A	---
JIS G 4304:2012	Symbol SUS430LX	---	---	---	---	175	---	360	---	22	A	183 max. HBW; 88 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS430LX	---	---	---	---	175	---	360	---	22	A	183 max. HBW; 88 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	Type 444	S44400	---	---	---	275	40	415	60	20	see standard	217 max. HB; 96 max. HRB
ASTM A240/A240M-15a	Type 444	S44400	---	---	---	275	40	415	60	20	---	217 max. HB; 96 max. HRBW
EN 10028-7:2007	X2CrMoTi18-2	---	1.4521	$t \leq 4$	---	300	---	420-640	---	20 L, 20 T	A	---
EN 10088-2:2014	X2CrMoTi18-2	---	1.4521	$t \leq 8$	---	300	---	420-640	---	20 L, 20 T	A	---
				$t \leq 12$	---	280	---	420-620	---	20 L, 20 T	A	---
				$t \leq 13.5$	---	280	---	400-600	---	20 L, 20 T	A	---
GB 3280-92	Grade 00Cr18Mo2	---	---	---	---	245	---	410	---	20	A	217 max. HB; 96 max. HRB
GB 4237-92	Grade 00Cr18Mo2	---	---	---	---	245	---	410	---	20	A	217 max. HB; 96 max. HRB
ISO 9328-7:2004	Grade X2CrMoTi18-2	---	---	$t \leq 2.5$	---	300	---	420-640	---	20 L, 20 T	A	---
JIS G 4304:2012	Symbol SUS444	---	---	---	---	245	---	410	---	20	A	217 max. HBW; 96 max. HRBW; 230 max. HV
JIS G 4305:2012	Symbol SUS444	---	---	---	---	245	---	410	---	20	A	217 max. HBW; 96 max. HRBW; 230 max. HV

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8A Chemical Composition of Austenitic Stainless Steels for Pressure Vessel Plates

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 301LN	S30153	---	0.03	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.07-0.20
ASME SA-666	Type 301LN	S30153	---	0.03	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.07-0.20
ASTM A240/A240M-15a	Type 301LN	S30153	---	0.03	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.07-0.20
ASTM A666-15	Type 301LN	S30153	---	0.03	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.07-0.20
EN 10028-7:2007	X2CrNi18-7	---	1.4318	0.030	2.00	1.00	0.045	0.015	16.5-18.5	6.0-8.0	---	N 0.10-0.20
EN 10088-2:2014	X2CrNi18-7	---	1.4318	0.030	2.00	1.00	0.045	0.015	16.5-18.5	6.0-8.0	---	N 0.10-0.20
ISO 9328-7:2004	Grade X2CrNi18-7	---	---	0.030	2.00	1.00	0.045	0.015	16.5-18.5	6.0-8.0	---	N 0.10-0.20
ASME SA-240/SA-240M	Type 304	S30400	---	0.07	2.00	0.75	0.045	0.030	17.5-19.5	8.0-10.5	---	N 0.10
ASME SA-666	Type 304	S30400	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10
ASTM A240/A240M-15a	Type 304	S30400	---	0.07	2.00	0.75	0.045	0.030	17.5-19.5	8.0-10.5	---	N 0.10
ASTM A666-15	Type 304	S30400	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10
EN 10028-7:2007	X5CrNi18-10	---	1.4301	0.07	2.00	1.00	0.045	0.015	17.5-19.5	8.0-10.5	---	N 0.10
EN 10088-2:2014	X5CrNi18-10	---	1.4301	0.07	2.00	1.00	0.045	0.015	17.5-19.5	8.0-10.5	---	N 0.10
GB 3280-92	Grade 0Cr18Ni9	---	---	0.07	2.00	1.00	0.035	0.030	17.00-19.00	8.00-11.00	---	---
GB 4237-92	Grade 0Cr18Ni9	---	---	0.07	2.00	1.00	0.035	0.030	17.00-19.00	8.00-11.00	---	---
GB 4238-92	Grade 0Cr18Ni9	---	---	0.07	2.00	1.00	0.035	0.030	17.00-19.00	8.00-11.00	---	---
ISO 9328-7:2004	Grade X5CrNi18-9	---	---	0.07	2.00	1.00	0.045	0.015	17.5-19.5	8.0-10.5	---	N 0.11
JIS G 4304:2012	Symbol SUS304	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
JIS G 4305:2012	Symbol SUS304	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
ASME SA-240/SA-240M	Type 304H	S30409	---	0.04-0.10	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	---
ASTM A240/A240M-15a	Type 304H	S30409	---	0.04-0.10	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	---
EN 10028-7:2007	X6CrNi18-10	---	1.4948	0.04-0.08	2.00	1.00	0.035	0.015	17.0-19.0	8.0-11.0	---	N 0.10
ISO 9328-7:2004	Grade X6CrNi18-10	---	---	0.04-0.08	2.00	1.00	0.035	0.015	17.0-19.0	8.0-11.0	---	N 0.11
ASME SA-240/SA-240M	Type 304L	S30403	---	0.030	2.00	0.75	0.045	0.030	17.5-19.5	8.0-12.0	---	N 0.10
ASME SA-666	Type 304L	S30403	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10
ASTM A240/A240M-15a	Type 304L	S30403	---	0.030	2.00	0.75	0.045	0.030	17.5-19.5	8.0-12.0	---	N 0.10
ASTM A666-15	Type 304L	S30403	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10
EN 10028-7:2007	X2CrNi19-11	---	1.4306	0.030	2.00	1.00	0.045	0.015	18.0-20.0	10.0-12.0	---	N 0.10
	X2CrNi18-9	---	1.4307	0.030	2.00	1.00	0.045	0.015	17.5-19.5	8.0-10.5	---	N 0.10
EN 10088-2:2014	X2CrNi19-11	---	1.4306	0.030	2.00	1.00	0.045	0.015	18.0-20.0	10.0-12.0	---	N 0.10
	X2CrNi18-9	---	1.4307	0.030	2.00	1.00	0.045	0.015	17.5-19.5	8.0-10.5	---	N 0.10
GB 3280-92	Grade 00Cr19Ni10	---	---	0.030	2.00	1.00	0.035	0.030	18.00-20.00	8.00-12.00	---	---
	Grade 00Cr19Ni13Mo3	---	---	0.030	2.50	1.00	0.035	0.030	18.00-20.00	11.00-15.00	---	---
GB 4237-92	Grade 00Cr19Ni10	---	---	0.030	2.00	1.00	0.035	0.030	18.00-20.00	8.00-12.00	---	---
ISO 9328-7:2004	Grade X2CrNi18-9	---	---	0.030	2.00	1.00	0.045	0.015	17.5-19.5	8.0-10.0	---	N 0.11
	Grade X2CrNi19-11	---	---	0.030	2.00	1.00	0.045	0.015	18.0-20.0	10.0-12.0	---	N 0.11
JIS G 4304:2012	Symbol SUS304L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	9.00-13.00	---	---
JIS G 4305:2012	Symbol SUS304L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	9.00-13.00	---	---

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8A Chemical Composition of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 304N	S30451	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10-0.16
ASME SA-666	Type 304N	S30451	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10-0.16
ASTM A240/A240M-15a	Type 304N	S30451	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10-0.16
ASTM A666-15	Type 304N	S30451	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10-0.16
EN 10028-7:2007	X5CrNiN19-9	---	1.4315	0.06	2.00	1.00	0.045	0.015	18.0-20.0	8.0-11.0	---	N 0.12-0.22
EN 10088-2:2014	X5CrNiN19-9	---	1.4315	0.06	2.00	1.00	0.045	0.015	18.0-20.0	8.0-11.0	---	N 0.12-0.22
GB 3280-92	Grade 0Cr19Ni9N	---	---	0.08	2.50	1.00	0.035	0.030	18.00-20.00	7.00-10.50	---	N 0.10-0.25
GB 4237-92	Grade 0Cr19Ni9N	---	---	0.08	2.50	1.00	0.035	0.030	18.00-20.00	7.00-10.50	---	N 0.10-0.25
ISO 9328-7:2004	Grade X5CrNiN18-8	---	---	0.07	2.50	1.00	0.045	0.015	18.0-20.0	8.0-11.0	---	N 0.10-0.16
JIS G 4304:2012	Symbol SUS304N1	---	---	0.08	2.50	1.00	0.045	0.030	18.00-20.00	7.00-10.50	---	N 0.10-0.25
JIS G 4305:2012	Symbol SUS304N1	---	---	0.08	2.50	1.00	0.045	0.030	18.00-20.00	7.00-10.50	---	N 0.10-0.25
ASME SA-240/SA-240M	Type 304LN	S30453	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10-0.16
ASME SA-666	Type 304LN	S30453	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10-0.16
ASTM A240/A240M-15a	Type 304LN	S30453	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10-0.16
ASTM A666-15	Type 304LN	S30453	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10-0.16
EN 10028-7:2007	X2CrNiN18-10	---	1.4311	0.030	2.00	1.00	0.045	0.015	17.5-19.5	8.5-11.5	---	N 0.12-0.22
EN 10088-2:2014	X2CrNiN18-10	---	1.4311	0.030	2.00	1.00	0.045	0.015	17.5-19.5	8.5-11.5	---	N 0.12-0.22
GB 3280-92	Grade 00Cr18Ni10N	---	---	0.030	2.00	1.00	0.035	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
GB 4237-92	Grade 00Cr18Ni10N	---	---	0.030	2.00	1.00	0.035	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
ISO 9328-7:2004	Grade X2CrNiN18-10	---	---	0.030	2.00	1.00	0.045	0.015	17.5-19.5	8.0-11.5	---	N 0.12-0.22
JIS G 4304:2012	Symbol SUS304LN	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
JIS G 4305:2012	Symbol SUS304LN	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
ASME SA-240/SA-240M	Type 309H	S30909	---	0.04-0.10	2.00	0.75	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASTM A240/A240M-15a	Type 309H	S30909	---	0.04-0.10	2.00	0.75	0.045	0.030	22.0-24.0	12.0-15.0	---	---
EN 10028-7:2007	X6CrNi23-13	---	1.4950	0.04-0.08	2.00	0.70	0.035	0.015	22.0-24.0	12.0-15.0	---	N 0.10
ISO 9328-7:2004	Grade X6CrNi23-13	---	---	0.04-0.08	2.00	0.70	0.035	0.015	22.0-24.0	12.0-15.0	---	N 0.11
ASME SA-240/SA-240M	Type 310H	S31009	---	0.04-0.10	2.00	0.75	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A240/A240M-15a	Type 310H	S31009	---	0.04-0.10	2.00	0.75	0.045	0.030	24.0-26.0	19.0-22.0	---	---
EN 10028-7:2007	X6CrNi25-20	---	1.4951	0.04-0.08	2.00	0.70	0.035	0.015	24.0-26.0	19.0-22.0	---	N 0.10
ISO 9328-7:2004	Grade X6CrNi25-20	---	---	0.04-0.08	2.00	0.70	0.035	0.015	24.0-26.0	19.0-22.0	---	N 0.11

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8A Chemical Composition of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASME SA-666	Type 316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A240/A240M-15a	Type 316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASTM A666-15	Type 316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
EN 10028-7:2007	X5CrNiMo17-12-2	---	1.4401	0.07	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-2.50	N 0.10
	X3CrNiMo17-13-3	---	1.4436	0.05	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.0	2.50-3.00	N 0.10
EN 10088-2:2014	X5CrNiMo17-12-2	---	1.4401	0.07	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-2.50	N 0.10
	X3CrNiMo17-13-3	---	1.4436	0.05	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.0	2.50-3.00	N 0.10
GB 3280-92	Grade 0Cr17Ni12Mo2	---	---	0.08	2.00	1.00	0.035	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
GB 4237-92	Grade 0Cr17Ni12Mo2	---	---	0.08	2.00	1.00	0.035	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
GB 4238-92	Grade 0Cr17Ni12Mo2	---	---	0.08	2.00	1.00	0.035	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
ISO 9328-7:2004	Grade X3CrNiMo17-12-3	---	---	0.05	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.0	2.50-3.00	N 0.11
	Grade X5CrNiMo17-12-2	---	---	0.07	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-3.00	N 0.11
JIS G 4304:2012	Symbol SUS316	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 4305:2012	Symbol SUS316	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
ASME SA-240/SA-240M	Type 316L	S31603	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASME SA-666	Type 316L	S31603	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A240/A240M-15a	Type 316L	S31603	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASTM A666-15	Type 316L	S31603	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
EN 10028-7:2007	X2CrNiMo17-12-2	---	1.4404	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-2.50	N 0.10
	X2CrNiMo17-12-3	---	1.4432	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.0	2.50-3.00	N 0.10
	X2CrNiMo18-14-3	---	1.4435	0.030	2.00	1.00	0.045	0.015	17.0-19.0	12.5-15.0	2.50-3.00	N 0.10
EN 10088-2:2014	X2CrNiMo17-12-2	---	1.4404	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-2.50	N 0.10
	X2CrNiMo17-12-3	---	1.4432	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.0	2.50-3.00	N 0.10
	X2CrNiMo18-14-3	---	1.4435	0.030	2.00	1.00	0.045	0.015	17.0-19.0	12.5-15.0	2.50-3.00	N 0.10
GB 3280-92	Grade 00Cr17Ni14Mo2	---	---	0.030	2.00	1.00	0.035	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
GB 4237-92	Grade 00Cr17Ni14Mo2	---	---	0.030	2.00	1.00	0.035	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
ISO 9328-7:2004	Grade X2CrNiMo17-12-2	---	---	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-3.00	N 0.11
	Grade X2CrNiMo17-12-3	---	---	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.0	2.50-3.00	N 0.11
	Grade X2CrNiMo18-14-3	---	---	0.030	2.00	1.00	0.045	0.015	17.0-19.0	12.5-15.0	2.50-3.00	N 0.11
JIS G 4304:2012	Symbol SUS316L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
JIS G 4305:2012	Symbol SUS316L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8A Chemical Composition of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 316Ti	S31635	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10; Ti 5x(C+N) to 0.70
ASTM A240/A240M-15a	Type 316Ti	S31635	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10; Ti 5x(C+N) to 0.70
EN 10028-7:2007	X6CrNiMoTi17-12-2	---	1.4571	0.08	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.5	2.00-2.50	Ti 5xC to 0.70
EN 10088-2:2014	X6CrNiMoTi17-12-2	---	1.4571	0.08	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.5	2.00-2.50	Ti 5xC to 0.70
GB 3280-92	Grade 0Cr18Ni12Mo2Ti	---	---	0.08	2.00	1.00	0.035	0.030	16.00-19.00	11.00-14.00	1.80-2.50	Ti 5xC to 0.70
GB 4237-92	Grade 0Cr18Ni12Mo2Ti	---	---	0.08	2.00	1.00	0.035	0.030	16.00-19.00	11.00-14.00	1.80-2.50	Ti 5xC to 0.07
ISO 9328-7:2004	Grade X6CrNiMoTi17-12-2	---	---	0.08	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.5	2.00-2.50	Ti 5xC to 0.70
JIS G 4304:2012	Symbol SUS316Ti	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti 5xC min
JIS G 4305:2012	Symbol SUS316Ti	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti 5xC min
ASME SA-240/SA-240M	Type 316Cb	S31640	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10; Cb 10xC to 1.10
ASTM A240/A240M-15a	Type 316Cb	S31640	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10; Cb 10xC to 1.10
EN 10028-7:2007	X6CrNiMoNb17-12-2	---	1.4580	0.08	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.5	2.00-2.50	Nb 10xC to 1.00
EN 10088-2:2014	X6CrNiMoNb17-12-2	---	1.4580	0.08	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.5	2.00-2.50	Nb 10xC to 1.00
ISO 9328-7:2004	Grade X6CrNiMoNb17-12-2	---	---	0.08	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.5	2.00-2.50	Nb 10xC to 1.00
ASME SA-479/SA-479M	Type 316LN	S31653	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
ASTM A479/A479M-14	Type 316LN	S31653	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
EN 10028-7:2007	X2CrNiMoN17-11-2	---	1.4406	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.0-12.5	2.00-2.50	N 0.12-0.22
EN 10088-3:2014	X2CrNiMoN17-13-3	---	1.4429	0.030	2.00	1.00	0.045	0.015	16.5-18.5	11.0-14.0	2.50-3.00	N 0.12-0.22
	X2CrNiMoN17-11-2	---	1.4406	0.030	2.00	1.00	0.045	0.030	16.5-18.5	10.0-12.5	2.00-2.50	N 0.12-0.22
	X2CrNiMoN17-13-3	---	1.4429	0.030	2.00	1.00	0.045	0.015	16.5-18.5	11.0-14.0	2.50-3.00	N 0.12-0.22
GB 3280-92	Grade 00Cr17Ni13Mo2N	---	---	0.030	2.00	1.00	0.035	0.030	16.50-18.50	10.50-14.50	2.00-3.00	N 0.12-0.22
GB 4237-92	Grade 00Cr17Ni13Mo2N	---	---	0.030	2.00	1.00	0.035	0.030	16.50-18.50	10.50-14.50	2.00-3.00	N 0.12-0.22
ISO 9328-7:2004	Grade X2CrNiMoN17-11-2	---	---	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.0-12.5	2.00-3.00	N 0.12-0.22
	Grade X2CrNiMoN17-13-3	---	---	0.030	2.00	1.00	0.045	0.015	16.5-18.5	11.0-13.0	2.50-3.00	N 0.12-0.22
JIS G 4304:2012	Symbol SUS316LN	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.50-14.50	2.00-3.00	N 0.12-0.22
JIS G 4305:2012	Symbol SUS316LN	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.50-14.50	2.00-3.00	N 0.12-0.22
ASME SA-240/SA-240M	Type 317L	S31703	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	N 0.10
ASTM A240/A240M-15a	Type 317L	S31703	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	N 0.10
EN 10028-7:2007	X2CrNiMo18-15-4	---	1.4438	0.030	2.00	1.00	0.045	0.015	17.5-19.5	13.0-16.0	3.0-4.0	N 0.10
EN 10088-2:2014	X2CrNiMo18-15-4	---	1.4438	0.030	2.00	1.00	0.045	0.015	17.5-19.5	13.0-16.0	3.0-4.0	N 0.10
GB 4237-92	Grade 00Cr19Ni13Mo3	---	---	0.030	2.00	1.00	0.035	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
ISO 9328-7:2004	Grade X2CrNiMo18-15-4	---	---	0.030	2.00	1.00	0.045	0.015	17.5-19.5	13.0-16.0	3.00-4.0	N 0.11
JIS G 4304:2012	Symbol SUS317L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 4305:2012	Symbol SUS317L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8A Chemical Composition of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 317LN	S31753	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	N 0.10-0.22
ASTM A240/A240M-15a	Type 317LN	S31753	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	N 0.10-0.22
EN 10028-7:2007	X2CrNiMoN18-12-4	---	1.4434	0.030	2.00	1.00	0.045	0.015	16.5-19.5	10.5-14.0	3.0-4.0	N 0.10-0.20
EN 10088-2:2014	X2CrNiMoN18-12-4	---	1.4434	0.030	2.00	1.00	0.045	0.015	16.5-19.5	10.5-14.0	3.0-4.0	N 0.10-0.20
ISO 9328-7:2004	Grade X2CrNiMoN18-12-4	---	---	0.030	2.00	1.00	0.045	0.015	16.5-19.5	10.5-14.0	3.00-4.0	N 0.10-0.20
JIS G 4304:2012	Symbol SUS317LN	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	N 0.10-0.22
JIS G 4305:2012	Symbol SUS317LN	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	N 0.10-0.22
ASME SA-240/SA-240M	Type 317LMN	S31726	---	0.030	2.00	0.75	0.045	0.030	17.0-20.0	13.5-17.5	4.0-5.0	N 0.10-0.20
ASTM A240/A240M-15a	Type 317LMN	S31726	---	0.030	2.00	0.75	0.045	0.030	17.0-20.0	13.5-17.5	4.0-5.0	N 0.10-0.20
EN 10028-7:2007	X2CrNiMoN17-13-5	---	1.4439	0.030	2.00	1.00	0.045	0.015	16.5-18.5	12.5-14.5	4.0-5.0	N 0.12-0.22
EN 10088-2:2014	X2CrNiMoN17-13-5	---	1.4439	0.030	2.00	1.00	0.045	0.015	16.5-18.5	12.5-14.5	4.0-5.0	N 0.12-0.22
ISO 9328-7:2004	Grade X2CrNiMoN17-13-5	---	---	0.030	2.00	1.00	0.045	0.015	16.5-18.5	12.5-14.5	4.0-5.0	N 0.12-0.22
ASME SA-240/SA-240M	Type 321	S32100	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-12.0	---	N 0.10; Ti 5x(C+N) to 0.70
ASTM A240/A240M-15a	Type 321	S32100	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-12.0	---	N 0.10; Ti 5x(C+N) to 0.70
EN 10028-7:2007	X6CrNiTi18-10	---	1.4541	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70
EN 10088-2:2014	X6CrNiTi18-10	---	1.4541	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70
GB 3280-92	Grade 0Cr18Ni10Ti	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-12.00	---	Ti 5xC min.
GB 4237-92	Grade 0Cr18Ni10Ti	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-12.00	---	Ti 5xC min.
GB 4238-92	Grade 0Cr18Ni10Ti	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-12.00	---	Ti 5xC min.
ISO 9328-7:2004	Grade X6CrNiTi18-10	---	---	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70
JIS G 4304:2012	Symbol SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5xC min.
JIS G 4305:2012	Symbol SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5xC min.
ASME SA-240/SA-240M	Type 347	S34700	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 10xC to 1.00
ASTM A240/A240M-15a	Type 347	S34700	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 10xC to 1.00
EN 10028-7:2007	X6CrNiNb18-10	---	1.4550	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Nb 10xC to 1.00
EN 10088-2:2014	X6CrNiNb18-10	---	1.4550	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Nb 10xC to 1.00
GB 3280-92	Grade 0Cr18Ni11Nb	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min.
GB 4237-92	Grade 0Cr18Ni11Nb	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min.
GB 4238-92	Grade 0Cr18Ni11Nb	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min.
ISO 9328-7:2004	Grade X6CrNiNb18-10	---	---	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Nb 10xC to 1.00
JIS G 4304:2012	Symbol SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min.
JIS G 4305:2012	Symbol SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min.

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8A Chemical Composition of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 904L	N08904	---	0.020	2.00	1.00	0.045	0.035	19.0-23.0	23.0-28.0	4.00-5.00	Cu 1.00-2.00; N 0.10
ASTM A240/A240M-15a	Type 904L	N08904	---	0.020	2.00	1.00	0.045	0.035	19.0-23.0	23.0-28.0	4.00-5.00	Cu 1.00-2.00; N 0.10
EN 10028-7:2007	X1NiCrMoCu25-20-5	---	1.4539	0.020	2.00	0.70	0.030	0.010	19.0-21.0	24.0-26.0	4.0-5.0	Cu 1.20-2.00; N 0.15
EN 10088-2:2014	X1NiCrMoCu25-20-5	---	1.4539	0.020	2.00	0.70	0.030	0.010	19.0-21.0	24.0-26.0	4.0-5.0	Cu 1.20-2.00; N 0.15
ISO 9328-7:2004	Grade X1NiCrMoCu25-20-5	---	---	0.020	2.00	0.70	0.030	0.010	19.0-21.0	24.0-26.0	4.0-5.0	Cu 1.20-2.00; N 0.15
JIS G 4304:2012	Symbol SUS890L	---	---	0.020	2.00	1.00	0.045	0.030	19.00-23.00	23.00-28.00	4.00-5.00	Cu 1.00-2.00
JIS G 4305:2012	Symbol SUS890L	---	---	0.020	2.00	1.00	0.045	0.030	19.00-23.00	23.00-28.00	4.00-5.00	Cu 1.00-2.00
ASME SA-240/SA-240M	---	N08367	---	0.030	2.00	1.00	0.040	0.030	20.0-22.0	23.5-25.5	6.0-7.0	Cu 0.75; N 0.18-0.25
		N08926	---	0.020	2.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.00-7.00	Cu 0.50-1.50; N 0.15-0.25
		S31277	---	0.020	3.00	0.50	0.030	0.010	20.5-23.0	26.0-28.0	6.5-8.0	Cu 0.50-1.50; N 0.30-0.40
ASTM A240/A240M-15a	---	N08367	---	0.030	2.00	1.00	0.040	0.030	20.0-22.0	23.5-25.5	6.0-7.0	Cu 0.75; N 0.18-0.25
		N08926	---	0.020	2.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.00-7.00	Cu 0.50-1.50; N 0.15-0.25
		S31277	---	0.020	3.00	0.50	0.030	0.010	20.5-23.0	26.0-28.0	6.5-8.0	Cu 0.50-1.50; N 0.30-0.40
EN 10028-7:2007	X1NiCrMoCuN25-20-7	---	1.4529	0.020	1.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.0-7.0	Cu 0.50-1.50; N 0.15-0.25
EN 10088-2:2014	X1NiCrMoCuN25-20-7	---	1.4529	0.020	1.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.0-7.0	Cu 0.50-1.50; N 0.15-0.25
ISO 9328-7:2004	Grade X1NiCrMoCuN25-20-7	---	---	0.020	2.00	0.75	0.030	0.010	19.0-21.0	24.0-26.0	6.0-7.0	Cu 0.50-1.50; N 0.15-0.25
JIS G 4304:2012	Symbol SUS836L	---	---	0.030	2.00	1.00	0.045	0.030	19.00-24.00	24.00-26.00	5.00-7.00	N 0.25
JIS G 4305:2012	Symbol SUS836L	---	---	0.030	2.00	1.00	0.045	0.030	19.00-24.00	24.00-26.00	5.00-7.00	N 0.25
ASME SA-240/SA-240M	Type 800H	N08810	---	0.05-0.10	1.50	1.00	0.045	0.015	19.0-23.0	30.0-35.0	---	Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60; Fe 39.5 min.
ASTM A240/A240M-15a	Type 800H	N08810	---	0.05-0.10	1.50	1.00	0.045	0.015	19.0-23.0	30.0-35.0	---	Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60; Fe 39.5 min.
EN 10028-7:2007	X8NiCrAlTi32-21	---	1.4959	0.05-0.10	1.50	0.70	0.015	0.010	19.0-22.0	30.0-34.0	---	Al 0.25-0.65; Cu 0.50; Ti 0.25-0.65; Co 0.50; N 0.030; (Ni+Co) 30.0 to 34.0
ISO 9328-7:2004	Grade X8NiCrAlTi32-21	---	---	0.05-0.10	1.50	0.70	0.015	0.010	19.0-22.0	30.0-34.0	---	Al 0.25-0.65; Cu 0.50; Ti 0.25-0.65; Co 1.00; N 0.11; (Ni+Co) 30.0 to 34.0

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 301LN	S30153	---	---	---	240	35	550	80	45	Q+SA	241 max. HB; 100 max. HRB
ASME SA-666	Type 301LN	S30153	---	---	---	240	35	550 L	80 L	45 L	A	241 max. HB; 100 max. HRB
ASTM A240/A240M-15a	Type 301LN	S30153	---	---	---	240	35	550	80	45	SA	241 max. HBW; 100 max. HRBW
ASTM A666-15	Type 301LN	S30153	---	---	---	240	35	550 L	80 L	45 L	A	241 max. HB; 100 max. HRB
EN 10028-7:2007	X2CrNiN18-7	---	1.4318	$t \leq 3$	---	350	---	650-850	---	35 T	SA	see standard for impact data
				$t \leq 8$	---	350	---	650-850	---	40 T	SA	
				$t \leq 13.5$	---	330	---	650-850	---	40 T	SA	
				$t \leq 75$	---	330	---	650-850	---	40 T	SA	
EN 10088-2:2014	X2CrNiN18-7	---	1.4318	$t \leq 8$	---	350	---	650-850	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	330	---	650-850	---	40 T	SA	
				$t \leq 75$	---	330	---	630-830	---	45 T	SA	
ISO 9328-7:2004	Grade X2CrNiN18-7	---	---	$t \leq 6$	---	350	---	650-850	---	40 T	SA	---
				$t \leq 12$	---	330	---	650-850	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	330	---	650-850	---	40 T	SA	
ASME SA-240/SA-240M	Type 304	S30400	---	---	---	205	30	515	75	40	Q+SA	201 max. HB; 92 max. HRB
ASME SA-666	Type 304	S30400	---	---	---	205	30	515 L	75 L	40 L	A	201 max. HB; 92 max. HRB
ASTM A240/A240M-15a	Type 304	S30400	---	---	---	205	30	515	75	40	SA	201 max. HBW; 92 max. HRBW
ASTM A666-15	Type 304	S30400	---	---	---	205	30	515 L	75 L	40 L	A	201 max. HB; 92 max. HRB
EN 10028-7:2007	X5CrNi18-10	---	1.4301	$t \leq 8$	---	230	---	540-750	---	45 T	SA	see standard for impact data
				$t \leq 13.5$	---	210	---	520-720	---	45 T	SA	
				$t \leq 75$	---	210	---	520-720	---	45 T	SA	
EN 10088-2:2014	X5CrNi18-10	---	1.4301	$t \leq 8$	---	230	---	540-750	---	45 T	SA	see standard for impact data
				$t \leq 13.5$	---	210	---	520-720	---	45 T	SA	
				$t \leq 75$	---	210	---	520-720	---	45 T	SA	
GB 3280-92	Grade 0Cr18Ni9	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 0Cr18Ni9	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB

Note: This section continued on next page.

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 4238-92	Grade 0Cr18Ni9	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
ISO 9328-7:2004	Grade X5CrNi18-9	---	---	$t \leq 6$	---	230	---	540-750	---	45 T	SA	---
				$t \leq 12$	---	210	---	520-720	---	45 T	SA	see standard for impact data
				$t \leq 75$	---	210	---	520-720	---	45 T	SA	
JIS G 4304:2012	Symbol SUS304	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS304	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	Type 304H	S30409	---	---	---	205	30	515	75	40	Q+SA	201 max. HB; 92 max. HRB
ASTM A240/A240M-15a	Type 304H	S30409	---	---	---	205	30	515	75	40	SA	201 max. HBW; 92 max. HRBW
EN 10028-7:2007	X6CrNi18-10	---	1.4948	$t \leq 8$	---	230	---	530-740	---	45 T	SA	see standard for impact data
				$t \leq 13.5$	---	210	---	510-710	---	45 T	SA	
				$t \leq 75$	---	190	---	510-710	---	45 T	SA	
ISO 9328-7:2004	Grade X6CrNi18-10	---	---	$t \leq 6$	---	230	---	530-740	---	45 T	SA	---
				$t \leq 12$	---	210	---	510-710	---	45 T	SA	see standard for impact data
				$t \leq 75$	---	190	---	510-710	---	45 T	SA	

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 304L	S30403	---	---	---	170	25	485	70	40	Q+SA	201 max. HB; 92 max. HRB
ASME SA-666	Type 304L	S30403	---	---	---	170	25	485 L	70 L	40 L	A	201 max. HB; 92 max. HRB
ASTM A240/A240M-15a	Type 304L	S30403	---	---	---	170	25	485	70	40	SA	201 max. HBW; 92 max. HRBW
ASTM A666-15	Type 304L	S30403	---	---	---	170	25	485 L	70 L	40 L	A	201 max. HB; 92 max. HRB
EN 10028-7:2007	X2CrNi19-11	---	1.4306	$t \leq 8$	---	220	---	520-700	---	45 T	SA	see standard for impact data
				$t \leq 13.5$	---	200	---	520-700	---	45 T	SA	
				$t \leq 75$	---	200	---	500-700	---	45 T	SA	
	X2CrNi18-9	---	1.4307	$t \leq 8$	---	220	---	520-700	---	45 T	SA	see standard for impact data
				$t \leq 13.5$	---	200	---	520-700	---	45 T	SA	
				$t \leq 75$	---	200	---	500-700	---	45 T	SA	
EN 10088-2:2014	X2CrNi19-11	---	1.4306	$t \leq 8$	---	220	---	520-700	---	45 T	SA	see standard for impact data
				$t \leq 13.5$	---	200	---	520-700	---	45 T	SA	
				$t \leq 75$	---	200	---	500-700	---	45 T	SA	
	X2CrNi18-9	---	1.4307	$t \leq 8$	---	220	---	520-700	---	45 T	SA	see standard for impact data
				$t \leq 13.5$	---	200	---	520-700	---	45 T	SA	
				$t \leq 75$	---	200	---	500-700	---	45 T	SA	
GB 3280-92	Grade 00Cr19Ni10	---	---	---	---	177	---	480	---	40	ST	187 max. HB; 90 max. HRB
	Grade 00Cr19Ni13Mo3	---	---	---	---	177	---	480	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 00Cr19Ni10	---	---	---	---	177	---	480	---	40	ST	187 min. HB; 90 max. HRB
ISO 9328-7:2004	Grade X2CrNi18-9	---	---	$t \leq 6$	---	220	---	520-670	---	45 T	SA	---
				$t \leq 12$	---	200	---	520-670	---	45 T	SA	see standard for impact data
				$t \leq 75$	---	200	---	500-650	---	45 T	SA	
	Grade X2CrNi19-11	---	---	$t \leq 6$	---	220	---	520-670	---	45 T	SA	---
				$t \leq 12$	---	200	---	520-670	---	45 T	SA	see standard for impact data
				$t \leq 75$	---	200	---	500-650	---	45 T	SA	
JIS G 4304:2012	Symbol SUS304L	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS304L	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 304N	S30451	---	---	---	240	35	550	80	30	Q+SA	217 max. HB; 95 max. HRB
ASME SA-666	Type 304N	S30451	---	---	---	240	35	550 L	80 L	30 L	A	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 304N	S30451	---	---	---	240	35	550	80	30	SA	217 max. HBW; 95 max. HRBW
ASTM A666-15	Type 304N	S30451	---	---	---	240	35	550 L	80 L	30 L	A	217 max. HB; 95 max. HRB
EN 10028-7:2007	X5CrNiN19-9	---	1.4315	t ≤ 8	---	290	---	550-750	---	40 T	SA	see standard for impact data
				t ≤ 13.5	---	270	---	550-750	---	40 T	SA	
				t ≤ 75	---	270	---	550-750	---	40 T	SA	
EN 10088-2:2014	X5CrNiN19-9	---	1.4315	t ≤ 8	---	290	---	500-750	---	40 T	SA	see standard for impact data
				t ≤ 13.5	---	270	---	500-750	---	40 T	SA	
				t ≤ 75	---	270	---	500-750	---	40 T	SA	
GB 3280-92	Grade 0Cr19Ni9N	---	---	---	---	275	---	550	---	35	ST	217 max. HB; 95 max. HRB
GB 4237-92	Grade 0Cr19Ni9N	---	---	---	---	275	---	550	---	35	ST	217 max. HB; 95 max. HRB
ISO 9328-7:2004	Grade X5CrNiN18-8	---	---	t ≤ 6	---	290	---	550-750	---	40 T	SA	---
				t ≤ 12	---	270	---	550-750	---	40 T	SA	see standard for impact data
				t ≤ 75	---	270	---	550-750	---	40 T	SA	
JIS G 4304:2012	Symbol SUS304N1	---	---	---	---	275	---	550	---	35	ST	217 max. HBW; 95 max. HRBW; 220 max. HV
JIS G 4305:2012	Symbol SUS304N1	---	---	---	---	275	---	550	---	35	ST	217 max. HBW; 95 max. HRBW; 220 max. HV

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 304LN	S30453	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASME SA-666	Type 304LN	S30453	---	---	---	205	30	515 L	75 L	40 L	A	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 304LN	S30453	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
ASTM A666-15	Type 304LN	S30453	---	---	---	205	30	515 L	75 L	40 L	A	217 max. HB; 95 max. HRB
EN 10028-7:2007	X2CrNiN18-10	---	1.4311	t ≤ 8	---	290	---	550-750	---	40 T	SA	see standard for impact data
				t ≤ 13.5	---	270	---	550-750	---	40 T	SA	
				t ≤ 75	---	270	---	550-750	---	40 T	SA	
EN 10088-2:2014	X2CrNiN18-10	---	1.4311	t ≤ 8	---	290	---	550-750	---	40 T	SA	see standard for impact data
				t ≤ 13.5	---	270	---	550-750	---	40 T	SA	
				t ≤ 75	---	270	---	550-750	---	40 T	SA	
GB 3280-92	Grade 00Cr18Ni10N	---	---	---	---	245	---	550	---	40	ST	217 max. HB; 95 max. HRB
GB 4237-92	Grade 00Cr18Ni10N	---	---	---	---	245	---	550	---	40	ST	217 max. HB; 95 max. HRB
ISO 9328-7:2004	Grade X2CrNiN18-10	---	---	t ≤ 6	---	290	---	550-750	---	40 T	SA	---
				t ≤ 12	---	270	---	550-750	---	40 T	SA	see standard for impact data
				t ≤ 75	---	270	---	550-750	---	40 T	SA	
JIS G 4304:2012	Symbol SUS304LN	---	---	---	---	245	---	550	---	40	ST	217 max. HBW; 95 max. HRBW; 220 max. HV
JIS G 4305:2012	Symbol SUS304LN	---	---	---	---	245	---	550	---	40	ST	217 max. HBW; 95 max. HRBW; 220 max. HV

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 309H	S30909	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 309H	S30909	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
EN 10028-7:2007	X6CrNi23-13	---	1.4950	$t \leq 8$	---	220	---	530-730	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	200	---	510-710	---	35 T	SA	
				$t \leq 75$	---	200	---	510-710	---	35 T	SA	
ISO 9328-7:2004	Grade X6CrNi23-13	---	---	$t \leq 6$	---	220	---	530-730	---	35 T	SA	---
				$t \leq 12$	---	200	---	510-710	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	200	---	510-710	---	35 T	SA	
ASME SA-240/SA-240M	Type 310H	S31009	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 310H	S31009	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
EN 10028-7:2007	X6CrNi25-20	---	1.4951	$t \leq 8$	---	220	---	530-730	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	200	---	510-710	---	35 T	SA	
				$t \leq 75$	---	200	---	510-710	---	35 T	SA	
ISO 9328-7:2004	Grade X6CrNi25-20	---	---	$t \leq 6$	---	220	---	530-730	---	35 T	SA	---
				$t \leq 12$	---	200	---	510-710	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	200	---	510-710	---	35 T	SA	

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 316	S31600	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASME SA-666	Type 316	S31600	---	---	---	205	30	515 L	75 L	40 L	A	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 316	S31600	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
ASTM A666-15	Type 316	S31600	---	---	---	205	30	515 L	75 L	40 L	A	217 max. HB; 95 max. HRB
EN 10028-7:2007	X5CrNiMo17-12-2	---	1.4401	$t \leq 8$	---	240	---	530-680	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	530-680	---	40 T	SA	
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
	X3CrNiMo17-13-3	---	1.4436	$t \leq 8$	---	240	---	550-700	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	550-700	---	40 T	SA	
				$t \leq 75$	---	220	---	530-730	---	40 T	SA	
EN 10088-2:2014	X5CrNiMo17-12-2	---	1.4401	$t \leq 8$	---	240	---	530-680	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	530-680	---	40 T	SA	
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
	X3CrNiMo17-13-3	---	1.4436	$t \leq 8$	---	240	---	550-700	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	550-700	---	40 T	SA	
				$t \leq 75$	---	220	---	530-730	---	40 T	SA	
GB 3280-92	Grade 0Cr17Ni12Mo2	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 0Cr17Ni12Mo2	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4238-92	Grade 0Cr17Ni12Mo2	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
ISO 9328-7:2004	Grade X3CrNiMo17-12-3	---	---	$t \leq 6$	---	240	---	550-700	---	40 T	SA	---
				$t \leq 12$	---	220	---	550-700	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	220	---	530-730	---	40 T	SA	
	Grade X5CrNiMo17-12-2	---	---	$t \leq 6$	---	240	---	530-680	---	40 T	SA	---
				$t \leq 12$	---	220	---	530-680	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
JIS G 4304:2012	Symbol SUS316	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS316	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 316L	S31603	---	---	---	170	25	485	70	40	Q+SA	217 max. HB; 95 max. HRB
ASME SA-666	Type 316L	S31603	---	---	---	170	25	485 L	70 L	40 L	A	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 316L	S31603	---	---	---	170	25	485	70	40	SA	217 max. HBW; 95 max. HRBW
ASTM A666-15	Type 316L	S31603	---	---	---	170	25	485 L	70 L	40 L	A	217 max. HB; 95 max. HRB
EN 10028-7:2007	X2CrNiMo17-12-2	---	1.4404	$t \leq 8$	---	240	---	530-680	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	530-680	---	40 T	SA	
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
	X2CrNiMo17-12-3	---	1.4432	$t \leq 8$	---	240	---	550-700	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	550-700	---	40 T	SA	
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
	X2CrNiMo18-14-3	---	1.4435	$t \leq 8$	---	240	---	550-700	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	550-700	---	40 T	SA	
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
EN 10088-2:2014	X2CrNiMo17-12-2	---	1.4404	$t \leq 8$	---	240	---	530-680	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	530-680	---	40 T	SA	
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
	X2CrNiMo17-12-3	---	1.4432	$t \leq 8$	---	240	---	550-700	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	550-700	---	40 T	SA	
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
	X2CrNiMo18-14-3	---	1.4435	$t \leq 8$	---	240	---	550-700	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	550-700	---	40 T	SA	
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
GB 3280-92	Grade 00Cr17Ni14Mo2	---	---	---	---	177	---	480	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 00Cr17Ni14Mo2	---	---	---	---	177	---	480	---	40	ST	187 max. HB; 90 max. HRB

Note: This section continued on next page.

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ISO 9328-7:2004	Grade X2CrNiMo17-12-2	---	---	t ≤ 6	---	240	---	530-680	---	40 T	SA	---
				t ≤ 12	---	220	---	530-680	---	40 T	SA	see standard for impact data
				t ≤ 75	---	220	---	520-670	---	45 T	SA	
	Grade X2CrNiMo17-12-3	---	---	t ≤ 6	---	240	---	550-700	---	40 T	SA	---
				t ≤ 12	---	220	---	550-700	---	40 T	SA	see standard for impact data
				t ≤ 75	---	220	---	520-670	---	45 T	SA	
	Grade X2CrNiMo18-14-3	---	---	t ≤ 6	---	240	---	550-700	---	40 T	SA	---
				t ≤ 12	---	220	---	550-700	---	40 T	SA	see standard for impact data
				t ≤ 75	---	220	---	520-670	---	45 T	SA	
JIS G 4304:2012	Symbol SUS316L	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS316L	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	Type 316Ti	S31635	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 316Ti	S31635	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
EN 10028-7:2007	X6CrNiMoTi17-12-2	---	1.4571	t ≤ 8	---	240	---	540-690	---	40 T	SA	see standard for impact data
				t ≤ 13.5	---	220	---	540-690	---	40 T	SA	
				t ≤ 75	---	220	---	520-670	---	40 T	SA	
EN 10088-2:2014	X6CrNiMoTi17-12-2	---	1.4571	t ≤ 8	---	240	---	540-690	---	40 T	SA	see standard for impact data
				t ≤ 13.5	---	220	---	540-690	---	40 T	SA	
				t ≤ 75	---	220	---	520-670	---	40 T	SA	
GB 3280-92	Grade 0Cr18Ni12Mo2Ti	---	---	---	---	205	---	530	---	35	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 0Cr18Ni12Mo2Ti	---	---	---	---	205	---	530	---	37	ST	187 max. HB; 90 max. HRB
ISO 9328-7:2004	Grade X6CrNiMoTi17-12-2	---	---	t ≤ 6	---	240	---	540-690	---	40 T	SA	---
				t ≤ 12	---	220	---	540-690	---	40 T	SA	see standard for impact data
				t ≤ 75	---	220	---	520-670	---	40 T	SA	
JIS G 4304:2012	Symbol SUS316Ti	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS316Ti	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 316Cb	S31640	---	---	---	205	30	515	75	30	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 316Cb	S31640	---	---	---	205	30	515	75	30	SA	217 max. HBW; 95 max. HRBW
EN 10028-7:2007	X6CrNiMoNb17-12-2	---	1.4580	$t \leq 75$	---	220	---	520-720	---	40 T	SA	see standard for impact data
EN 10088-2:2014	X6CrNiMoNb17-12-2	---	1.4580	$t \leq 75$	---	220	---	520-720	---	40 T	SA	see standard for impact data
ISO 9328-7:2004	Grade X6CrNiMoNb17-12-2	---	---	$t \leq 75$	---	220	---	520-720	---	40 T	SA	see standard for impact data
ASME SA-479/SA-479M	Type 316LN	S31653	---	---	---	205	30	515	75	30	A	---
ASTM A479/A479M-14	Type 316LN	S31653	---	---	---	205	30	515	75	30	SA	---
EN 10028-7:2007	X2CrNiMoN17-11-2	---	1.4406	$t \leq 8$	---	300	---	580-780	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	280	---	580-780	---	40 T	SA	
				$t \leq 75$	---	280	---	580-780	---	40 T	SA	
	X2CrNiMoN17-13-3	---	1.4429	$t \leq 8$	---	300	---	580-780	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	280	---	580-780	---	35 T	SA	
				$t \leq 75$	---	280	---	580-780	---	40 T	SA	
EN 10088-3:2014	X2CrNiMoN17-11-2	---	1.4406	$t \leq 160$	---	280	---	580-800	---	40 L	SA	250 max. HBW
				$160 < t \leq 250$	---	280	---	580-800	---	30 T	SA	250 max. HBW
GB 3280-92	Grade 00Cr17Ni13Mo2N	---	---	---	---	245	---	550	---	40	ST	217 max. HB; 95 max. HRB
GB 4237-92	Grade 00Cr17Ni13Mo2N	---	---	---	---	245	---	550	---	40	ST	217 max. HB; 95 max. HRB
ISO 9328-7:2004	Grade X2CrNiMoN17-11-2	---	---	$t \leq 6$	---	300	---	580-780	---	40 T	SA	---
				$t \leq 12$	---	280	---	580-780	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	280	---	580-780	---	40 T	SA	
	Grade X2CrNiMoN17-13-3	---	---	$t \leq 6$	---	300	---	580-780	---	35 T	SA	---
				$t \leq 12$	---	280	---	580-780	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	280	---	580-780	---	40 T	SA	
JIS G 4304:2012	Symbol SUS316LN	---	---	---	---	245	---	550	---	40	ST	217 max. HBW; 95 max. HRBW; 220 max. HV
JIS G 4305:2012	Symbol SUS316LN	---	---	---	---	245	---	550	---	40	ST	217 max. HBW; 95 max. HRBW; 220 max. HV

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 317L	S31703	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 317L	S31703	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
EN 10028-7:2007	X2CrNiMo18-15-4	---	1.4438	$t \leq 8$	---	240	---	550-700	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	550-700	---	35 T	SA	
				$t \leq 75$	---	220	---	520-720	---	40 T	SA	
EN 10088-2:2014	X2CrNiMo18-15-4	---	1.4438	$t \leq 8$	---	240	---	550-700	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	550-700	---	35 T	SA	
				$t \leq 75$	---	220	---	520-720	---	40 T	SA	
GB 4237-92	Grade 00Cr19Ni13Mo3	---	---	---	---	177	---	480	---	35	ST	187 max. HB; 90 max. HRB
ISO 9328-7:2004	Grade X2CrNiMo18-15-4	---	---	$t \leq 6$	---	240	---	550-700	---	35 T	SA	---
				$t \leq 12$	---	220	---	550-700	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	220	---	520-720	---	40 T	SA	
JIS G 4304:2012	Symbol SUS317L	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS317L	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	Type 317LN	S31753	---	---	---	240	35	550	80	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 317LN	S31753	---	---	---	240	35	550	80	40	SA	217 max. HBW; 95 max. HRBW
EN 10028-7:2007	X2CrNiMoN18-12-4	---	1.4434	$t \leq 8$	---	290	---	570-770	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	270	---	570-770	---	35 T	SA	
				$t \leq 75$	---	270	---	540-740	---	40 T	SA	
EN 10088-2:2014	X2CrNiMoN18-12-4	---	1.4434	$t \leq 8$	---	290	---	570-770	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	270	---	570-770	---	35 T	SA	
				$t \leq 75$	---	270	---	540-740	---	40 T	SA	
ISO 9328-7:2004	Grade X2CrNiMoN18-12-4	---	---	$t \leq 6$	---	290	---	570-770	---	35 T	SA	---
				$t \leq 12$	---	270	---	570-770	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	270	---	540-740	---	40 T	SA	
JIS G 4304:2012	Symbol SUS317LN	---	---	---	---	245	---	550	---	40	ST	217 max. HBW; 95 max. HRBW; 220 max. HV
JIS G 4305:2012	Symbol SUS317LN	---	---	---	---	245	---	550	---	40	ST	217 max. HBW; 95 max. HRBW; 220 max. HV

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 317LMN	S31726	---	---	---	240	35	550	80	40	Q+SA	223 max. HB; 96 max. HRB
ASTM A240/A240M-15a	Type 317LMN	S31726	---	---	---	240	35	550	80	40	SA	223 max. HBW; 96 max. HRBW
EN 10028-7:2007	X2CrNiMoN17-13-5	---	1.4439	$t \leq 8$	---	290	---	580-780	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	270	---	580-780	---	35 T	SA	
				$t \leq 75$	---	270	---	580-780	---	40 T	SA	
EN 10088-2:2014	X2CrNiMoN17-13-5	---	1.4439	$t \leq 8$	---	290	---	580-780	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	270	---	580-780	---	35 T	SA	
				$t \leq 75$	---	270	---	580-780	---	40 T	SA	
ISO 9328-7:2004	Grade X2CrNiMoN17-13-5	---	---	$t \leq 6$	---	290	---	580-780	---	35 T	SA	---
				$t \leq 12$	---	270	---	580-780	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	270	---	580-780	---	40 T	SA	
ASME SA-240/SA-240M	Type 321	S32100	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 321	S32100	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
EN 10028-7:2007	X6CrNiTi18-10	---	1.4541	$t \leq 8$	---	220	---	520-720	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	200	---	520-720	---	40 T	SA	
				$t \leq 75$	---	200	---	500-700	---	40 T	SA	
EN 10088-2:2014	X6CrNiTi18-10	---	1.4541	$t \leq 8$	---	220	---	520-720	---	40 T	SA	---
				$t \leq 13.5$	---	200	---	520-720	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	200	---	500-700	---	40 T	SA	
GB 3280-92	Grade 0Cr18Ni10Ti	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 0Cr18Ni10Ti	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4238-92	Grade 0Cr18Ni10Ti	---	---	---	---	205 max.	---	520	---	40	ST	187 max. HB; 90 max. HRB
ISO 9328-7:2004	Grade X6CrNiTi18-10	---	---	$t \leq 6$	---	220	---	520-720	---	40 T	SA	---
				$t \leq 12$	---	200	---	520-720	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	200	---	500-700	---	40 T	SA	
JIS G 4304:2012	Symbol SUS321	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS321	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 347	S34700	---	---	---	205	30	515	75	40	Q+SA	201 max. HB; 92 max. HRB
ASTM A240/A240M-15a	Type 347	S34700	---	---	---	205	30	515	75	40	SA	201 max. HBW; 92 max. HRBW
EN 10028-7:2007	X6CrNiNb18-10	---	1.4550	$t \leq 13.5$	---	200	---	520-720	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	200	---	500-700	---	40 T	SA	
EN 10088-2:2014	X6CrNiNb18-10	---	1.4550	$t \leq 8$	---	220	---	520-720	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	200	---	520-720	---	40 T	SA	
				$t \leq 75$	---	200	---	500-700	---	40 T	SA	
GB 3280-92	Grade 0Cr18Ni11Nb	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 0Cr18Ni11Nb	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4238-92	Grade 0Cr18Ni11Nb	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
ISO 9328-7:2004	Grade X6CrNiNb18-10	---	---	$t \leq 75$	---	200	---	500-700	---	40 T	SA	see standard for impact data
JIS G 4304:2012	Symbol SUS347	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS347	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	Type 904L	N08904	---	---	---	220	31	490	71	35	Q+SA	90 max. HRB
ASTM A240/A240M-15a	Type 904L	N08904	---	---	---	220	31	490	71	35	SA	90 max. HRBW
EN 10028-7:2007	X1NiCrMoCu25-20-5	---	1.4539	$t \leq 8$	---	240	---	530-730	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	530-730	---	35 T	SA	
				$t \leq 75$	---	220	---	520-720	---	35 T	SA	
EN 10088-2:2014	X1NiCrMoCu25-20-5	---	1.4539	$t \leq 8$	---	240	---	530-730	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	530-730	---	35 T	SA	
				$t \leq 75$	---	220	---	520-720	---	35 T	SA	
ISO 9328-7:2004	Grade X1NiCrMoCu25-20-5	---	---	$t \leq 6$	---	240	---	530-730	---	35 T	SA	---
				$t \leq 12$	---	220	---	530-730	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	220	---	520-720	---	35 T	SA	
JIS G 4304:2012	Symbol SUS890L	---	---	---	---	215	---	490	---	35	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS890L	---	---	---	---	215	---	490	---	35	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	---	N08367	---	---	---	310	45	655	95	30	Q+SA	241 max. HB
				---	---	310	45	690	100	30	Q+SA	100 max. HRB
		N08926	---	---	---	295	43	650	94	35	Q+SA	---
		S31277	---	---	---	360	52	770	112	40	Q+SA	---
ASTM A240/A240M-15a	---	N08367	---	---	---	310	45	655	95	30	SA	241 max. HBW
				---	---	310	45	690	100	30	SA	100 max. HRBW
		N08926	---	---	---	295	43	650	94	35	SA	---
		S31277	---	---	---	360	52	770	112	40	SA	---
EN 10028-7:2007	X1NiCrMoCuN25-20-7	---	1.4529	$t \leq 75$	---	300	---	650-850	---	40 T	SA	see standard for impact data
EN 10088-2:2014	X1NiCrMoCuN25-20-7	---	1.4529	$t \leq 75$	---	300	---	650-850	---	40 T	SA	see standard for impact data
ISO 9328-7:2004	Grade X1NiCrMoCuN25-20-7	---	---	$t \leq 75$	---	300	---	650-850	---	40 T	SA	see standard for impact data
JIS G 4304:2012	Symbol SUS836L	---	---	---	---	275	---	640	---	40	ST	217 max. HBW; 96 max. HRBW; 230 max. HV
JIS G 4305:2012	Symbol SUS836L	---	---	---	---	275	---	640	---	40	ST	217 max. HBW; 96 max. HRBW; 230 max. HV
ASME SA-240/SA-240M	Type 800H	N08810	---	---	---	170	25	450	65	30	Q+SA	---
ASTM A240/A240M-15a	Type 800H	N08810	---	---	---	170	25	450	65	30	SA	---
EN 10028-7:2007	X8NiCrAlTi32-21	---	1.4959	$t \leq 75$	---	170	---	500-750	---	30 T	SA	see standard for impact data
ISO 9328-7:2004	Grade X8NiCrAlTi32-21	---	---	$t \leq 75$	---	170	---	500-750	---	30 T	SA	see standard for impact data

4.9 Duplex (Ferritic-Austenitic) Stainless Steels for Pressure Vessel Plates

4.9A Chemical Composition of Duplex (Ferritic-Austenitic) Stainless Steels for Pressure Vessel Plates

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 2205	S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
ASTM A240/A240M-15a	---	S31803	---	0.030	2.00	1.00	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
	Type 2205	S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
EN 10028-7:2007	X2CrNiMoN22-5-3	---	1.4462	0.030	2.00	1.00	0.035	0.015	21.0-23.0	4.5-6.5	2.50-3.5	N 0.10-0.22
EN 10088-2:2014	X2CrNiMoN22-5-3	---	1.4462	0.030	2.00	1.00	0.035	0.015	21.0-23.0	4.5-6.5	2.50-3.5	N 0.10-0.22
ISO 9328-7:2004	Grade X2CrNiMoN22-5-3	---	---	0.030	2.00	1.00	0.035	0.015	21.0-23.0	4.5-6.5	2.5-3.5	N 0.10-0.22
JIS G 4304:2012	Symbol SUS329J3L	---	---	0.030	2.00	1.00	0.040	0.030	21.00-24.00	4.50-6.50	2.50-3.50	N 0.08-0.20
JIS G 4305:2012	Symbol SUS329J3L	---	---	0.030	2.00	1.00	0.040	0.030	21.00-24.00	4.50-6.50	2.50-3.50	N 0.08-0.20
ASME SA-240/SA-240M	Type 2304	S32304	---	0.030	2.50	1.00	0.040	0.030	21.5-24.5	3.0-5.5	0.05-0.60	Cu 0.05-0.60; N 0.05-0.20
ASTM A240/A240M-15a	Type 2304	S32304	---	0.030	2.50	1.00	0.040	0.030	21.5-24.5	3.0-5.5	0.05-0.60	Cu 0.05-0.60; N 0.05-0.20
EN 10028-7:2007	X2CrNiN23-4	---	1.4362	0.030	2.00	1.00	0.035	0.015	22.0-24.0	3.5-5.5	0.10-0.60	Cu 0.10-0.60; N 0.05-0.20
EN 10088-2:2014	X2CrNiN23-4	---	1.4362	0.030	2.00	1.00	0.035	0.015	22.0-24.5	3.5-5.5	0.10-0.60	Cu 0.10-0.60; N 0.05-0.20
ISO 9328-7:2004	Grade X2CrNiN23-4	---	---	0.030	2.00	1.00	0.035	0.015	22.0-24.0	3.5-5.5	0.10-0.60	Cu 0.10-0.60; N 0.05-0.20
ASME SA-240/SA-240M	---	S32520	---	0.030	1.50	0.80	0.035	0.020	24.0-26.0	5.5-8.0	3.0-4.0	Cu 0.50-2.00; N 0.20-0.35
ASTM A240/A240M-15a	---	S32520	---	0.030	1.50	0.80	0.035	0.020	24.0-26.0	5.5-8.0	3.0-4.0	Cu 0.50-2.00; N 0.20-0.35
EN 10028-7:2007	X2CrNiMoCuN25-6-3	---	1.4507	0.030	2.00	0.70	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.0	Cu 1.00-2.50; N 0.20-0.30
EN 10088-2:2014	X2CrNiMoCuN25-6-3	---	1.4507	0.030	2.00	0.70	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.0	Cu 1.00-2.50; N 0.20-0.30
ISO 9328-7:2004	Grade X2CrNiMoCuN25-6-3	---	---	0.030	2.00	0.70	0.035	0.015	24.0-26.0	5.0-7.5	2.5-4.0	Cu 1.00-2.50; N 0.15-0.30
ASME SA-240/SA-240M	Type 2507	S32750	---	0.030	1.20	0.80	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	Cu 0.50; N 0.24-0.32
ASTM A240/A240M-15a	Type 2507	S32750	---	0.030	1.20	0.80	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	Cu 0.50; N 0.24-0.32
EN 10028-7:2007	X2CrNiMoN25-7-4	---	1.4410	0.030	2.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.5	N 0.24-0.35
EN 10088-2:2014	X2CrNiMoN25-7-4	---	1.4410	0.030	2.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.5	N 0.24-0.35
ISO 9328-7:2004	Grade X2CrNiMoN25-7-4	---	---	0.030	2.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.5	N 0.24-0.35
ASME SA-240/SA-240M	---	S32760	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] = 40 min.
ASTM A240/A240M-15a	---	S32760	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] = 40 min.
EN 10028-7:2007	X2CrNiMoCuWN25-7-4	---	1.4501	0.030	1.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30
EN 10088-2:2014	X2CrNiMoCuWN25-7-4	---	1.4501	0.030	1.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30
ISO 9328-7:2004	Grade X2CrNiMoCuWN25-7-4	---	---	0.030	1.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30

4.9 Duplex Stainless Steels for Pressure Vessel Plates

4.9B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steels for Pressure Vessel Plates

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 2205	S32205	---	---	---	450	65	655	95	25	Q+SA	293 max. HB; 31 max. HRC
ASTM A240/A240M-15a	---	S31803	---	---	---	450	65	620	90	25	SA	293 max. HBW; 31 max. HRC
	Type 2205	S32205	---	---	---	450	65	655	95	25	SA	293 max. HBW; 31 max. HRC
EN 10028-7:2007	X2CrNiMoN22-5-3	---	1.4462	t ≤ 8	---	485	---	700-950	---	20 L, 20 T	SA	see standard for impact data
				t ≤ 13.5	---	445	---	700-950	---	25 L, 25 T	SA	
				t ≤ 75	---	445	---	640-480	---	25 L, 25 T	SA	
EN 10088-2:2014	X2CrNiMoN22-5-3	---	1.4462	t ≤ 8	---	500	---	700-950	---	20 L, 20 T	SA	see standard for impact data
				t ≤ 13.5	---	460	---	700-950	---	25 L, 25 T	SA	
				t ≤ 75	---	460	---	640-840	---	25 L, 25 T	SA	
ISO 9328-7:2004	Grade X2CrNiMoN22-5-3	---	---	t ≤ 6	---	465	---	660-950	---	20 L, 20 T	SA	---
				t ≤ 12	---	445	---	660-950	---	25 L, 25 T	SA	see standard for impact data
				t ≤ 75	---	445	---	640-840	---	25 L, 25 T	SA	
JIS G 4304:2012	Symbol SUS329J3L	---	---	---	---	450	---	620	---	18	ST	302 max. HBW; 32 max. HRC; 320 max. HV
JIS G 4305:2012	Symbol SUS329J3L	---	---	---	---	450	---	620	---	18	ST	302 max. HBW; 32 max. HRC; 320 max. HV
ASME SA-240/SA-240M	Type 2304	S32304	---	---	---	400	58	600	87	25	Q+SA	290 max. HB; 32 max. HRC
ASTM A240/A240M-15a	Type 2304	S32304	---	---	---	400	58	600	87	25	SA	290 max. HBW; 32 max. HRC
EN 10028-7:2007	X2CrNiN23-4	---	1.4362	t ≤ 8	---	405	---	600-850	---	20 L, 20 T	SA	see standard for impact data
				t ≤ 13.5	---	385	---	600-850	---	20 L, 20 T	SA	
				t ≤ 50	---	385	---	630-800	---	25 L, 25 T	SA	
EN 10088-2:2014	X2CrNiN23-4	---	1.4362	t ≤ 8	---	450	---	650-850	---	20 L, 20 T	SA	see standard for impact data
				t ≤ 13.5	---	400	---	650-850	---	20 L, 20 T	SA	
				t ≤ 75	---	400	---	630-800	---	25 L, 25 T	SA	
ISO 9328-7:2004	Grade X2CrNiN23-4	---	---	t ≤ 6	---	405	---	600-850	---	20 L, 20 T	SA	---
				t ≤ 12	---	385	---	600-850	---	20 L, 20 T	SA	see standard for impact data
				t ≤ 75	---	385	---	630-800	---	25 L, 25 T	SA	

4.9 Duplex Stainless Steels for Pressure Vessel Plates

4.9B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steels for Pressure Vessel Plates (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness / Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	---	S32520	---	---	---	550	80	770	112	25	Q+SA	310 max. HB
ASTM A240/A240M-15a	---	S32520	---	---	---	550	80	770	112	25	SA	310 max. HBW; 32 max. HRC
EN 10028-7:2007	X2CrNiMoCuN25-6-3	---	1.4507	$t \leq 8$	---	495	---	690-940	---	20 L, 20 T	SA	see standard for impact data
				$t \leq 13.5$	---	475	---	690-940	---	20 L, 20 T	SA	
				$t \leq 50$	---	475	---	690-890	---	25 L, 25 T	SA	
EN 10088-2:2014	X2CrNiMoCuN25-6-3	---	1.4507	$t \leq 8$	---	550	---	750-1000	---	20 L, 20 T	SA	see standard for impact data
				$t \leq 13.5$	---	530	---	750-1000	---	20 L, 20 T	SA	
				$t \leq 75$	---	530	---	730-930	---	25 L, 25 T	SA	
ISO 9328-7:2004	Grade X2CrNiMoCuN25-6-3	---	---	$t \leq 6$	---	495	---	690-940	---	20 L, 20 T	SA	---
				$t \leq 12$	---	475	---	690-940	---	20 L, 20 T	SA	see standard for impact data
				$t \leq 75$	---	475	---	690-890	---	25 L, 25 T	SA	
ASME SA-240/SA-240M	Type 2507	S32750	---	---	---	550	80	795	116	15	Q+SA	310 max. HB; 32 max. HRC
ASTM A240/A240M-15a	Type 2507	S32750	---	---	---	550	80	795	116	15	SA	310 max. HBW; 32 max. HRC
EN 10028-7:2007	X2CrNiMoN25-7-4	---	1.4410	$t \leq 8$	---	535	---	750-1000	---	20 L, 20 T	SA	see standard for impact data
				$t \leq 13.5$	---	515	---	750-1000	---	20 L, 20 T	SA	
				$t \leq 50$	---	515	---	730-930	---	20 L, 20 T	SA	
EN 10088-2:2014	X2CrNiMoN25-7-4	---	1.4410	$t \leq 8$	---	550	---	750-1000	---	20 L, 20 T	SA	see standard for impact data
				$t \leq 13.5$	---	530	---	750-1000	---	20 L, 20 T	SA	
				$t \leq 75$	---	530	---	730-930	---	20 L, 20 T	SA	
ISO 9328-7:2004	Grade X2CrNiMoN25-7-4	---	---	$t \leq 6$	---	535	---	750-1000	---	20 L, 20 T	SA	---
				$t \leq 12$	---	515	---	750-1000	---	20 L, 20 T	SA	see standard for impact data
				$t \leq 75$	---	515	---	730-930	---	20 L, 20 T	SA	
ASME SA-240/SA-240M	---	S32760	---	---	---	550	80	750	108	25	Q+SA	270 max. HB
ASTM A240/A240M-15a	---	S32760	---	---	---	550	80	750	108	25	SA	270 max. HBW; 28 max. HRC
EN 10028-7:2007	X2CrNiMoCuWN25-7-4	---	1.4501	$t \leq 50$	---	515	---	730-930	---	25 L, 25 T	SA	see standard for impact data
EN 10088-2:2014	X2CrNiMoCuWN25-7-4	---	1.4501	$t \leq 75$	---	530	---	730-930	---	25 L, 25 T	SA	see standard for impact data
ISO 9328-7:2004	Grade X2CrNiMoCuWN25-7-4	---	---	$t \leq 75$	---	515	---	730-930	---	25 L, 25 T	SA	see standard for impact data

Chapter

5

STEEL TUBES AND PIPES

AFNOR Standards

AFNOR NF A 49-220:1990	Grooved Seamless Steel Tubes for Use at High Temperature - Dimensions - Technical Delivery Conditions
AFNOR NF A 49-647:1979	Structural Welded Tubes, Circular, Square, Rectangular or Oval, in Ferritic or Austenitic Stainless Steels Dimensions - Technical Delivery Conditions

API Standard

API 5L - 2012	Specification for Line Pipe

ASME Standards

ASME SA-53/SA-53M	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASME SA-106/SA-106M	Seamless Carbon Steel Pipe for High-Temperature Service
ASME SA-135	Electric-Resistance-Welded Steel Pipe
ASME SA-178/SA-178M	Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASME SA-179/SA-179M	Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASME SA-192/SA-192M	Seamless Carbon Steel Boiler Tubes for High-Pressure Service <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASME SA-209/SA-209M	Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes
ASME SA-210/SA-210M	Seamless Medium-Carbon Steel Boiler and Superheater Tubes
ASME SA-213/SA-213M	Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
ASME SA-214/SA-214M	Electric-Resistance-Welded Carbon Steel Heat-Exchanger and Condenser Tubes
ASME SA-249/SA-249M	Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes
ASME SA-250/SA-250M	Electric-Resistance-Welded Ferritic Alloy-Steel Boiler and Superheater Tubes
ASME SA-268/SA-268M	Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
ASME SA-312/SA-312M	Seamless and Welded Austenitic Stainless Steel Pipes
ASME SA-333/SA-333M	Seamless and Welded Steel Pipe for Low-Temperature Service
ASME SA-334/SA-334M	Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service
ASME SA-335/SA-335M	Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
ASME SA-358/SA-358M	Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service <i>Note: The listed tensile requirements conform to ASTM A240/A240M plate material that is used to make the pipe. See the applicable AWS filler metal specifications listed in ASTM A240/A240M for the weld tensile property requirements.</i>
ASME SA-376/SA-376M	Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service
ASME SA-409/SA-409M	Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service
ASME SA-513	Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASME SA-556/SA-556M	Seamless Cold-Drawn Carbon Steel Feedwater Heater Tubes
ASME SA-688/SA-688M	Welded Austenitic Stainless Steel Feedwater Heater Tubes
ASME SA-789/SA-789M	Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service
ASME SA-803/SA-803M	Welded Ferritic Stainless Steel Feedwater Heater Tubes

ASTM Standards

ASTM A53/A53M-12	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A106/A106M-14	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A135/A135M-09 (2014)	Electric-Resistance-Welded Steel Pipe
ASTM A139/A139M-04 (2010)	Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
ASTM A178/A178M-02 (2012)	Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A179/A179M-90a (2012)	Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A192/A192-02 (2012)	Seamless Carbon Steel Boiler Tubes for High-Pressure Service <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A209/A209-03 (2012)	Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes
ASTM A210/A210M-02 (2012)	Seamless Medium-Carbon Steel Boiler and Superheater Tubes
ASTM A213/A213M-15a	Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
ASTM A214/A214M-96 (2012)	Electric-Resistance-Welded Carbon Steel Heat-Exchanger and Condenser Tubes
ASTM A249/A249M-14a	Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes
ASTM A250/A250M-05 (2014)	Electric-Resistance-Welded Ferritic Alloy-Steel Boiler and Superheater Tubes
ASTM A268/A268M-10	Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
ASTM A269/A269M-14e1	Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A270/A270M-15	Seamless and Welded Austenitic and Ferritic/Austenitic Stainless Steel Sanitary Tubing <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A312/A312M-15	Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A333/A333M-13	Seamless and Welded Steel Pipe for Low-Temperature Service and Other Applications with Required Notch Toughness
ASTM A334/A334M-04a (2010)	Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service
ASTM A335/A335M-15	Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
ASTM A358/A358M-14a	Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications <i>Note: The listed tensile requirements conform to ASTM A240/A240M plate material that is used to make the pipe. See the applicable AWS filler metal specifications listed in ASTM A240/A240M for the weld tensile property requirements.</i>
ASTM A376/A376M-14	Seamless Austenitic Steel Pipe for High-Temperature Service
ASTM A409/A409M-15	Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service
ASTM A500/A500M-13	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A501/A501M-14	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A511/A511M-15a	Seamless Stainless Steel Mechanical Tubing <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A512-06 (2012)	Cold-Drawn Buttweld Carbon Steel Mechanical Tubing <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A513/A513M-15	Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A519-06 (2012)	Seamless Carbon and Alloy Steel Mechanical Tubing <i>Note: Mechanical properties data are supplementary requirements, provided for information only. Data are "typical" values.</i>
ASTM A554-15	Welded Stainless Steel Mechanical Tubing <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A556/A556M-96 (2012)	Seamless Cold-Drawn Carbon Steel Feedwater Heater Tubes
ASTM A595/A595M-14	Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use
ASTM A632-04 (2014)	Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service
ASTM A688/A688M-15	Seamless and Welded Austenitic Stainless Steel Feedwater Heater Tubes
ASTM A778-01 (2009)e1	Welded, Unannealed Austenitic Stainless Steel Tubular Products
ASTM A789/A789M-14	Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service
ASTM A803/A803M-12	Seamless and Welded Ferritic Stainless Steel Feedwater Heater Tubes
ASTM A908-03 (2013)	Stainless Steel Needle Tubing

BSI Standards

BS 3604-2:1991	Steel Pipes and Tubes for Pressure Purposes: Ferritic Alloy Steel with Specified Elevated Temperature Properties – Part 2: Specification for Longitudinally Arc Welded Tubes

CSA Standard

CSA Z245.1-14	Steel Pipe

EN Standards

EN 10216-1:2013	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 1: Non-alloy steel tubes with specified room temperature properties
EN 10216-2:2013	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties
EN 10216-3:2013	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 3: Alloy fine grain steel tubes
EN 10216-4:2013	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 4: Non-alloy and alloy steel tubes with specified low temperature properties
EN 10216-5:2013	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 5: Stainless steel tubes
EN 10217-1:2002 A1:2005	Welded steel tubes for pressure purposes – Technical delivery conditions – Part 1: Non-alloy steel tubes with specified room temperature properties
EN 10217-2:2002 A1:2005	Welded steel tubes for pressure purposes – Technical delivery conditions – Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties
EN 10217-4:2002 A1:2005	Welded steel tubes for pressure purposes – Technical delivery conditions – Part 4: Electric welded non-alloy steel tubes with specified low temperature properties
EN 10217-5:2002 A1:2005	Welded steel tubes for pressure purposes – Technical delivery conditions – Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties
EN 10217-6:2002 A1:2005	Welded steel tubes for pressure purposes – Technical delivery conditions – Part 6: Submerged arc welded non-alloy steel tubes with specified low temperature properties
EN 10217-7:2014	Welded steel tubes for pressure purposes – Technical delivery conditions – Part 7: Stainless steel tubes
EN 10296-1:2003	Welded circular steel tubes for mechanical and general engineering purposes – Technical delivery conditions – Part 1: Non-alloy and alloy steel tubes
EN 10296-2:2005 C2:2007	Welded circular steel tubes for mechanical and general engineering purposes – Technical delivery conditions – Part 2: Stainless steel
EN 10297-1:2003	Seamless circular steel tubes for mechanical and general engineering purposes – Technical delivery conditions – Part 1: Non-alloy and alloy steel tubes
EN 10297-2:2005 C1:2007	Seamless circular steel tubes for mechanical and general engineering purposes – Technical delivery conditions – Part 2: Stainless steel
EN 10305-1:2010	Steel tubes for precision applications – Technical delivery conditions – Part 1: Seamless cold drawn tubes
EN 10305-2:2010	Steel tubes for precision applications – Technical delivery conditions – Part 2: Welded cold drawn tubes
EN 10305-3:2010	Steel tubes for precision applications – Technical delivery conditions – Part 3: Welded cold sized tubes

ISO Standards

ISO 2937:1974	Plain End Seamless Steel Tubes for Mechanical Application
ISO 3304:1985	Plain End Seamless Precision Steel Tubes - Technical Conditions for Delivery
ISO 3305:1985	Plain End Welded Precision Steel Tubes - Technical Conditions for Delivery
ISO 3306:1985	Plain End As-Welded and Sized Precision Steel Tubes - Technical Conditions for Delivery
ISO 9329-2:1997	Seamless Steel Tubes for Pressure Purposes - Technical Delivery Conditions - Part 2: Unalloyed and Alloyed Steels with Specified Elevated Temperature Properties
ISO 9329-3:1997	Seamless Steel Tubes for Pressure Purposes. Technical Delivery Conditions Part 3: Unalloyed and Alloyed Steels with Specified Low Temperature Properties
ISO 9330-3:1997	Welded Steel Tubes for Pressure Purposes. Technical Delivery Conditions. Part 3: Electric Resistance and Induction Welded Unalloyed and Alloyed Steel Tubes with Specified Low Temperature Properties
ISO 9330-5:2000	Welded Steel Tubes for Pressure Purposes - Technical Delivery Conditions Part 5: Submerged Arc-Welded Unalloyed and Alloyed Steel Tubes with Specified Low Temperature Properties

EN ISO Standard

EN ISO 3183:2013	Petroleum and natural gas industries – Steel pipe for pipeline transportation systems

GB Standards

GB 3087-1999	Seamless Steel Tubes for Low and Medium Pressure
GB 5310-1995	Seamless Steel Tubes and Pipes for High Pressure Boiler
GB 6479-2000	Seamless Steel Tubes for High-Pressure for Chemical Fertilizer Equipments
GB/T 12770-2002	Welded Stainless Steel Tubes for Machine Structures
GB/T 14164:2005	Hot-Rolled Wide Strips for Line Pipe of Petroleum and Natural Gas
GB/T 14975-2002	Stainless Steel Seamless Tubes for Structures
GB/T 17396-1998	Seamless Hot-Rolled Steel Tubes for Hydraulic Pillar Service
GB 18248-2000	Seamless Steel Tubes for Gas Cylinder
GB/T 18984-2003	Seamless Steel Tubes for Low-Temperature-Service Piping

JIS Standards

JIS G 3441:2012	Alloy steel tubes for machine purposes
JIS G 3444:2010	Carbon steel tubes for general structure
JIS G 3445:2010	Carbon steel tubes for machine structure
JIS G 3446:2012	Stainless steel pipes for machine and structural purposes
JIS G 3452:2014	Carbon steel pipes for ordinary piping
JIS G 3454:2012	Carbon steel tubes for pressure service
JIS G 3455:2012	Carbon steel pipes for high pressure service
JIS G 3456:2014	Carbon steel pipes for high temperature service
JIS G 3457:2012	Arc welded carbon steel pipes
JIS G 3458:2013	Alloy steel pipes
JIS G 3459:2012	Stainless steel pipes
JIS G 3460:2013	Steel tubes for low temperature service
JIS G 3461:2012	Carbon steel boiler and heat exchanger tubes
JIS G 3462:2014	Alloy steel tubes for boiler and heat exchanger
JIS G 3463:2012	Stainless steel boiler and heat exchanger tubes
JIS G 3464:2013	Steel heat exchanger tubes for low temperature service
JIS G 3467:2013	Steel tubes for fired heater
JIS G 3468:2011	Large diameter welded stainless steel pipes
JIS G 3472:2013	Electric resistance welded carbon steel tubes for automobile
JIS G 3473:2013	Carbon steel tubes for cylinder barrels
JIS G 3474:2014	High strength steel tubes for steel tower

SAE Standard

SAE J526 NOV10	Welded Low-Carbon Steel Tubing Suitable for Bending, Flaring, Beading, Forming and Brazing

Heat Treatment Terms Applicable to this Chapter

5.1 Tubes for General and Structural Applications

Standard	Heat Treatment Terms
AFNOR NF A 49-647:1979	AM: as manufactured
ASME SA-268/SA-268M	HT: heat treated
ASME SA-513	N: normalized; AW: as-welded; SD: sink-drawn; MD: mandrel-drawn; MD SR: mandrel-drawn stress-relieved
ASME SA-789/SA-789M	ST+Q: solution treated and quenched
ASTM A268/A268M-10	HT: heat treated
ASTM A269/A269M-14e1	HT: heat treated
ASTM A270/A270M-15	HT+Q: heat treated then quenched with water; RC: rapidly cooled
ASTM A500/A500M-13	CF: cold formed; SR: stress relieved; A: annealed; HT: heat treated
ASTM A501/A501M-14	HF: hot formed
ASTM A511/A511M-15a	A: annealed; A+Q: annealed then water quenched; RC: cooled rapidly
ASTM A512-06 (2012)	SA: soft-annealed; SR A: stress relief annealed
ASTM A513/A513M-15	AW: as-welded; N: normalized; SD: sink-drawn; MD: mandrel-drawn; MD SR: mandrel-drawn stress-relieved
ASTM A519-06 (2012)	HR: hot rolled; CW: cold worked; SR: stress relieved; A: annealed; N: normalized; AM: as manufactured
ASTM A554-15	A: annealed; none: not thermally treated
ASTM A595/A595M-14	RCCM: roll compressed cold on a mandrel
ASTM A632-04 (2014)	HT: heat treated; HT+Q: heat treated then water quenched; RC: cooled rapidly
ASTM A778-01 (2009)e1	AM: as manufactured
ASTM A789/A789M-14	ST+Q: solution treated and quenched
EN 10296-1:2003	CR: cold rolled; A: annealed; N: full tube normalized; NW: normalized weld zone; U: see standard
EN 10296-2:2005 C2:2007	AW: as welded; A: annealed; SA: solution annealed
EN 10297-1:2003	AR: as rolled; N: normalized; QT: quenched and tempered; A: annealed
EN 10297-2:2005 C1:2007	A: annealed; SA: solution annealed; Q+T: quenched and tempered; CF: cold finished; HF: hot finished
EN 10305-1:2010	A: annealed; C: cold drawn, hard; LC: cold drawn, soft; N: normalized; SR: cold drawn and stress relieved
EN 10305-2:2010	A: annealed; C: cold drawn, hard; LC: cold drawn, soft; N: normalized; SR: cold drawn and stress relieved
EN 10305-3:2010	A: annealed; N: normalized; CR1: welded and cold sized, suitable for final annealing; CR2: welded and cold sized, not intended for heat treatment after welding and resizing
GB/T 12770-2002	A: annealed; W: as-welded; ST: solution treated
GB/T 14975-2002	BA: by agreement
GB/T 17396-1998	HR: hot-rolled; A: annealed; H+T: hardened and tempered
GB 18248-2000	Q+T: quenched and tempered
ISO 2937:1974	HF: hot finished
ISO 3304:1985	BK: cold-finished, as drawn; BKW: lightly cold-worked condition; GBK and GZF (A): annealed; NBK and NZF (N): normalized
ISO 3305:1985	BK: cold-finished, as drawn; BKW: lightly cold-worked condition; GBK and GZF (A): annealed; NBK and NZF (N): normalized
ISO 3306:1985	KM: as-welded and sized; GKM and GZF (A): annealed; NKM and NZF (N): normalized
JIS G 3441:2012	AM: as manufactured; CF: cold finished; A: annealed
JIS G 3444:2010	AM: as manufactured
JIS G 3445:2010	AM: as manufactured; CF: cold formed; AHT: appropriately heat treated
JIS G 3446:2012	ST: solution treated; AM: as manufactured; A: annealed
JIS G 3472:2013	See standard
JIS G 3473:2013	AM: as manufactured; CF: cold finished; SR: stress relieved annealed
JIS G 3474:2014	AM: as manufactured
SAE J526 NOV10	See standard

Heat Treatment Terms Applicable to this Chapter (Continued)

5.2 Tubes for Heat Transfer Applications

Standard	Heat Treatment Terms
ASME SA-178/SA-178M	See standard
ASME SA-179/SA-179M	HT: heat treated after final cold draw pass at 1200°F (650°C) or higher
ASME SA-192/SA-192M	CF: cold finished
ASME SA-209/SA-209M	HF: hot finished; CF+IA: cold finished and isothermally annealed; FA: fully annealed; N+T: normalized and tempered
ASME SA-210/SA-210M	HF: hot finished; CF+A: cold finished and subcritically annealed; CF+N: cold finished and normalized heat treatment
ASME SA-213/SA-213M	A+N+T+SCA: fully or isothermally annealed, normalized and tempered, and subcritically annealed; A+N+T: fully or isothermally annealed and normalized and tempered; N+T: normalized and tempered; ST+Q: solution treated then water quenched; RC: cooled rapidly
ASME SA-214/SA-214M	See standard
ASME SA-249/SA-249M	ST+Q: solution treated then water quenched; RC: cooled rapidly
ASME SA-250/SA-250M	FA: fully annealed; IA: isothermally annealed; N: normalized; N+T: normalized and tempered
ASME SA-556/SA-556M	HT: heat treated
ASME SA-688/SA-688M	SA+RC: solution annealed then cooled rapidly; SA+Q: solution annealed then quenched rapidly
ASME SA-803/SA-803M	SA: solution-annealed
ASTM A178/A178M-02 (2012)	See standard
ASTM A179/A179M-90a (2012)	CD + 1200°F min: cold drawn + heat treated at 1200°F or higher
ASTM A192/A192M-02 (2012)	HF: hot finished; CF + 1200°F min: cold finished + heat treated at 1200°F or higher
ASTM A209/A209M-03 (2012)	See standard
ASTM A210/A210M-02 (2012)	HF: hot finished; CF+SA: cold finished and subcritically annealed; A: fully annealed; N: normalized
ASTM A213/A213M-15a	A: annealed; IA: isothermally annealed; NT: normalized and tempered; SA: subcritically annealed; ST+Q: solution treated then water quenched; RC: cooled rapidly
ASTM A214/A214M-96 (2012)	See standard
ASTM A249/A249M-14a	ST+Q: solution treated then water quenched; RC: rapidly cooled; SA: solution annealed
ASTM A250/A250M-05 (2014)	A: fully annealed; IA: isothermally annealed; N: normalized; NT: normalized and tempered
ASTM A556/A556M-96 (2012)	CD + 1200°F min: cold drawn + heat treated to 1200°F or higher
ASTM A688/A688M-15	SA+RC: solution-annealed then rapidly cooled; SA+Q: solution-annealed then quenched in water
ASTM A803/A803M-12	SA: solution-annealed
EN 10216-1:2013	HF: hot formed; HFCF: hot formed cold finished; AF: as formed; N: normalized; NF: normalizing formed; I: isothermally annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered; NF: normalizing formed
EN 10216-2:2013	See standard
EN 10217-1:2002 A1:2005	See standard
EN 10217-2:2002 A1:2005	See standard
EN 10217-7:2014	SA: solution annealed
JIS G 3461:2012	See standard; N: normalized
JIS G 3462:2014	LTA: low temperature annealed; IA: isothermally annealed; A: fully annealed; N: normalized; NT: normalized and tempered
JIS G 3463:2012	A: annealed; ST: solution treated
JIS G 3467:2013	HFS: hot finished seamless; CFS: cold finished seamless; AM: as manufactured; LTA: low temperature annealed; IA: isothermally annealed; A: fully annealed; N: normalized; NT: normalized and tempered; ST: solution treated

5.3 Tubes for Low Temperature Service

Standard	Heat Treatment Terms
ASME SA-334/SA-334M	N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered; NN+T: double normalized and tempered
ASTM A334/A334M-04a (2010)	N: normalized; NT: normalized and tempered; QT: quenched and tempered; NNT: double normalized and tempered
EN 10216-4:2013	N: normalized; NT: normalized and tempered; QT: quenched and tempered
EN 10217-4:2002 A1:2005	See standard
GB/T 18984-2003	N: normalized
ISO 9329-3:1997	N: normalized; QT: quenched and tempered
ISO 9330-3:1997	N: normalized; QT: quenched and tempered
ISO 9330-5:2000	N: normalized; QT: quenched and tempered
JIS G 3464:2013	N: normalized; NT: normalized and tempered; NNT: double normalized and tempered; QT: quenched and tempered

Heat Treatment Terms Applicable to this Chapter (Continued)

5.4 Tubes and Pipes for Pressure Service

Standard	Heat Treatment Terms
AFNOR NF A 49-220:1990	See standard; N: normalized; T: tempered
ASME SA-53/SA-53M	---
ASME SA-106	CF+HT: cold finished and heat treated; HF: hot finished
ASME SA-135	---
ASME SA-312/SA-312M	A+Q: annealed then water quenched; RC: cooled rapidly
ASME SA-333/SA-333M	N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered; NN+T: double normalized and tempered
ASME SA-335/SA-335M	A: fully or isothermally annealed; N+T: normalized and tempered; SA: subcritically annealed; Q+T: quenched and tempered
ASME SA-358/SA-358M	H: heated at specified temperature and water quenched or rapidly cooled; HT: a final heat treatment temperature under 1900°F; A+Q: annealed and quenched; ST: solution treated
ASME SA-376/SA-376M	HT+Q: heat treated then water quenched; RC: cooled rapidly; SA+Q: solution annealed then water quenched; SA+RC: solution annealed then cooled rapidly
ASME SA-409/SA-409M	HT+Q: heat treated then water quenched; RC: cooled rapidly
ASTM A53/A53M-12	AM: as manufactured; T: tempered
ASTM A106/A106M-14	HF: hot finished; CD + 1200°F min: cold drawn + heat treated at 1200°F or higher
ASTM A135/A135M-09 (2012)	AM: as manufactured; T: tempered
ASTM A139/A139M-04 (2010)	See standard
ASTM A312/A312M-15	A+Q: annealed then water quenched; RC: cooled rapidly
ASTM A333/A333M-13	QT: quenched and tempered; NNT: double normalized and tempered; N: normalized; NT: normalized and tempered
ASTM A335/A335M-15	FA: fully annealed; IA: isothermally annealed; NT: normalized and tempered; QT: liquid quenched and tempered; SA: subcritically annealed
ASTM A358/A358M-14a	H: heated at specified temperature and water quenched or rapidly cooled; HT: a final heat treatment temperature under 1900°F; HT-O: no final heat treatment of pipe fabricated of plate that has been solution treated at temperatures required by this specification; HT-SO: No final heat treatment of pipe fabricated of plate that has not been heat treated
ASTM A376/A376M-14	See standard; HT: heat treated
ASTM A409/A409M-15	H: heated at specified temperature and water quenched or rapidly cooled; HT: a final heat treatment temperature under 1900°F; HT-O: no final heat treatment of pipe fabricated of plate that has been solution treated at temperatures required by this specification; HT-SO: No final heat treatment of pipe fabricated of plate that has not been heat treated
ASTM A908-03 (2013)	---
BS 3604-2:1991	See standard
EN 10216-1:2013	HF: hot formed; HFCE: hot formed cold finished; AF: as formed; N: normalized; NF: normalizing formed;
EN 10216-2:2013	I: isothermally annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered; NF: normalizing formed
EN 10216-3:2013	N: normalized
EN 10216-4:2013	N: normalized; NT: normalized and tempered; QT: quenched and tempered
EN 10216-5:2013	SA: solution annealed; SA+CF: solution annealed and cold finished; SA+HF: solution annealed and hot finished
EN 10217-1:2002 A1:2005	See standard
EN 10217-2:2002 A1:2005	See standard
EN 10217-4:2002 A1:2005	See standard
EN 10217-7:2014	SA: solution annealed
GB 3087-1999	HF: hot finished; CF: cold finished; HT: heat treated
GB 5310-1995	N+T: normalized and tempered; N: normalized; ST: solution treated
GB 6479-2000	N: normalized; N+T: normalized and tempered; A: annealed

Heat Treatment Terms Applicable to this Chapter (Continued)**5.4 Tubes and Pipes for Pressure Service (Continued)**

Standard	Heat Treatment Terms
JIS G 3452:2014	See Standard
JIS G 3454:2012	AM: as manufactured; CF + A: cold finished and annealed
JIS G 3455:2012	See standard
JIS G 3456:2014	See standard
JIS G 3457:2012	AW: as welded; ACE: as cold expanded
JIS G 3458:2013	LTA: low temperature annealed; IA: isothermally annealed; FA: fully annealed; N: normalized; NT: normalized and tempered
JIS G 3459:2012	ST: solution treated
JIS G 3460:2013	N: normalized; NT: normalized and tempered; QT: quenched and tempered; NNT: double normalized and tempered
JIS G 3468:2011	ST: solution treated

5.5 Line Pipe Steels

Standard	Heat Treatment Terms
API 5L - 2012	See standard
CSA Z245.1-14	See standard
EN ISO 3183:2013	See standard
GB/T 14164-2005	HR: hot-rolled; CtR: control-rolled

Impact Testing Notes Applicable to this Chapter

see standard for impact data: impact testing requirements are listed in the standard for multiple test temperatures.

5.1 Carbon Steel Tubes for General and Structural Applications

5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10296-1:2003	E155	---	1.0033	---	---	---	---	260	---	28	A	---
EN 10305-3:2010	E155	---	1.0033	---	---	---	---	260	---	28	A	see standard
EN 10305-2:2010	E155	---	1.0033	---	---	---	---	260	---	28	A	see standard
ASTM A513-15*	Grade 1008	G10080	---	---	---	160	23	260	38	30	N	65 max HRB
ASME SA-513*	Grade 1008	G10080	---	---	---	159	23	262	38	30	N	65 max HRB
ISO 3304:1985	R28	---	---	---	---	---	---	270	---	30	GBK & GZF	---
ISO 3305:1985	R28	---	---	---	---	---	---	270	---	30	GBK & GZF	---
ISO 3306:1985	R28	---	---	---	---	---	---	270	---	30	GKM & GZF	---
EN 10305-2:2010	E155	---	1.0033	---	---	155	---	270-410	---	28	N	see standard
EN 10305-3:2010	E155	---	1.0033	---	---	155	---	270-410	---	28	N	see standard
EN 10296-1:2003	E155	---	1.0033	---	---	155	---	270	---	28	N	---
	E190	---	1.0031	---	---	190	---	270	---	26 L; 24 T	CR	---
EN 10305-3:2010	E190	---	1.0031	---	---	190	---	270	---	26	CR2	see standard
ASTM A513-15*	Grade 1010	G10100	---	---	---	170	25	275	40	30	N	65 max HRB
ASTM A512-06 (2012)*	Grade MT 1010	G10100	---	---	---	138	20	276	40	35	SA	40-65 HRB
ASME SA-513*	Grade 1010	G10100	---	---	---	172	25	276	40	30	N	65 max HRB
EN 10305-1:2010	E215	---	1.0212	---	---	140	---	280	---	30	A	see standard
ISO 3304:1985	R28	---	---	---	---	155	---	280	---	28	NBK & NZF	---
ISO 3305:1985	R28	---	---	---	---	155	---	280	---	28	NBK & NZF	---
ISO 3306:1985	R28	---	---	---	---	155	---	280	---	28	NKM & NZF	---
JIS G 3444:2010	Symbol STK290	---	---	d < 40	---	---	---	290	---	30 L	AM	---
				40 < d ≤ 350	---	---	---	290	---	30 L	AM	---
				d > 350	---	---	---	290	---	25 T	AM	---
JIS G 3445:2010	Symbol STKM11A	---	---	d > 40	---	---	---	290	---	35 L; 30 T	AM, CF, or AHT	---
JIS G 3452:2014	Symbol SGP	---	---	3 < t ≤ 4	---	---	---	290	---	24 L; 19 T	see standard	---
				4 < t ≤ 5	---	---	---	290	---	26 L; 20 T	see standard	---
				5 < t ≤ 6	---	---	---	290	---	27 L; 22 T	see standard	---
				6 < t ≤ 7	---	---	---	290	---	28 L; 24 T	see standard	---
				7 < t < 8	---	---	---	290	---	30 L; 25 T	see standard	---
				t ≥ 8	---	---	---	290	---	30 L; 25 T	see standard	---
EN 10305-3:2010	E155	---	1.0033	---	---	203	---	290	---	15	CR1	see standard
	E195	---	1.0034	---	---	---	---	290	---	28	A	see standard
EN 10305-2:2010	E195	---	1.0034	---	---	145	---	290	---	28	A	see standard

*: See "List of Standards" at the beginning of the chapter.

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5.1 Carbon Steel Tubes for General and Structural Applications

5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
SAE J526 NOV10	---	---	---	---	---	170	---	290	---	14	see standard	65 max HR30T
EN 10296-1:2003	E155	---	1.0033	---	---	175	---	290	---	15	U, NW	---
JIS G 3472:2013	Symbol STAM290GA	---	---	---	---	175	---	290	---	40	see standard	---
	Symbol STAM290GB	---	---	---	---	175	---	290	---	35	see standard	---
ASTM A513-15*	Grade 1008	G10080	---	---	---	205	30	290	42	15	AW	50 min HRB
ASME SA-513*	Grade 1008	G10080	---	---	---	207	30	290	42	15	AW	50 min HRB
EN 10305-1:2010	E215	---	1.0212	---	---	215	---	290-430	---	30	N	see standard
ASTM A512-06 (2012)*	Grade MT 1015	G10150	---	---	---	172	25	296	43	34	SA	40 min HRB
EN 10305-2:2010	E195	---	1.0034	---	---	195	---	300-440	---	28	N	see standard
EN 10305-3:2010	E195	---	1.0034	---	---	195	---	300-440	---	28	N	see standard
EN 10296-1:2003	E195	---	1.0034	---	---	---	---	300	---	28	A	---
				---	---	195	---	300	---	28	N	---
ISO 3306:1985	R28	---	---	---	---	---	---	300	---	10	KM	---
ASTM A513-15*	Grade 1015	G10150	---	---	---	205	30	310	45	30	N	70 max HRB
ASME SA-513*	Grade 1015	G10150	---	---	---	207	30	310	45	30	N	70 max HRB
EN 10305-3:2010	E220	---	1.0215	---	---	220	---	310	---	23	CR2	see standard
ASTM A513-15*	Grade 1010	G10100	---	---	---	220	32	310	45	15	AW	55 min HRB
ASME SA-513*	Grade 1010	G10100	---	---	---	221	32	310	45	15	AW	55 min HRB
ASTM A500-13	Grade A	K03000	---	d ≤ 22	d ≤ 0.875	230	33	310 L	45 L	25 L	CF, SR, A	---
				d ≤ 22	d ≤ 0.875	270	39	310 L	45 L	25 L	CF, SR, A	---
EN 10296-1:2003	E220	---	1.0215	---	---	220	---	310	---	23 L; 21 T	CR	---
	E235	---	1.0308	---	---	---	---	315	---	25	A	---
EN 10305-3:2010	E235	---	1.0308	---	---	---	---	315	---	25	A	see standard
EN 10305-1:2010	E235	---	1.0308	---	---	158	---	315	---	25	A	see standard
EN 10305-2:2010	E235	---	1.0308	---	---	158	---	315	---	25	A	see standard
ISO 3304:1985	R33	---	---	---	---	---	---	320	---	27	GBK & GZF	---
ISO 3305:1985	R33	---	---	---	---	---	---	320	---	27	GBK & GZF	---
ISO 3306:1985	R33	---	---	---	---	---	---	320	---	27	GKM & GZF	---
ISO 3304:1985	R33	---	---	---	---	195	---	320	---	25	NBK & NZF	---
ISO 3305:1985	R33	---	---	---	---	195	---	320	---	25	NBK & NZF	---
ISO 3306:1985	R33	---	---	---	---	195	---	320	---	25	NKM & NZF	---
ISO 2937:1974	TS 1	---	---	---	---	195	---	320-440	---	25	HF	---

*: See "List of Standards" at the beginning of the chapter.

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5.1 Carbon Steel Tubes for General and Structural Applications

5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ISO 3306:1985	R33	---	---	---	---	---	---	330	---	8	KM	---
EN 10305-3:2010	E195	---	1.0034	---	---	231	---	330	---	8	CR1	see standard
EN 10296-1:2003	E195	---	1.0034	---	---	250	---	330	---	8	U, NW	---
ASTM A513-15*	Grade 1015	G10150	---	---	---	240	35	330	48	15	AW	58 min HRB
	Grade 1008	G10080	---	---	---	260	38	330	48	8	SD	65 min HRB
ASTM A519-06 (2012)*	Grade 1020	G10200	---	O.D. ≤ 323.8	O.D. ≤ 12.75	193	28	331	48	30	A	50 HRB
ASME SA-513*	Grade 1015	G10150	---	---	---	241	35	331	48	15	AW	58 min HRB
	Grade 1008	G10080	---	---	---	262	38	331	48	8	SD	65 min HRB
ISO 3304:1985	R37	---	---	---	---	---	---	340	---	26	GBK & GZF	---
ISO 3305:1985	R37	---	---	---	---	---	---	340	---	26	GBK & GZF	---
ISO 3306:1985	R37	---	---	---	---	---	---	340	---	26	GKM & GZF	---
JIS G 3445:2010	Symbol STKM12A	---	---	d > 40	---	175	---	340	---	35 L; 30 T	AM, CF, or AHT	---
JIS G 3472:2013	Symbol STAM340G	---	---	---	---	195	---	340	---	35	see standard	---
EN 10305-1:2010	E235	---	1.0308	---	---	235	---	340-480	---	25	N	see standard
EN 10305-2:2010	E235	---	1.0308	---	---	235	---	340-480	---	25	N	see standard
EN 10305-3:2010	E235	---	1.0308	---	---	235	---	340-480	---	25	N	see standard
EN 10296-1:2003	E235	---	1.0308	---	---	235	---	340	---	25	N	---
	E260	---	1.0220	---	---	260	---	340	---	21 L; 19 T	CR	---
EN 10305-3:2010	E260	---	1.0220	---	---	260	---	340	---	21	CR2	see standard
ASTM A512-06 (2012)*	Grade MT 1020	G10200	---	---	---	207	30	345	50	32	SA	50 min HRB
ASTM A519-06 (2012)*	Grade 1020	G10200	---	---	---	221	32	345	50	25	HR	55 HRB
ASTM A513-15*	Grade 1020	G10200	---	---	---	240	35	345	50	25	N	75 max HRB
	Grade 1021	G10210	---	---	---	240	35	345	50	25	N	78 max HRB
	Grade 1010	G10100	---	---	---	275	40	345	50	8	SD	65 min HRB
ASME SA-513*	Grade 1020	G10200	---	---	---	241	35	345	50	25	N	75 max HRB
	Grade 1021	G10210	---	---	---	241	35	345	50	25	N	78 max HRB
	Grade 1010	G10100	---	---	---	276	40	345	50	8	SD	65 min HRB

*: See "List of Standards" at the beginning of the chapter.

5.1 Carbon Steel Tubes for General and Structural Applications

5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ISO 3304:1985	R28	---	---	---	---	---	---	350	---	10	BKW	---
ISO 3305:1985	R28	---	---	---	---	---	---	350	---	10	BKW	---
EN 10305-2:2010	E155	---	1.0033	---	---	245	---	350	---	10	LC	see standard
				---	---	245	---	350	---	18	SR	---
ASME SA-513*	Grade 1020	G10200	---	---	---	262	38	359	52	12	AW	62 min HRB
ISO 2937:1974	TS 4	---	---	---	---	215	---	360-480	---	24	HF	---
ISO 3304:1985	R37	---	---	---	---	215	---	360	---	24	NBK & NZF	---
ISO 3305:1985	R37	---	---	---	---	215	---	360	---	24	NBK & NZF	---
ISO 3306:1985	R37	---	---	---	---	215	---	360	---	24	NKM & NZF	---
EN 10297-1:2003	E235	---	1.0308	t ≤ 16	---	235	---	360	---	25 L; 23 T	AR, N	---
				16 < t ≤ 40	---	225	---	360	---	25 L; 23 T	AR, N	---
				40 < t ≤ 65	---	215	---	360	---	25 L; 23 T	AR, N	---
				65 < t ≤ 80	---	205	---	340	---	25 L; 23 T	AR, N	---
				80 < t ≤ 100	---	195	---	340	---	25 L; 23 T	AR, N	---
ASTM A513-15*	Grade 1020	G10200	---	---	---	260	38	360	52	12	AW	62 min HRB
ASTM A519-06 (2012)*	Grade 1025	G10250	---	O.D. ≤ 323.8	O.D. ≤ 12.75	207	30	365	53	25	A	57 HRB
ISO 3304:1985	R33	---	---	---	---	---	---	370	---	10	BKW	---
ISO 3305:1985	R33	---	---	---	---	---	---	370	---	10	BKW	---
JIS G 3473:2013	Symbol STC370	---	---	---	---	215	---	370	---	30	AM	---
JIS G 3445:2010	Symbol STKM13A	---	---	d > 40	---	215	---	370	---	30 L; 25 T	AM, CF, or AHT	---
EN 10305-2:2010	E195	---	1.0034	---	---	259	---	370	---	10	LC	see standard
				---	---	260	---	370	---	18	SR	see standard
EN 10296-1:2003	E275K2	---	1.0456	t ≤ 16	---	275	---	370	---	24 L; 22 T	---	40 J at -20°C
				t > 16	---	265	---	370	---	24 L; 22 T	---	40 J at -20°C
ASTM A513-15*	Grade 1021	G10210	---	---	---	275	40	370	54	12	AW	62 min HRB
ASME SA-513*	Grade 1021	G10210	---	---	---	276	40	372	54	12	AW	62 min HRB
ASTM A519-06 (2012)*	Grade 1020	G10200	---	O.D. ≤ 323.8	O.D. ≤ 12.75	234	34	379	55	22	N	60 HRB
ASTM A512-06 (2012)*	Grade MT 1025	G10250	---	---	---	241	35	379	55	32	SA	55 min HRB
ASTM A519-06 (2012)*	Grade 1025	G10250	---	O.D. ≤ 323.8	O.D. ≤ 12.75	241	35	379	55	25	HR	60 HRB
				O.D. ≤ 323.8	O.D. ≤ 12.75	248	36	379	55	22	N	60 HRB

*: See "List of Standards" at the beginning of the chapter.

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5.1 Carbon Steel Tubes for General and Structural Applications

5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-513*	Grade 1025	G10250	---	---	---	255	37	379	55	25	N	80 max HRB
	Grade 1008	G10080	---	---	---	310	45	379	55	12	MD SR	68 min HRB
	Grade 1010	G10100	---	---	---	310	45	379	55	12	MD SR	68 min HRB
	Grade 1015	G10150	---	---	---	310	45	379	55	8	SD	67 min HRB
ASTM A513-15*	Grade 1025	G10250	---	---	---	255	37	379	55	25	N	80 max HRB
	Grade 1008	G10080	---	---	---	310	45	380	55	12	MD SR	68 min HRB
	Grade 1010	G10100	---	---	---	310	45	380	55	12	MD SR	68 min HRB
	Grade 1015	G10150	---	---	---	310	45	380	55	8	SD	67 min HRB
EN 10305-1:2010	E215	---	1.0212	---	---	266	---	380	---	12	LC	see standard
						280	---	380	---	16	SR	see standard
ASTM A513-15*	Grade 1025	G10250	---	---	---	275	40	385	56	12	AW	65 min HRB
ASME SA-513*	Grade 1025	G10250	---	---	---	276	40	386	56	12	AW	65 min HRB
EN 10296-1:2003	E275	---	1.0225	---	---	---	---	390	---	21	A	---
EN 10305-1:2010	E255	---	1.0408	---	---	---	---	390	---	21	A	see standard
EN 10305-3:2010	E275	---	1.0225	---	---	---	---	390	---	22	A	see standard
	E235	---	1.0308	---	---	273	---	390	---	7	CR1	see standard
EN 10305-2:2010	E275	---	1.0225	---	---	195	---	390	---	22	A	see standard
EN 10296-1:2003	E235	---	1.0308	---	---	300	---	390	---	7	U, NW	---
JIS G 3472:2013	Symbol STAM390G	---	---	---	---	235	---	390	---	30	see standard	---
JIS G 3445:2010	Symbol STKM12B	---	---	---	---	275	---	390	---	25 L; 20 T	AM, CF, or AHT	---
ISO 3304:1985	R28	---	---	---	---	---	---	400	---	8	BK	---
	R37	---	---	---	---	---	---	400	---	9	BKW	---
	R44	---	---	---	---	---	---	400	---	24	GBK & GZF	---
ISO 3305:1985	R28	---	---	---	---	---	---	400	---	8	BK	---
	R37	---	---	---	---	---	---	400	---	9	BKW	---
	R44	---	---	---	---	---	---	400	---	24	GBK & GZF	---
ISO 3306:1985	R37	---	---	---	---	---	---	400	---	7	KM	---
	R44	---	---	---	---	---	---	400	---	24	GKM & GZF	---
EN 10305-2:2010	E155	---	1.0033	---	---	320	---	400	---	6	C	see standard
JIS G 3444:2010	Symbol STK400	---	---	d < 40	---	235	---	400	---	23 L	AM	---
				40 < d ≤ 350	---	235	---	400	---	23 L	AM	---
				d > 350	---	235	---	400	---	18 T	AM	---

*: See "List of Standards" at the beginning of the chapter.

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5.1 Carbon Steel Tubes for General and Structural Applications

5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A500-13	Grade D	---	---	$d \leq 22$	$d \leq 0.875$	250	36	400 L	58 L	23 L	HT	---
GB/T 17396-1998	Grade 20	---	---	---	---	245	---	400	---	20	HR, A or H+T	---
ASTM A501-14	Grade A	K03000	---	---	---	250	36	400 L	58 L	23 L	HF	---
ASTM A500-13	Grade B	K03000	---	$d \leq 22$	$d \leq 0.875$	290	42	400 L	58 L	23 L	CF, SR, A	---
				$d \leq 22$	$d \leq 0.875$	315	46	400 L	58 L	23 L	CF, SR, A	---
EN 10296-1:2003	E275	---	1.0225	---	---	275	---	410	---	21	N	---
EN 10297-1:2003	E275	---	1.0225	$t \leq 16$	---	275	---	410	---	22 L; 20 T	AR, N	---
				$16 < t \leq 40$	---	265	---	410	---	22 L; 20 T	AR, N	---
				$40 < t \leq 65$	---	255	---	410	---	22 L; 20 T	AR, N	---
				$65 < t \leq 80$	---	245	---	380	---	22 L; 20 T	AR, N	---
				$80 < t \leq 100$	---	235	---	380	---	22 L; 20 T	AR, N	---
EN 10305-2:2010	E275	---	1.0225	---	---	275	---	410-550	---	22	N	see standard
EN 10305-3:2010	E275	---	1.0225	---	---	275	---	410-550	---	22	N	see standard
EN 10296-1:2003	E320	---	1.0237	---	---	320	---	410	---	19 L; 17 T	CR	---
EN 10305-3:2010	E320	---	1.0237	---	---	320	---	410	---	19	CR2	see standard
EN 10297-1:2003	E275K2	---	1.0456	≤ 16	---	275	---	410	---	22 L; 20 T	N	L: 40 J at -20°C T: 27 J at -20°C
				$16 < t \leq 40$	---	265	---	410	---	22 L; 20 T	N	L: 40 J at -20°C T: 27 J at -20°C
				$40 < t \leq 65$	---	255	---	410	---	22 L; 20 T	N	L: 40 J at -20°C T: 27 J at -20°C
				$65 < t \leq 80$	---	245	---	380	---	22 L; 20 T	N	L: 40 J at -20°C T: 27 J at -20°C
				$80 < t \leq 100$	---	235	---	380	---	22 L; 20 T	N	L: 40 J at -20°C T: 27 J at -20°C

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5.1 Carbon Steel Tubes for General and Structural Applications

5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ISO 2937:1974	TS 9	---	---	---	---	235	---	410-530	---	22	HF	---
JIS G 3445:2010	Symbol STKM14A	---	---	---	---	245	---	410	---	25 L; 20 T	AM, CF, or AHT	---
ASTM A519-06 (2012)*	Grade 1035	G10350	---	O.D. $\leq$ 323.8	O.D. $\leq$ 12.75	228	33	414	60	25	A	67 HRB
ASME SA-513*	Grade 1026	G10260	---	---	---	276	40	414	60	25	N	85 max HRB
	Grade 1030	G10300	---	---	---	276	40	414	60	25	N	85 max HRB
	Grade 1008	G10080	---	---	---	345	50	414	60	5	MD	73 min HRB
	Grade 1010	G10100	---	---	---	345	50	414	60	5	MD	73 min HRB
	Grade 1015	G10150	---	---	---	345	50	414	60	12	MD SR	72 min HRB
	Grade 1020	G10200	---	---	---	345	50	414	60	8	SD	70 min HRB
ASTM A513-15*	Grade 1026	G10260	---	---	---	275	40	414	60	25	N	85 max HRB
	Grade 1030	G10300	---	---	---	275	40	415	60	25	N	85 max HRB
	Grade 1008	G10080	---	---	---	345	50	415	60	5	MD	73 min HRB
	Grade 1010	G10100	---	---	---	345	50	415	60	5	MD	73 min HRB
	Grade 1015	G10150	---	---	---	345	50	415	60	12	MD SR	72 min HRB
	Grade 1020	G10200	---	---	---	345	50	415	60	8	SD	70 min HRB
ISO 3304:1985	R33	---	---	---	---	---	---	420	---	6	BK	---
ISO 3305:1985	R33	---	---	---	---	---	---	420	---	6	BK	---
EN 10305-1:2010	E235	---	1.0308	---	---	294	---	420	---	10	LC	see standard
EN 10305-2:2010	E195	---	1.0034	---	---	336	---	420	---	6	C	see standard
EN 10305-1:2010	E235	---	1.0308	---	---	350	---	420	---	16	SR	---
ASTM A513-15*	Grade 1026	G10260	---	---	---	310	45	425	62	12	AW	68 min HRB
	Grade 1030	G10300	---	---	---	310	45	425	62	10	AW	70 min HRB
ASTM A500-13	Grade C	K02705	---	$d \leq 22$	$d \leq 0.875$	315	46	425 L	62 L	21 L	CF, SR, A	---
				$d \leq 22$	$d \leq 0.875$	345	50	425 L	62 L	21 L	CF, SR, A	---
ASTM A513-15*	Grade 1021	G10210	---	---	---	360	52	425	62	7	SD	70 min HRB
ASME SA-513*	Grade 1026	G10260	---	---	---	310	45	427	62	12	AW	68 min HRB
	Grade 1030	G10300	---	---	---	310	45	427	62	10	AW	70 min HRB
	Grade 1021	G10210	---	---	---	359	52	428	62	7	SD	70 min HRB
EN 10297-1:2003	C22E	---	1.1151	$t \leq 16$	---	240	---	430	---	24 L; 22 T	N	see standard
				$16 < t \leq 40$	---	210	---	410	---	25 L; 23 T	N	see standard
				$40 < t \leq 80$	---	210	---	410	---	25 L; 23 T	N	see standard
ISO 3306:1985	R44	---	---	---	---	---	---	430	---	6	KM	---
ISO 3304:1985	R44	---	---	---	---	255	---	430	---	22	NBK & NZF	---
ISO 3305:1985	R44	---	---	---	---	255	---	430	---	22	NBK & NZF	---

*: See "List of Standards" at the beginning of the chapter.

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5.1 Carbon Steel Tubes for General and Structural Applications

5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ISO 3306:1985	R44	---	---	---	---	255	---	430	---	22	NKM & NZF	---
EN 10305-1:2010	E215	---	1.0212	---	---	344	---	430	---	8	C	see standard
ASTM A512-06 (2012)*	Grade MT 1010	G10100	---	---	---	400	58	434-689	63-100	15	SR A	70-90 HRB
EN 10305-1:2010	C35E	---	1.1181	---	---	---	---	440	---	22	A	see standard
	E255	---	1.0408	---	---	255	---	440-570	---	21	N	see standard
EN 10305-3:2010	E275	---	1.0225	---	---	308	---	440	---	6	CR1	see standard
EN 10305-2:2010	E235	---	1.0308	---	---	308	---	440	---	10	LC	see standard
				---	---	325	---	440	---	14	SR	see standard
EN 10296-1:2003	E275	---	1.0225	---	---	340	---	440	---	6	U, NW	---
JIS G 3445:2010	Symbol STKM18A	---	---	d > 40	---	275	---	440	---	25 L; 20 T	AM, CF, or AHT	---
	Symbol STKM13B	---	---	d > 40	---	305	---	440	---	20 L; 15 T	AM, CF, or AHT	---
JIS G 3472:2013	Symbol STAM440G	---	---	---	---	305	---	440	---	25	see standard	---
JIS G 3473:2013	Symbol STC440	---	---	---	---	305	---	440	---	10	CF and SR	---
JIS G 3472:2013	Symbol STAM440H	---	---	---	---	355	---	440	---	20	see standard	---
ASTM A519-06 (2012)*	Grade 1045	G10450	---	O.D. ≤ 323.8	O.D. ≤ 12.75	241	35	448	65	20	A	72 HRB
	Grade 1035	G10350	---	O.D. ≤ 323.8	O.D. ≤ 12.75	276	40	448	65	20	HR	72 HRB
	Grade 1035	G10350	---	O.D. ≤ 323.8	O.D. ≤ 12.75	276	40	448	65	20	N	72 HRB
ASME SA-513*	Grade 1035	G10350	---	---	---	310	45	448	65	20	N	88 max HRB
	Grade 1040	G10400	---	---	---	310	45	448	65	20	N	90 max HRB
ASTM A519-06 (2012)*	Grade 1020	G10200	---	O.D. ≤ 323.8	O.D. ≤ 12.75	345	50	448	65	10	SR	72 HRB
ASME SA-513*	Grade 1015	G10150	---	---	---	379	55	448	65	5	MD	77 min HRB
	Grade 1020	G10200	---	---	---	379	55	448	65	10	MD SR	75 min HRB
	Grade 1025	G10250	---	---	---	379	55	448	65	7	SD	72 min HRB
ASTM A512-06 (2012)*	Grade MT 1030	G10300	---	---	---	276	40	448	65	30	SA	60 min HRB
	Grade 1110	G11100	---	---	---	400	58	434-689	63-100	15	SR A	70-100 HRB
	Grade 1011	G10110	---	---	---	407	59	448-689	65-100	13	SR A	70-100 HRB
ASTM A513-15*	Grade 1035	G10350	---	---	---	310	45	450	65	20	N	88 max HRB
	Grade 1040	G10400	---	---	---	310	45	450	65	20	N	90 max HRB
ASTM A513-15*	Grade 1015	G10150	---	---	---	380	55	450	65	5	MD	77 min HRB
	Grade 1020	G10200	---	---	---	380	55	450	65	10	MD SR	75 min HRB
	Grade 1025	G10250	---	---	---	380	55	450	65	7	SD	72 min HRB
ISO 3304:1985	R37	---	---	---	---	---	---	450	---	6	BK	---
	R44	---	---	---	---	---	---	450	---	8	BKW	---
ISO 3305:1985	R37	---	---	---	---	---	---	450	---	6	BK	---
	R44	---	---	---	---	---	---	450	---	8	BKW	---

*: See "List of Standards" at the beginning of the chapter.

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5.1 Carbon Steel Tubes for General and Structural Applications

5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10305-3:2010	E355	---	1.0580	---	---	---	---	450	---	22	A	see standard
EN 10305-1:2010	E355	---	1.0580	---	---	225	---	450	---	22	A	see standard
EN 10305-2:2010	E355	---	1.0580	---	---	225	---	450	---	22	A	see standard
EN 10297-1:2003	E315	---	1.0236	t ≤ 16	---	315	---	450	---	21 L; 19 T	AR, N	---
				16 < t ≤ 40	---	305	---	450	---	21 L; 19 T	AR, N	---
				40 < t ≤ 65	---	295	---	450	---	21 L; 19 T	AR, N	---
				65 < t ≤ 80	---	280	---	420	---	21 L; 19 T	AR, N	---
				80 < t ≤ 100	---	270	---	420	---	21 L; 19 T	AR, N	---
EN 10305-3:2010	E370	---	1.0261	---	---	370	---	450	---	15	CR2	see standard
EN 10296-1:2003	E370	---	1.0261	---	---	370	---	450	---	15 L; 13 T	CR	---
ASTM A595/A595M-14	Grade A	K02004	---	---	---	380	55	450	65	23	RCCM	---
ASTM A513-15*	Grade 1035	G10350	---	---	---	345	50	455	66	10	AW	75 min HRB
	Grade 1524	G15240	---	---	---	345	50	455	66	10	AW	75 min HRB
	Grade 1040	G10400	---	---	---	345	50	455	66	10	AW	75 min HRB
ASME SA-513*	Grade 1035	G10350	---	---	---	345	50	455	66	10	AW	75 min HRB
	Grade 1524	G15240	---	---	---	345	50	455	66	10	AW	75 min HRB
	Grade 1040	G10400	---	---	---	345	50	455	66	10	AW	75 min HRB
ASTM A512-06 (2012)*	Grade MT 1015	G10150	---	---	---	414	60	455-689	66-100	14	SR A	70-100 HRB
EN 10305-1:2010	C35E	---	1.1181	---	---	280	---	460	---	21	N	see standard
ASTM A512-06 (2012)*	Grade 1016	G10160	---	---	---	421	61	462-689	67-100	13	SR A	70-100 HRB
	Grade MT 1017	G10170	---	---	---	427	62	462-689	67-100	13	SR A	72-100 HRB
ASTM A519-06 (2012)*	Grade 1050	G10500	---	O.D. ≤ 323.8	O.D. ≤ 12.75	262	38	469	68	18	A	74 HRB
ASME SA-513*	Grade 1021	G10210	---	---	---	400	58	469	68	10	MD SR	75 min HRB
ASTM A512-06 (2012)*	Grade 1018	G10180	---	---	---	427	62	469-689	68-100	13	SR A	73-100 HRB
JIS G 3445:2010	Symbol STKM15A	---	---	d > 40	---	275	---	470	---	22 L; 17 T	AM, CF, or AHT	---
JIS G 3472:2013	Symbol STAM470G	---	---	---	---	325	---	470	---	22	see standard	---
JIS G 3445:2010	Symbol STKM12C	---	---	d > 40	---	355	---	470	---	20 L; 15 T	AM, CF, or AHT	---
ASTM A513-15*	Grade 1021	G10210	---	---	---	400	58	470	68	10	MD SR	75 min HRB
JIS G 3472:2013	Symbol STAM470H	---	---	---	---	410	---	470	---	18	see standard	---
ISO 3304:1985	R50	---	---	---	---	---	---	480	---	23	GBK & GZF	---
ISO 3305:1985	R50	---	---	---	---	---	---	480	---	23	GBK & GZF	---
ISO 3306:1985	R50	---	---	---	---	---	---	480	---	23	GKM & GZF	---
EN 10305-1:2010	E235	---	1.0308	---	---	384	---	480	---	6	C	see standard
ASTM A595/A595M-14	Grade B	K02005	---	---	---	410	60	480	70	21	RCCM	---

*: See "List of Standards" at the beginning of the chapter.

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5.1 Carbon Steel Tubes for General and Structural Applications

5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A513-15*	Grade 1026	G10260	---	---	---	380	55	480	70	7	SD	77 min HRB
	Grade 1020	G10200	---	---	---	415	60	480	70	5	MD	80 min HRB
	Grade 1025	G10250	---	---	---	415	60	480	70	10	MD SR	77 min HRB
	Grade 1030	G10300	---	---	---	425	62	480	70	7	SD	78 min HRB
ASTM A519-06 (2012)*	Grade 1025	G10250	---	O.D. $\leq$ 323.8	O.D. $\leq$ 12.75	379	55	483	70	8	SR	75 HRB
ASTM A519-06 (2012)*	Grade 1020	G10200	---	O.D. $\leq$ 323.8	O.D. $\leq$ 12.75	414	60	483	70	5	CW	75 HRB
ASME SA-513*	Grade 1026	G10260	---	---	---	379	55	483	70	7	SD	77 min HRB
	Grade 1020	G10200	---	---	---	414	60	483	70	5	MD	80 min HRB
	Grade 1025	G10250	---	---	---	414	60	483	70	10	MD SR	77 min HRB
	Grade 1030	G10300	---	---	---	427	62	483	70	7	SD	78 min HRB
EN 10297-1:2003	E355	---	1.0580	$t \leq 16$	---	355	---	490	---	20 L; 18 T	AR, N	---
				$16 < t \leq 40$	---	345	---	490	---	20 L; 18 T	AR, N	---
				$40 < t \leq 65$	---	335	---	490	---	20 L; 18 T	AR, N	---
				$65 < t \leq 80$	---	315	---	470	---	20 L; 18 T	AR, N	---
				$80 < t \leq 100$	---	295	---	470	---	20 L; 18 T	AR, N	---
EN 10296-1:2003	E355	---	1.0580	---	---	---	---	490	---	22	A	---
ISO 3304:1985	R50	---	---	---	---	285	---	490	---	21	NBK & NZF	---
ISO 3305:1985	R50	---	---	---	---	285	---	490	---	21	NBK & NZF	---
ISO 3306:1985	R50	---	---	---	---	285	---	490	---	21	NKM & NZF	---
JIS G 3444:2010	Symbol STK490	---	---	$d < 40$	---	315	---	490	---	23 L	AM	---
				$40 < d \leq 350$	---	315	---	490	---	23 L	AM	---
				$d > 350$	---	315	---	490	---	18 T	AM	---
JIS G 3445:2010	Symbol STKM18B	---	---	---	---	315	---	490	---	23 L; 18 T	AM, CF, or AHT	---
	Symbol STKM19A	---	---	---	---	315	---	490	---	23 L; 18 T	AM, CF, or AHT	---
ISO 2937:1974	TS 18	---	---	---	---	285	---	490-610	---	21	HF	---
EN 10296-1:2003	E355	---	1.0580	---	---	355	---	490	---	22	N	---
EN 10305-1:2010	E355	---	1.0580	---	---	355	---	490-630	---	22	N	see standard
EN 10305-2:2010	E355	---	1.0580	---	---	355	---	490-630	---	22	N	see standard
EN 10305-3:2010	E355	---	1.0580	---	---	355	---	490-630	---	22	N	see standard
EN 10305-2:2010	E235	---	1.0308	---	---	392	---	490	---	6	C	see standard
EN 10305-3:2010	E420	---	1.0575	---	---	420	---	490	---	12	CR2	see standard
ASTM A512-06 (2012)*	Grade MT 1020	G10200	---	---	---	448	65	490-896	71-130	11	SR A	75 HRB-20 HRC
ASTM A513-15*	Grade 1021	G10210	---	---	---	425	62	495	72	5	MD	80 min HRB
ASME SA-513*	Grade 1021	G10210	---	---	---	427	62	496	72	5	MD	80 min HRB
ASTM A512-06 (2012)*	Grade 1025	G10250	---	---	---	462	67	496-896	72-130	11	SR A	78 HRB-20 HRC

*: See "List of Standards" at the beginning of the chapter.

5.1 Carbon Steel Tubes for General and Structural Applications

5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10297-1:2003	C22E	---	1.1151	$t \leq 8$	---	340	---	500	---	20 L; 18 T	QT	---
				$8 < t \leq 20$	---	290	---	470	---	22 L; 20 T	QT	---
				$20 < t \leq 50$	---	270	---	440	---	22 L; 20 T	QT	---
				$50 < t \leq 80$	---	260	---	420	---	22 L; 20	QT	---
JIS G 3444:2010	Symbol STK500	---	---	$d < 40$	---	355	---	500	---	15 L	AM	---
				$40 < d \leq 350$	---	355	---	500	---	15 L	AM	---
				$d > 350$	---	355	---	500	---	10 T	AM	---
JIS G 3472:2013	Symbol STAM500G	---	---	---	---	355	---	500	---	18	see standard	---
JIS G 3445:2010	Symbol STKM14B	---	---	---	---	355	---	500	---	15 L; 10 T	AM, CF, or AHT	---
JIS G 3472:2013	Symbol STAM500H	---	---	---	---	430	---	500	---	16	see standard	---
EN 10305-1:2010	C45E	---	1.1191	---	---	---	---	510	---	20	A	see standard
GB/T 17396-1998	Grade 35	---	---	---	---	305	---	510	---	17	HR, A or H+T	---
JIS G 3445:2010	Symbol STKM16A	---	---	$d > 40$	---	325	---	510	---	20 L; 15 T	AM, CF, or AHT	---
EN 10305-2:2010	E275	---	1.0225	---	---	357	---	510	---	8	LC	see standard
				---	---	375	---	510	---	12	SR	see standard
JIS G 3445:2010	Symbol STKM13C	---	---	$d > 40$	---	380	---	510	---	15 L; 10 T	AM, CF, or AHT	---
	Symbol STKM18C	---	---	$d > 40$	---	380	---	510	---	15 L; 10 T	AM, CF, or AHT	---
JIS G 3473:2013	Symbol STC510A	---	---	---	---	380	---	510	---	10	CF or SR	---
	Symbol STC510B	---	---	---	---	380	---	510	---	15	SR	---
ASTM A513-15*	Grade 1025	G10250	---	---	---	450	65	515	75	5	MD	82 min HRB
	Grade 1026	G10260	---	---	---	450	65	515	75	10	MD SR	80 min HRB
ASTM A519-06 (2012)*	Grade 1045	G10450	---	$O.D. \leq 323.8$	$O.D. \leq 12.75$	310	45	517	75	15	HR	80 HRB
				$O.D. \leq 323.8$	$O.D. \leq 12.75$	331	48	517	75	15	N	80 HRB
ASME SA-513*	Grade 1025	G10250	---	---	---	448	65	517	75	5	MD	82 min HRB
	Grade 1026	G10260	---	---	---	448	65	517	75	10	MD SR	80 min HRB
ASTM A519-06 (2012)*	Grade 1025	G10250	---	$O.D. \leq 323.8$	$O.D. \leq 12.75$	448	65	517	75	5	CW	80 HRB
	Grade 1035	G10350	---	$O.D. \leq 323.8$	$O.D. \leq 12.75$	448	65	517	75	8	SR	80 HRB
EN 10305-1:2010	E255	---	1.0408	---	---	---	---	520	---	8	LC	see standard
	E410	---	1.0509	---	---	---	---	520	---	22	A	see standard
ISO 3304:1985	R44	---	---	---	---	---	---	520	---	5	BK	---
ISO 3305:1985	R44	---	---	---	---	---	---	520	---	5	BK	---
ISO 3306:1985	R50	---	---	---	---	---	---	520	---	5	KM	---
EN 10305-1:2010	E255	---	1.0408	---	---	375	---	520	---	12	SR	see standard
ASTM A519-06 (2012)*	Grade 1050	G10500	---	$O.D. \leq 323.8$	$O.D. \leq 12.75$	345	50	538	78	12	N	82 HRB
EN 10305-1:2010	C35E	---	1.1181	---	---	---	---	540	---	7	LC	see standard

*: See "List of Standards" at the beginning of the chapter.

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5.1 Carbon Steel Tubes for General and Structural Applications

5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ISO 2937:1974	C 35	---	---	---	---	275	---	540-660	---	20	HF	---
EN 10305-1:2010	C45E	---	1.1191	---	---	340	---	540	---	18	N	see standard
EN 10305-3:2010	E355	---	1.0580	---	---	378	---	540	---	5	CR1	see standard
JIS G 3444:2010	Symbol STK540	---	---	d < 40	---	390	---	540	---	20 L	AM	---
				40 < d ≤ 350	---	390	---	540	---	20 L	AM	---
				d > 350	---	390	---	540	---	16 T	AM	---
JIS G 3445:2010	Symbol STKM20A	---	---	d > 40	---	390	---	540	---	23 L; 18 T	AM, CF, or AHT	---
JIS G 3473:2013	Symbol STC540	---	---	---	---	390	---	540	---	20	AM	---
EN 10296-1:2003	E355	---	1.0580	---	---	400	---	540	---	5	U, NW	---
JIS G 3472:2013	Symbol STAM540H	---	---	---	---	480	---	540	---	13	see standard	---
ISO 3304:1985	R50	---	---	---	---	---	---	550	---	7	BKW	---
ISO 3305:1985	R50	---	---	---	---	---	---	550	---	7	BKW	---
EN 10297-1:2003	C35E	---	1.1181	t ≤ 16	---	300	---	550	---	18 L; 16 T	N	see standard
				16 < t ≤ 40	---	270	---	520	---	19 L; 17 T	N	see standard
				40 < t ≤ 80	---	270	---	520	---	19 L; 17 T	N	see standard
JIS G 3445:2010	Symbol STKM17A	---	---	d > 40	---	345	---	550	---	20 L; 15 T	AM, CF, or AHT	---
EN 10305-1:2010	E410	---	1.0509	---	---	410	---	550-700	---	22	N	see standard
JIS G 3445:2010	Symbol STKM14C	---	---	d > 40	---	410	---	550	---	15 L; 10 T	AM, CF, or AHT	---
	Symbol STKM19C	---	---	d > 40	---	410	---	550	---	15 L; 10 T	AM, CF, or AHT	---
ASTM A513-15*	Grade 1026	G10260	---	---	---	480	70	550	80	5	MD	85 min HRB
	Grade 1030	G10300	---	---	---	480	70	550	80	10	MD SR	81 min HRB
	Grade 1035	G10350	---	---	---	480	70	550	80	7	SD	82 min HRB
ASTM A519-06 (2012)*	Grade 1050	G10500	---	O.D. ≤ 323.8	O.D. ≤ 12.75	345	50	552	80	10	HR	85 HRB
ASTM A512-06 (2012)*	Grade 1030	G10300	---	---	---	483	70	552-896	80-130	10	SR A	80 HRB-20 HRC
ASTM A519-06 (2012)*	Grade 1045	G10450	---	O.D. ≤ 323.8	O.D. ≤ 12.75	483	70	552	80	8	SR	85 HRB
ASME SA-513*	Grade 1026	G10260	---	---	---	483	70	552	80	5	MD	85 min HRB
	Grade 1030	G10300	---	---	---	483	70	552	80	10	MD SR	81 min HRB
	Grade 1035	G10350	---	---	---	483	70	552	80	7	SD	82 min HRB
EN 10305-2:2010	E275	---	1.0225	---	---	448	---	560	---	5	C	see standard
ASTM A519-06 (2012)*	Grade 1050	G10500	---	O.D. ≤ 323.8	O.D. ≤ 12.75	483	70	565	82	6	SR	86 HRB
EN 10305-1:2010	E255	---	1.0408	---	---	---	---	580	---	5	C	see standard
	E355	---	1.0580	---	---	406	---	580	---	7	LC	see standard
	---	---	---	---	---	450	---	580	---	10	SR	see standard
JIS G 3445:2010	Symbol STKM15C	---	---	d > 40	---	430	---	580	---	12 L; 7 T	AM, CF, or AHT	---

*: See "List of Standards" at the beginning of the chapter.

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5.1 Carbon Steel Tubes for General and Structural Applications

5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A513-15*	Grade 1030	G10300	---	---	---	515	75	585	85	5	MD	87 min HRB
	Grade 1035	G10350	---	---	---	515	75	585	85	10	MD SR	85 min HRB
	Grade 1040	G10400	---	---	---	515	75	585	85	10	MD SR	85 min HRB
	Grade 1524	G15240	---	---	---	515	75	585	85	10	MD SR	85 min HRB
ASME SA-513*	Grade 1030	G10300	---	---	---	517	75	586	85	5	MD	87 min HRB
	Grade 1035	G10350	---	---	---	517	75	586	85	10	MD SR	85 min HRB
	Grade 1040	G10400	---	---	---	517	75	586	85	10	MD SR	85 min HRB
	Grade 1524	G15240	---	---	---	517	75	586	85	10	MD SR	85 min HRB
ASTM A519-06 (2012)*	Grade 1035	G10350	---	O.D. ≤ 323.8	O.D. ≤ 12.75	517	75	586	85	5	CW	88 HRB
EN 10305-1:2010	C35E	---	1.1181	---	---	---	---	590	---	5	C	see standard
GB/T 17396-1998	Grade 45	---	---	---	---	335	---	590	---	14	HR, A or H+T	---
EN 10305-2:2010	E355	---	1.0580	---	---	413	---	590	---	6	LC	see standard
				---	---	435	---	590	---	10	SR	see standard
JIS G 3474:2014	Symbol STKT590	---	---	---	---	440	---	590-740	---	20 L; 16 T	AM	---
JIS G 3473:2013	Symbol STC590A	---	---	---	---	490	---	590	---	10	CF or SR	---
	Symbol STC590B	---	---	---	---	490	---	590	---	15	SR	---
EN 10297-1:2003	E420J2	---	1.0599	t ≤ 16	---	420	---	600	---	19 L; 17 T	N	L: 27J at -20°C T: 20 J at -20°C
				16 < t ≤ 40	---	400	---	560	---	19 L; 17 T	N	L: 27J at -20°C T: 20 J at -20°C
				40 < t ≤ 65	---	390	---	530	---	19 L; 17 T	N	L: 27J at -20°C T: 20 J at -20°C
				65 < t ≤ 80	---	370	---	500	---	19 L; 17 T	N	L: 27J at -20°C T: 20 J at -20°C
				80 < t ≤ 100	---	360	---	500	---	19 L; 17 T	N	L: 27J at -20°C T: 20 J at -20°C
ISO 3304:1985	R50	---	---	---	---	---	---	600	---	4	BK	---
ISO 3305:1985	R50	---	---	---	---	---	---	600	---	4	BK	---
EN 10305-1:2010	E410	---	1.0509	---	---	---	---	620	---	8	LC	see standard
EN 10297-1:2003	C45E	---	1.1181	t ≤ 16	---	340	---	620	---	14 L; 12 T	N	see standard
				16 < t ≤ 40	---	305	---	580	---	16 L; 14 T	N	see standard
				40 < t ≤ 80	---	305	---	580	---	16 L; 14 T	N	see standard
JIS G 3445:2010	Symbol STKM16C	---	---	d > 40	---	460	---	620	---	12 L; 7 T	AM, CF, or AHT	---
ASTM A513-15*	Grade 1035	G10350	---	---	---	550	80	620	90	5	MD	90 min HRB
	Grade 1040	G10400	---	---	---	550	80	620	90	5	MD	90 min HRB
	Grade 1524	G15240	---	---	---	550	80	620	90	5	MD	90 min HRB
ASTM A519-06 (2012)*	Grade 1045	G10450	---	O.D. ≤ 323.8	O.D. ≤ 12.75	552	80	621	90	5	CW	90 HRB

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page

5.1 Carbon Steel Tubes for General and Structural Applications

5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-513*	Grade 1035	G10350	---	---	---	552	80	621	90	5	MD	90 min HRB
	Grade 1040	G10400	---	---	---	552	80	621	90	5	MD	90 min HRB
	Grade 1524	G15240	---	---	---	552	80	621	90	5	MD	90 min HRB
EN 10297-1:2003	C35E	---	1.1181	$t \leq 8$	---	430	---	630	---	17 L; 15 T	QT	---
				$8 < t \leq 20$	---	380	---	600	---	19 L; 17 T	QT	---
				$20 < t \leq 50$	---	320	---	550	---	20 L; 18 T	QT	---
				$50 < t \leq 80$	---	290	---	500	---	20 L; 18 T	QT	---
EN 10305-1:2010	E355	---	1.0580	---	---	512	---	640	---	4	C	see standard
EN 10305-2:2010	E355	---	1.0580	---	---	512	---	640	---	4	C	see standard
EN 10305-1:2010	26Mn5	---	1.1161	---	---	---	---	650	---	7	LC	see standard
EN 10297-1:2003	E470	---	1.0536	$t \leq 16$	---	470	---	650	---	17 L; 15 T	AR	---
				$16 < t \leq 40$	---	430	---	600	---	17 L; 15 T	AR	---
				$40 < t \leq 65$	---	---	---	---	---	17 L; 15 T	AR	---
				$65 < t \leq 80$	---	---	---	---	---	17 L; 15 T	AR	---
				$80 < t \leq 100$	---	---	---	---	---	17 L; 15 T	AR	---
JIS G 3445:2010	Symbol STKM17C	---	---	$d > 40$	---	480	---	650	---	10 L; 5 T	AM, CF, or AHT	---
EN 10305-1:2010	C45E	---	1.1191	---	---	---	---	670	---	6	LC	see standard
EN 10297-1:2003	38Mn6	---	1.1127	$t \leq 16$	---	400	---	670	---	14 L; 12 T	N	---
				$16 < t \leq 40$	---	380	---	620	---	15 L; 13 T	N	---
				$40 < t \leq 80$	---	360	---	570	---	16 L; 14 T	N	---
EN 10305-1:2010	E410	---	1.0509	---	---	590	---	690	---	12	SR	see standard

*: See "List of Standards" at the beginning of the chapter.

5.1 Carbon Steel Tubes for General and Structural Applications

5.1A Mechanical Properties of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10305-1:2010	26Mn5	---	1.1161	---	---	---	---	700	---	4	C	see standard
EN 10297-1:2003	C45E	---	1.1181	$t \leq 8$	---	490	---	700	---	14 L; 12 T	QT	---
				$8 < t \leq 20$	---	430	---	650	---	16 L; 14 T	QT	---
				$20 < t \leq 50$	---	370	---	630	---	17 L; 15 T	QT	---
				$50 < t \leq 80$	---	340	---	600	---	17 L; 15 T	QT	---
	E590K2	---	1.0644	$t \leq 16$	---	590	---	700	---	16 L; 14 T	QT	L: 40 J at -20°C T: 27 J at -20°C
				$16 < t \leq 40$	---	540	---	650	---	16 L; 14 T	QT	L: 40 J at -20°C T: 27 J at -20°C
				$40 < t \leq 65$	---	480	---	570	---	16 L; 14 T	QT	L: 40 J at -20°C T: 27 J at -20°C
				$65 < t \leq 80$	---	455	---	520	---	16 L; 14 T	QT	L: 40 J at -20°C T: 27 J at -20°C
				$80 < t \leq 100$	---	420	---	520	---	16 L; 14 T	QT	L: 40 J at -20°C T: 27 J at -20°C
EN 10305-1:2010	C45E	---	1.1191	---	---	---	---	720	---	4	C	see standard
	E410	---	1.0509	---	---	---	---	750	---	4	C	see standard
GB 18248-2000	Grade 37Mn	---	---	---	---	630	---	750 L	---	16 L	Q+T	L: 55 J @ RT

5.1 Carbon Steel Tubes for General and Structural Applications

5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10296-1:2003	E155	---	1.0033	0.11	0.70	0.35	0.045	0.045	---	---	---	---
EN 10305-3:2010	E155	---	1.0033	0.11	0.70	0.35	0.025	0.025	---	---	---	Al 0.015 min.
EN 10305-2:2010	E155	---	1.0033	0.11	0.70	0.35	0.025	0.025	---	---	---	Al 0.015 min.
ASTM A513-15*	Grade 1008	G10080	---	0.10	0.50	---	0.035	0.035	---	---	---	---
ASME SA-513*	Grade 1008	G10080	---	0.10	0.50	---	0.035	0.035	---	---	---	---
ISO 3304:1985	R28	---	---	0.10	0.30	---	0.040	0.040	---	---	---	---
ISO 3305:1985	R28	---	---	0.13	0.60	---	0.050	0.050	---	---	---	---
ISO 3306:1985	R28	---	---	0.13	0.60	---	0.050	0.050	---	---	---	---
EN 10296-1:2003	E190	---	1.0031	0.10	0.70	0.35	0.045	0.045	---	---	---	---
EN 10305-3:2010	E190	---	1.0031	0.10	0.70	0.35	0.025	0.025	---	---	---	Al 0.015 min.
ASTM A513-15*	Grade 1010	G10100	---	0.08-0.13	0.30-0.60	---	0.035	0.035	---	---	---	---
ASTM A512-06 (2012)*	Grade MT 1010	G10100	---	0.05-0.15	0.30-0.60	---	0.04	0.045	---	---	---	---
ASME SA-513*	Grade 1010	G10100	---	0.08-0.13	0.30-0.60	---	0.035	0.035	---	---	---	---
EN 10305-1:2010	E215	---	1.0212	0.10	0.70	0.05	0.025	0.025	---	---	---	Al 0.025 min
JIS G 3444:2010	Symbol STK290	---	---	---	---	---	0.050	0.050	---	---	---	---
JIS G 3445:2010	Symbol STKM11A	---	---	0.12	0.60	0.35	0.040	0.040	---	---	---	---
JIS G 3452:2014	Symbol SGP	---	---	---	---	---	0.040	0.040	---	---	---	---
EN 10305-3:2010	E195	---	1.0034	0.15	0.70	0.35	0.025	0.025	---	---	---	Al 0.015 min.
EN 10305-2:2010	E195	---	1.0034	0.15	0.70	0.35	0.025	0.025	---	---	---	Al 0.015 min.
SAE J526 NOV10	---	---	---	0.18	0.60	---	0.035	0.035	---	---	---	---
EN 10296-1:2003	E155	---	1.0033	0.11	0.70	0.35	0.045	0.045	---	---	---	---
JIS G 3472:2013	Symbol STAM290GA	---	---	0.12	0.60	0.35	0.035	0.035	---	---	---	---
	Symbol STAM290GB	---	---	0.12	0.60	0.35	0.035	0.035	---	---	---	---
ASTM A513-15*	Grade 1008	G10080	---	0.10	0.50	---	0.035	0.035	---	---	---	---
ASME SA-513*	Grade 1008	G10080	---	0.10	0.50	---	0.035	0.035	---	---	---	---
ASTM A512-06 (2012)*	Grade MT 1015	G10150	---	0.10-0.20	0.30-0.60	---	0.04	0.045	---	---	---	---

*: See "List of Standards" at the beginning of the chapter.

5.1 Carbon Steel Tubes for General and Structural Applications

5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10305-3:2010	E195	---	1.0034	0.15	0.70	0.35	0.025	0.025	---	---	---	Al 0.015 min.
ISO 3306:1985	R28	---	---	0.13	0.60	---	0.050	0.050	---	---	---	---
ASTM A513-15*	Grade 1015	G10150	---	0.13-0.18	0.30-0.60	---	0.035	0.035	---	---	---	---
ASME SA-513*	Grade 1015	G10150	---	0.12-0.18	0.30-0.60	---	0.035	0.035	---	---	---	---
EN 10305-3:2010	E220	---	1.0215	0.14	0.70	0.35	0.025	0.025	---	---	---	Al 0.015 min.
ASTM A513-15*	Grade 1010	G10100	---	0.08-0.13	0.30-0.60	---	0.035	0.035	---	---	---	---
ASME SA-513*	Grade 1010	G10100	---	0.08-0.13	0.30-0.60	---	0.035	0.035	---	---	---	---
ASTM A500-13	Grade A	K03000	---	0.26	1.35	---	0.035	0.035	---	---	---	Cu 0.20 min
EN 10296-1:2003	E220	---	1.0215	0.14	0.70	0.35	0.045	0.045	---	---	---	---
EN 10305-3:2010	E235	---	1.0308	0.17	1.20	0.35	0.025	0.025	---	---	---	Al 0.015 min.
EN 10305-1:2010	E235	---	1.0308	0.17	1.20	0.35	0.025	0.025	---	---	---	Al 0.015 min.
EN 10305-2:2010	E235	---	1.0308	0.17	1.20	0.35	0.025	0.025	---	---	---	Al 0.015 min.
ISO 3304:1985	R33	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
ISO 3305:1985	R33	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
ISO 3306:1985	R33	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
ISO 2937:1974	TS 1	---	---	0.16	0.30-0.70	---	0.050	0.050	---	---	---	---
ASTM A513-15*	Grade 1015	G10150	---	0.13-0.18	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1008	G10080	---	0.10	0.50	---	0.035	0.035	---	---	---	---
ASTM A519-06 (2012)*	Grade 1020	G10200	---	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
ASME SA-513*	Grade 1015	G10150	---	0.12-0.18	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1008	G10080	---	0.10	0.50	---	0.035	0.035	---	---	---	---
ISO 3304:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
ISO 3305:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
ISO 3306:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
JIS G 3445:2010	Symbol STKM12A	---	---	0.20	0.60	0.35	0.040	0.040	---	---	---	---
JIS G 3472:2013	Symbol STAM340G	---	---	0.20	0.60	0.35	0.035	0.035	---	---	---	---
EN 10296-1:2003	E235	---	1.0308	0.17	1.20	0.35	0.045	0.045	---	---	---	---
	E260	---	1.0220	0.16	1.20	0.35	0.045	0.045	---	---	---	---
EN 10305-3:2010	E260	---	1.0220	0.16	1.20	0.35	0.025	0.025	---	---	---	Al 0.015 min.
ASTM A512-06 (2012)*	Grade MT 1020	G10200	---	0.15-0.25	0.30-0.60	---	0.04	0.045	---	---	---	---
ASTM A513-15*	Grade 1020	G10200	---	0.18-0.23	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1021	G10210	---	0.18-0.23	0.60-0.90	---	0.035	0.035	---	---	---	---
ASME SA-513*	Grade 1020	G10200	---	0.17-0.23	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1021	G10210	---	0.17-0.23	0.60-0.90	---	0.035	0.035	---	---	---	---

*: See "List of Standards" at the beginning of the chapter.

5.1 Carbon Steel Tubes for General and Structural Applications

5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 3304:1985	R28	---	---	0.10	0.30	---	0.040	0.040	---	---	---	---
ISO 3305:1985	R28	---	---	0.13	0.60	---	0.050	0.050	---	---	---	---
EN 10305-2:2010	E155	---	1.0033	0.11	0.70	0.35	0.025	0.025	---	---	---	Al 0.015 min.
ASME SA-513*	Grade 1020	G10200	---	0.17-0.23	0.30-0.60	---	0.035	0.035	---	---	---	---
ISO 2937:1974	TS 4	---	---	0.17	0.40-0.80	0.35	0.045	0.045	---	---	---	---
ISO 3304:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
ISO 3305:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
ISO 3306:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
EN 10297-1:2003	E235	---	1.0308	0.17	1.20	0.35	0.030	0.035	---	---	---	---
ASTM A513-15*	Grade 1020	G10200	---	0.18-0.23	0.30-0.60	---	0.035	0.035	---	---	---	---
ASTM A519-06 (2012)*	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
ISO 3304:1985	R33	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
ISO 3305:1985	R33	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
JIS G 3473:2013	Symbol STC370	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
JIS G 3445:2010	Symbol STKM13A	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
EN 10305-2:2010	E195	---	1.0034	0.15	0.70	0.35	0.025	0.025	---	---	---	Al 0.015 min.
EN 10296-1:2003	E275K2	---	1.0456	0.20	0.50-1.40	0.40	0.035	0.030	0.30	0.30	0.10	Al 0.020 min; Cu 0.35; N 0.015; Nb 0.050; Ti 0.03; V 0.05
ASTM A513-15*	Grade 1021	G10210	---	0.18-0.23	0.60-0.90	---	0.035	0.035	---	---	---	---
ASME SA-513*	Grade 1021	G10210	---	0.17-0.23	0.60-0.90	---	0.035	0.035	---	---	---	---
ASTM A519-06 (2012)*	Grade 1020	G10200	---	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A512-06 (2012)*	Grade MT 1025	G10250	---	---	---	---	---	---	---	---	---	---
ASTM A519-06 (2012)*	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
ASME SA-513*	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1008	G10080	---	0.10	0.50	---	0.035	0.035	---	---	---	---
	Grade 1010	G10100	---	0.08-0.13	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1015	G10150	---	0.12-0.18	0.30-0.60	---	0.035	0.035	---	---	---	---
ASTM A513-15*	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1008	G10080	---	0.10	0.50	---	0.035	0.035	---	---	---	---
	Grade 1010	G10100	---	0.08-0.13	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1015	G10150	---	0.13-0.18	0.30-0.60	---	0.035	0.035	---	---	---	---

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page

5.1 Carbon Steel Tubes for General and Structural Applications

5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10305-1:2010	E215	---	1.0212	0.10	0.70	0.05	0.025	0.025	---	---	---	Al 0.025 min
EN 10296-1:2003	E275	---	1.0225	0.21	1.40	0.35	0.045	0.045	---	---	---	---
EN 10305-1:2010	E255	---	1.0408	0.21	0.40-1.10	0.35	0.025	0.025	---	---	---	--
EN 10305-3:2010	E275	---	1.0225	0.21	1.40	0.35	0.025	0.025	---	---	---	Al 0.015 min.
	E235	---	1.0308	0.17	1.20	0.35	0.025	0.025	---	---	---	Al 0.015 min.
EN 10305-2:2010	E275	---	1.0225	0.21	1.40	0.35	0.025	0.025	---	---	---	Al 0.015 min.
EN 10296-1:2003	E235	---	1.0308	0.17	1.20	0.35	0.045	0.045	---	---	---	---
JIS G 3472:2013	Symbol STAM390G	---	---	0.25	0.30-0.90	0.35	0.035	0.035	---	---	---	---
JIS G 3445:2010	Symbol STKM12B	---	---	0.20	0.60	0.35	0.040	0.040	---	---	---	---

5.1 Carbon Steel Tubes for General and Structural Applications

5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 3304:1985	R28	---	---	0.10	0.30	---	0.040	0.040	---	---	---	---
	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
	R44	---	---	0.21	1.2	0.35	0.050	0.050	---	---	---	---
ISO 3305:1985	R28	---	---	0.13	0.60	---	0.050	0.050	---	---	---	---
	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
	R44	---	---	0.21	1.2	0.35	0.050	0.050	---	---	---	---
ISO 3306:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
	R44	---	---	0.21	1.2	0.35	0.050	0.050	---	---	---	---
EN 10305-2:2010	E155	---	1.0033	0.11	0.70	0.35	0.025	0.025	---	---	---	Al 0.015 min.
JIS G 3444:2010	Symbol STK400	---	---	0.25	---	---	0.040	0.040	---	---	---	---
ASTM A500-13	Grade D	---	---	0.26	1.35	---	0.035	0.035	---	---	---	Cu 0.20 min
GB/T 17396-1998	Grade 20	---	---	0.17-0.24	0.35-0.65	0.17-0.37	0.035	0.035	0.25	0.25	---	Cu 0.20
ASTM A501-14	Grade A	K03000	---	0.26	---	---	0.035	0.035	---	---	---	Cu 0.20 min
ASTM A500-13	Grade B	K03000	---	0.26	1.35	---	0.035	0.035	---	---	---	Cu 0.20 min
EN 10296-1:2003	E275	---	1.0225	0.21	1.40	0.35	0.045	0.045	---	---	---	---
EN 10297-1:2003	E275	---	1.0225	0.21	1.40	0.35	0.030	0.035	---	---	---	---
EN 10305-2:2010	E275	---	1.0225	0.21	1.40	0.35	0.025	0.025	---	---	---	Al 0.015 min.
EN 10305-3:2010	E275	---	1.0225	0.21	1.40	0.35	0.025	0.025	---	---	---	Al 0.015 min.
EN 10296-1:2003	E320	---	1.0237	0.20	1.40	0.35	0.045	0.045	---	---	---	---
EN 10305-3:2010	E320	---	1.0237	0.20	1.40	0.35	0.025	0.025	---	---	---	Al 0.015 min.
EN 10297-1:2003	E275K2	---	1.0456	0.20	0.50-1.40	0.40	0.030	0.030	0.30	0.30	0.10	Al 0.020 min; Cu 0.35; N 0.015; Nb 0.05; Ti 0.03; V 0.05
ISO 2937:1974	TS 9	---	---	0.21	0.40-1.20	0.35	0.045	0.045	---	---	---	---
JIS G 3445:2010	Symbol STKM14A	---	---	0.30	0.30-1.00	0.35	0.040	0.040	---	---	---	---
ASTM A519-06 (2012)*	Grade 1035	G10350	---	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
ASME SA-513*	Grade 1026	G10260	---	0.22-0.28	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1030	G10300	---	0.27-0.34	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1008	G10080	---	0.10	0.50	---	0.035	0.035	---	---	---	---
	Grade 1010	G10100	---	0.08-0.13	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1015	G10150	---	0.12-0.18	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1020	G10200	---	0.17-0.23	0.30-0.60	---	0.035	0.035	---	---	---	---

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page.

5.1 Carbon Steel Tubes for General and Structural Applications

5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A513-15*	Grade 1026	G10260	---	0.22-0.28	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1030	G10300	---	0.28-0.34	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1008	G10080	---	0.10	0.50	---	0.035	0.035	---	---	---	---
	Grade 1010	G10100	---	0.08-0.13	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1015	G10150	---	0.13-0.18	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1020	G10200	---	0.18-0.23	0.30-0.60	---	0.035	0.035	---	---	---	---
ISO 3304:1985	R33	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
ISO 3305:1985	R33	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
EN 10305-1:2010	E235	---	1.0308	0.17	1.20	0.35	0.025	0.025	---	---	---	Al 0.015 min.

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page.

5.1 Carbon Steel Tubes for General and Structural Applications

5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10305-2:2010	E195	---	1.0034	0.15	0.70	0.35	0.025	0.025	---	---	---	Al 0.015 min.
ASTM A500-13	Grade C	K02705	---	0.23	1.35	---	0.035	0.035	---	---	---	Cu 0.20 min
ASTM A513-15*	Grade 1021	G10210	---	0.18-0.23	0.60-0.90	---	0.035	0.035	---	---	---	---
ASME SA-513*	Grade 1021	G10210	---	0.17-0.23	0.60-0.90	---	0.035	0.035	---	---	---	---
EN 10297-1:2003	C22E	---	1.1151	0.17-0.24	0.40-0.70	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10305-1:2010	E215	---	1.0212	0.10	0.70	0.05	0.025	0.025	---	---	---	Al 0.025 min
ASTM A512-06 (2012)*	Grade MT 1010	G10100	---	0.05-0.15	0.30-0.60	---	0.04	0.045	---	---	---	---
EN 10305-1:2010	C35E	---	1.1181	0.32-0.39	0.50-0.80	0.40	0.030	0.035	0.40	---	0.10	Cr+Mo+Ni 0.63
	E255	---	1.0408	0.21	0.40-1.10	0.35	0.025	0.025	---	---	---	---
EN 10305-2:2010	E235	---	1.0308	0.17	1.20	0.35	0.025	0.025	---	---	---	Al 0.015 min.
JIS G 3445:2010	Symbol STKM18A	---	---	0.18	1.50	0.55	0.040	0.040	---	---	---	---
	Symbol STKM13B	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
JIS G 3472:2013	Symbol STAM440G	---	---	0.25	0.30-0.90	0.35	0.035	0.035	---	---	---	---
JIS G 3473:2013	Symbol STC440	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
JIS G 3472:2013	Symbol STAM440H	---	---	0.25	0.30-0.90	0.35	0.035	0.035	---	---	---	---
ASTM A519-06 (2012)*	Grade 1045	G10450	---	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1035	G10350	---	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
ASME SA-513*	Grade 1035	G10350	---	0.31-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1040	G10400	---	0.36-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A519-06 (2012)*	Grade 1020	G10200	---	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
ASME SA-513*	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.035	0.035	---	---	---	---
ASTM A512-06 (2012)*	Grade MT 1030	G10300	---	---	---	---	---	---	---	---	---	---
	Grade 1011	G10110	---	---	---	---	---	---	---	---	---	---
	Grade 1110	G11100	---	0.08-0.13	0.30-0.60	---	0.040	0.08-0.130	---	---	---	---
ASTM A513-15*	Grade 1035	G10350	---	0.32-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1040	G10400	---	0.37-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A513-15*	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.035	0.035	---	---	---	---
ISO 3304:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
	R44	---	---	0.21	1.2	0.35	0.050	0.050	---	---	---	---
ISO 3305:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
	R44	---	---	0.21	1.2	0.35	0.050	0.050	---	---	---	---
EN 10305-3:2010	E355	---	1.0580	0.22	1.60	0.55	0.025	0.025	---	---	---	Al 0.020 min.
EN 10305-1:2010	E355	---	1.0580	0.22	1.60	0.55	0.025	0.025	---	---	---	Al 0.020 min.
EN 10305-2:2010	E355	---	1.0580	0.22	1.60	0.55	0.025	0.025	---	---	---	Al 0.020 min.
EN 10297-1:2003	E315	---	1.0236	0.21	1.50	0.30	0.030	0.035	---	---	---	---
EN 10305-3:2010	E370	---	1.0261	0.21	1.60	0.55	0.025	0.025	---	---	---	Al 0.020 min.

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page.

5.1 Carbon Steel Tubes for General and Structural Applications

5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10296-1:2003	E370	---	1.0261	0.21	1.60	0.55	0.045	0.045	---	---	---	---
ASTM A595/A595M-14	Grade A	K02004	---	0.15-0.25	0.30-0.90	0.060	0.035	0.035	---	---	---	(Si+Al) 0.020 min
ASTM A513-15*	Grade 1035	G10350	---	0.32-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1524	G15240	---	0.19-0.25	1.35-1.65	---	0.040	0.050	---	---	---	---
	Grade 1040	G10400	---	0.37-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
ASME SA-513*	Grade 1035	G10350	---	0.31-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1524	G15240	---	0.18-0.25	1.35-1.65	---	0.040	0.050	---	---	---	---
	Grade 1040	G10400	---	0.36-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A512-06 (2012)*	Grade MT 1015	G10150	---	0.10-0.20	0.30-0.60	---	0.04	0.045	---	---	---	---
EN 10305-1:2010	C35E	---	1.1181	0.32-0.39	0.50-0.80	0.40	0.030	0.035	0.40	---	0.10	Cr+Mo+Ni 0.63
ASTM A512-06 (2012)*	Grade 1016	G10160	---	0.13-0.18	0.60-0.90	---	0.040	0.045	---	---	---	---
	Grade MT 1017	G10170	---	---	---	---	---	---	---	---	---	---
ASTM A519-06 (2012)*	Grade 1050	G10500	---	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
ASME SA-513*	Grade 1021	G10210	---	0.17-0.23	0.60-0.90	---	0.035	0.035	---	---	---	---
ASTM A512-06 (2012)*	Grade 1018	G10180	---	0.15-0.20	0.60-0.90	---	0.040	0.045	---	---	---	---
JIS G 3445:2010	Symbol STKM15A	---	---	0.25-0.35	0.30-1.00	0.35	0.040	0.040	---	---	---	---
JIS G 3472:2013	Symbol STAM470G	---	---	0.25	0.30-0.90	0.35	0.035	0.035	---	---	---	---
JIS G 3445:2010	Symbol STKM12C	---	---	0.20	0.60	0.35	0.040	0.040	---	---	---	---
ASTM A513-15*	Grade 1021	G10210	---	0.18-0.23	0.60-0.90	---	0.035	0.035	---	---	---	---
JIS G 3472:2013	Symbol STAM470H	---	---	0.25	0.30-0.90	0.35	0.035	0.035	---	---	---	---
ISO 3304:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
ISO 3305:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
ISO 3306:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
EN 10305-1:2010	E235	---	1.0308	0.17	1.20	0.35	0.025	0.025	---	---	---	Al 0.015 min.
ASTM A595/A595M-14	Grade B	K02005	---	0.15-0.25	0.40-1.35	0.060	0.035	0.035	---	---	---	(Si+Al) 0.020 min
ASTM A513-15*	Grade 1026	G10260	---	0.22-0.28	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1020	G10200	---	0.18-0.23	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1030	G10300	---	0.28-0.34	0.60-0.90	---	0.035	0.035	---	---	---	---
ASTM A519-06 (2012)*	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A519-06 (2012)*	Grade 1020	G10200	---	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
ASME SA-513*	Grade 1026	G10260	---	0.22-0.28	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1020	G10200	---	0.17-0.23	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1030	G10300	---	0.27-0.34	0.60-0.90	---	0.035	0.035	---	---	---	---

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page.

5.1 Carbon Steel Tubes for General and Structural Applications

5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10297-1:2003	E355	---	1.0580	0.22	1.60	0.55	0.030	0.035	---	---	---	---
EN 10296-1:2003	E355	---	1.0580	0.22	1.60	0.55	0.045	0.045	---	---	---	---
JIS G 3444:2010	Symbol STK490	---	---	0.18	1.65	0.55	0.035	0.035	---	---	---	---
JIS G 3445:2010	Symbol STKM18B	---	---	0.18	1.50	0.55	0.040	0.040	---	---	---	---
	Symbol STKM19A	---	---	0.25	1.50	0.55	0.040	0.040	---	---	---	---
ISO 2937:1974	TS 18	---	---	0.23	0.80-1.50	0.35	0.045	0.045	---	---	---	---
EN 10305-2:2010	E235	---	1.0308	0.17	1.20	0.35	0.025	0.025	---	---	---	Al 0.015 min.
EN 10305-3:2010	E420	---	1.0575	0.16	1.70	0.50	0.025	0.025	---	---	---	Al 0.020 min.
ASTM A512-06 (2012)*	Grade MT 1020	G10200	---	0.15-0.25	0.30-0.60	---	0.04	0.045	---	---	---	---
ASTM A513-15*	Grade 1021	G10210	---	0.18-0.23	0.60-0.90	---	0.035	0.035	---	---	---	---
ASME SA-513*	Grade 1021	G10210	---	0.17-0.23	0.60-0.90	---	0.035	0.035	---	---	---	---
ASTM A512-06 (2012)*	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.040	0.045	---	---	---	---
EN 10297-1:2003	C22E	---	1.1151	0.17-0.24	0.40-0.70	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
JIS G 3444:2010	Symbol STK500	---	---	0.24	0.30-1.30	0.35	0.040	0.040	---	---	---	---
JIS G 3472:2013	Symbol STAM500G	---	---	0.30	0.30-1.00	0.35	0.035	0.035	---	---	---	---
JIS G 3445:2010	Symbol STKM14B	---	---	0.30	0.30-1.00	0.35	0.040	0.040	---	---	---	---
JIS G 3472:2013	Symbol STAM500H	---	---	0.30	0.30-1.00	0.35	0.035	0.035	---	---	---	---
EN 10305-1:2010	C45E	---	1.1191	0.42-0.55	0.50-0.80	0.40	0.030	0.035	0.40	---	0.10	Cr+Mo+Ni 0.63
GB/T 17396-1998	Grade 35	---	---	0.32-0.40	0.50-0.80	0.17-0.37	0.035	0.035	0.25	0.25	---	Cu 0.20
JIS G 3445:2010	Symbol STKM16A	---	---	0.35-0.45	0.40-1.00	0.40	0.040	0.040	---	---	---	---
EN 10305-2:2010	E275	---	1.0225	0.21	1.40	0.35	0.025	0.025	---	---	---	Al 0.015 min.
JIS G 3445:2010	Symbol STKM13C	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
	Symbol STKM18C	---	---	0.18	1.50	0.55	0.040	0.040	---	---	---	---
JIS G 3473:2013	Symbol STC510A	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
	Symbol STC510B	---	---	0.18	1.50	0.55	0.040	0.040	---	---	---	---
ASTM A513-15*	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1026	G10260	---	0.22-0.28	0.60-0.90	---	0.035	0.035	---	---	---	---
ASTM A519-06 (2012)*	Grade 1045	G10450	---	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
ASME SA-513*	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.035	0.035	---	---	---	---
	Grade 1026	G10260	---	0.22-0.28	0.60-0.90	---	0.035	0.035	---	---	---	---
ASTM A519-06 (2012)*	Grade 1025	G10250	---	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
	Grade 1035	G10350	---	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
EN 10305-1:2010	E255	---	1.0408	0.21	0.40-1.10	0.35	0.025	0.025	---	---	---	---
	E410	---	1.0509	0.16-0.22	1.30-1.70	0.10-0.50	0.030	0.035	---	---	---	V 0.08-0.15; Al 0.010-0.060; Nb 0.07; Ti 0.05; (Nb+V) 0.20
ISO 3304:1985	R44	---	---	0.21	1.2	0.35	0.050	0.050	---	---	---	---
ISO 3305:1985	R44	---	---	0.21	1.2	0.35	0.050	0.050	---	---	---	---

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page.

5.1 Carbon Steel Tubes for General and Structural Applications

5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 3306:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
ASTM A519-06 (2012)*	Grade 1050	G10500	---	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
EN 10305-1:2010	C35E	---	1.1181	0.32-0.39	0.50-0.80	0.40	0.030	0.035	0.40	---	0.10	Cr+Mo+Ni 0.63
EN 10305-3:2010	E355	---	1.0580	0.22	1.60	0.55	0.025	0.025	---	---	---	Al 0.020 min.
ISO 2937:1974	C 35	---	---	0.32-0.39	0.50-0.80	0.15-0.40	0.035	0.035	---	---	---	---
JIS G 3444:2010	Symbol STK540	---	---	0.23	1.50	0.55	0.040	0.040	---	---	---	---
JIS G 3445:2010	Symbol STKM20A	---	---	0.25	1.60	0.55	0.040	0.040	---	---	---	Nb or V 0.15
JIS G 3473:2013	Symbol STC540	---	---	0.25	1.60	0.55	0.040	0.040	---	---	---	Nb or V 0.15
EN 10296-1:2003	E355	---	1.0580	0.22	1.60	0.55	0.045	0.045	---	---	---	---
JIS G 3472:2013	Symbol STAM540H	---	---	0.30	0.30-1.00	0.35	0.035	0.035	---	---	---	---
ISO 3304:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
ISO 3305:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
EN 10297-1:2003	C35E	---	1.1181	0.32-0.39	0.50-0.80	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
JIS G 3445:2010	Symbol STKM17A	---	---	0.45-0.55	0.40-1.00	0.40	0.040	0.040	---	---	---	---
EN 10305-1:2010	E410	---	1.0509	0.16-0.22	1.30-1.70	0.10-0.50	0.030	0.035	---	---	---	V 0.08-0.15; Al 0.010-0.060; Nb 0.07; Ti 0.05; (Nb+V) 0.20
JIS G 3445:2010	Symbol STKM14C	---	---	0.30	0.30-1.00	0.35	0.040	0.040	---	---	---	---
	Symbol STKM19C	---	---	0.25	1.50	0.55	0.040	0.040	---	---	---	---
ASTM A513-15*	Grade 1026	G10260	---	0.22-0.28	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1030	G10300	---	0.28-0.34	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1035	G10350	---	0.32-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
ASTM A519-06 (2012)*	Grade 1050	G10500	---	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A512-06 (2012)*	Grade 1030	G10300	---	0.28-0.34	0.60-0.90	---	0.040	0.045	---	---	---	---
ASTM A519-06 (2012)*	Grade 1045	G10450	---	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
ASME SA-513*	Grade 1026	G10260	---	0.22-0.28	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1030	G10300	---	0.27-0.34	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1035	G10350	---	0.31-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
EN 10305-2:2010	E275	---	1.0225	0.21	1.40	0.35	0.025	0.025	---	---	---	Al 0.015 min.
ASTM A519-06 (2012)*	Grade 1050	G10500	---	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
EN 10305-1:2010	E255	---	1.0408	0.21	0.40-1.10	0.35	0.025	0.025	---	---	---	---
	E355	---	1.0580	0.22	1.60	0.55	0.025	0.025	---	---	---	Al 0.020 min.
ASTM A513-15*	Grade 1030	G10300	---	0.28-0.34	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1035	G10350	---	0.32-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1040	G10400	---	0.37-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1524	G15240	---	0.19-0.25	1.35-1.65	---	0.040	0.050	---	---	---	---
JIS G 3445:2010	Symbol STKM15C	---	---	0.25-0.35	0.30-1.00	0.35	0.040	0.040	---	---	---	---

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page.

5.1 Carbon Steel Tubes for General and Structural Applications

5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
ASME SA-513*	Grade 1030	G10300	---	0.27-0.34	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1035	G10350	---	0.31-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1040	G10400	---	0.36-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1524	G15240	---	0.18-0.25	1.35-1.65	---	0.040	0.050	---	---	---	---
ASTM A519-06 (2012)*	Grade 1035	G10350	---	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
EN 10305-1:2010	C35E	---	1.1181	0.32-0.39	0.50-0.80	0.40	0.030	0.035	0.40	---	0.10	Cr+Mo+Ni 0.63
GB/T 17396-1998	Grade 45	---	---	0.42-0.50	0.50-0.80	0.17-0.37	0.035	0.035	0.25	0.25	---	Cu 0.20
EN 10305-2:2010	E355	---	1.0580	0.22	1.60	0.55	0.025	0.025	---	---	---	Al 0.020 min.
JIS G 3474:2014	Symbol STKT590	---	---	0.12	2.00	0.40	0.030	0.030	---	---	---	(Nb+V) 0.15; B 0.0002
JIS G 3473:2013	Symbol STC590A	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
	Symbol STC590B	---	---	0.25	1.50	0.55	0.040	0.040	---	---	---	---
EN 10297-1:2003	E420J2	---	1.0599	0.16-0.22	1.30-1.70	0.10-0.50	0.030	0.035	0.30	0.40	0.08	Al 0.010 min; Cu 0.30; N 0.020; Nb 0.07; Ti 0.05; V 0.08-0.15; (Nb+V) 0.20
ISO 3304:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
ISO 3305:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
EN 10305-1:2010	E410	---	1.0509	0.16-0.22	1.30-1.70	0.10-0.50	0.030	0.035	---	---	---	V 0.08-0.15; Al 0.010-0.060; Nb 0.07; Ti 0.05; (Nb+V) 0.20
EN 10297-1:2003	C45E	---	1.1191	0.42-0.50	0.50-0.80	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
JIS G 3445:2010	Symbol STKM16C	---	---	0.35-0.45	0.40-1.00	0.40	0.040	0.040	---	---	---	---
ASTM A513-15*	Grade 1035	G10350	---	0.32-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1040	G10400	---	0.37-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1524	G15240	---	0.19-0.25	1.35-1.65	---	0.040	0.050	---	---	---	---
ASTM A519-06 (2012)*	Grade 1045	G10450	---	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
ASME SA-513*	Grade 1035	G10350	---	0.31-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
	Grade 1040	G10400	---	0.36-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 1524	G15240	---	0.18-0.25	1.35-1.65	---	0.040	0.050	---	---	---	---
EN 10297-1:2003	C35E	---	1.1181	0.32-0.39	0.50-0.80	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10305-1:2010	E355	---	1.0580	0.22	1.60	0.55	0.025	0.025	---	---	---	Al 0.020 min.
EN 10305-2:2010	E355	---	1.0580	0.22	1.60	0.55	0.025	0.025	---	---	---	Al 0.020 min.
EN 10305-1:2010	26Mn5	---	1.1161	0.20-0.30	1.20-1.50	0.40	0.030	0.035	---	---	---	---
EN 10297-1:2003	E470	---	1.0536	0.16-0.22	1.30-1.70	0.10-0.50	0.030	0.035	---	---	---	Al 0.010 min; N 0.020; Nb 0.07; V 0.08-0.15
JIS G 3445:2010	Symbol STKM17C	---	---	0.45-0.55	0.40-1.00	0.40	0.040	0.040	---	---	---	---
EN 10305-1:2010	C45E	---	1.1191	0.42-0.55	0.50-0.80	0.40	0.030	0.035	0.40	---	0.10	Cr+Mo+Ni 0.63
EN 10297-1:2003	38Mn6	---	1.1127	0.34-0.42	1.40-1.65	0.15-0.35	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10305-1:2010	E410	---	1.0509	0.16-0.22	1.30-1.70	0.10-0.50	0.030	0.035	---	---	---	V 0.08-0.15; Al 0.010-0.060; Nb 0.07; Ti 0.05; (Nb+V) 0.20

*: See "List of Standards" at the beginning of the chapter.

5.1 Carbon Steel Tubes for General and Structural Applications

5.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10305-1:2010	26Mn5	---	1.1161	0.20-0.30	1.20-1.50	0.40	0.030	0.035	---	---	---	---
EN 10297-1:2003	C45E	---	1.1181	0.42-0.50	0.50-0.80	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
	E590K2	---	1.0644	0.16-0.22	1.30-1.70	0.10-0.50	0.030	0.035	0.30	0.40	0.08	Al 0.010 min; Cu 0.30; N 0.020; Nb 0.07; Ti 0.05; V 0.08-0.15; (Nb+V) 0.20
GB 18248-2000	Grade 37Mn	---	---	0.34-0.40	1.35-1.65	0.10-0.30	0.03	0.03	0.3	0.3	---	Cu 0.20; (P+S) 0.055

5.2 Alloy Steel Tubes for General and Structural Applications

5.2A Chemical Composition of Alloy Steel Tubes for General and Structural Applications

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A519-06 (2012)*	Grade 4028	G40280	---	0.25-0.30	0.70-0.90	0.15-0.35	0.040	0.035-0.050	0.20	0.25	0.20-0.30	Cu 0.35
EN 10305-1:2010	26Mo2	---	1.5417	0.22-0.29	1.50	0.40	0.025	0.035	---	0.40	0.15-0.25	---
ASME SA-513*	Grade 4130	G41300	---	0.28-0.33	0.40-0.60	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A513-15*	Grade 4130	G41300	---	0.28-0.33	0.40-0.60	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A519-06 (2012)*	Grade 4130	G41300	---	0.28-0.33	0.40-0.60	0.15-0.35	0.040	0.040	0.80-1.10	---	0.15-0.25	---
EN 10297-1:2003	25CrMo4	---	1.7218	0.22-0.29	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
	30CrMo4	---	1.7216	0.27-0.34	0.35-0.60	0.35	0.035	0.035	0.80-1.15	---	0.15-0.30	---
EN 10305-1:2010	25CrMo4	---	1.7218	0.22-0.29	0.60-0.90	0.40	0.025	0.035	0.90-1.20	---	0.15-0.30	---
JIS G 3441:2012	Symbol SCM418TK	---	---	0.16-0.21	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.30	Cu 0.30
	Symbol SCM420TK	---	---	0.18-0.23	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.30	Cu 0.30
	Symbol SCM430TK	---	---	0.28-0.33	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.30	Cu 0.30
ASTM A519-06 (2012)*	Grade 4135	G41350	---	0.32-0.39	0.65-0.95	0.15-0.35	0.040	0.040	0.80-1.10	---	0.15-0.25	---
	Grade 4137	G41370	---	0.35-0.40	0.70-0.90	0.15-0.35	0.040	0.040	0.80-1.10	---	0.15-0.25	---
EN 10297-1:2003	34CrMo4	---	1.7220	0.30-0.37	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
JIS G 3441:2012	Symbol SCM435TK	---	---	0.33-0.38	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.30	Cu 0.30
ASME SA-513*	Grade 4140	G41400	---	0.38-0.43	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A513-15*	Grade 4140	G41400	---	0.38-0.43	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A519-06 (2012)*	Grade 4140	G41400	---	0.38-0.43	0.75-1.00	0.15-0.35	0.040	0.040	0.80-1.10	---	0.15-0.25	---
	Grade 4142	G41420	---	0.40-0.45	0.75-1.00	0.15-0.35	0.040	0.040	0.80-1.10	---	0.15-0.25	---
EN 10297-1:2003	42CrMo4	---	1.7225	0.38-0.45	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
EN 10305-1:2010	42CrMo4	---	1.7225	0.38-0.45	0.60-0.90	0.40	0.025	0.035	0.90-1.20	---	0.15-0.30	---
JIS G 3441:2012	Symbol SCM440TK	---	---	0.38-0.43	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.30	Cu 0.30

*: See "List of Standards" at the beginning of the chapter.

5.2 Alloy Steel Tubes for General and Structural Applications

5.2B Mechanical Properties of Alloy Steel Tubes for General and Structural Applications

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A519-06 (2012)*	Grade 4028	G40280	---	---	---	---	---	---	---	---	A, N, SR, QT, or none	---
EN 10305-1:2010	26Mo2	---	1.5417	---	---	---	---	720	---	4	C	---
						---	---	670	---	6	LC	---
						---	---	---	---	---	SR, or A, or N	---
ASME SA-513*	Grade 4130	G41300	---	---	---	345	50	483	70	20	N	100 max HRB
				---	---	379	55	496	72	10	AW	80 min HRB
				---	---	552	80	621	90	10	MD SR	87 min HRB
				---	---	586	85	655	95	5	MD	90 min HRB
ASTM A513-15*	Grade 4130	G41300	---	---	---	345	50	480	70	20	N	100 max HRB
				---	---	380	55	495	72	10	AW	80 min HRB
				---	---	550	80	620	90	10	MD SR	87 min HRB
				---	---	585	85	655	95	5	MD	90 min HRB
ASTM A519-06 (2012)*	Grade 4130	G41300	---	---	---	379	55	517	75	30	A	81 HRB
				---	---	414	60	621	90	20	N	89 HRB
				---	---	483	70	621	90	20	HR	89 HRB
				---	---	586	85	724	105	10	SR	95 HRB
EN 10297-1:2003	25CrMo4	---	1.7218	---	---	---	---	---	---	---	A	212 HB
				t ≤ 8	---	700	---	900	---	12 L; 10 T	QT	L: 45 J @ 20°C
				8 < t ≤ 20	---	600	---	800	---	14 L; 12 T		L: 50 J @ 20°C T: 32 J @ 20°C
				20 < t ≤ 50	---	450	---	700	---	15 L; 13 T		see standard for impact data
				50 < t ≤ 80	---	400	---	650	---	16 L; 14 T		see standard for impact data
	30CrMo4	---	1.7216	t ≤ 8	---	750	---	950	---	9 L; 7 T	QT	L: 40 J @ 20°C
				8 < t ≤ 20	---	630	---	850	---	9 L; 7 T		L: 45 J @ 20°C T: 27 J @ 20°C
				20 < t ≤ 50	---	520	---	750	---	10 L; 8 T		see standard for impact data
				50 < t ≤ 80	---	480	---	700	---	11 L; 9 T		see standard for impact data
				---	---	---	---	---	---	---		A
EN 10305-1:2010	25CrMo4	---	1.7218	---	---	---	---	720	---	4	C	---
						---	---	670	---	6	LC	---
						---	---	---	---	---	SR, or A, or N	---
JIS G 3441:2012	Symbol SCM418TK	---	---	---	---	---	---	---	---	---	AM, CF or A	---
	Symbol SCM420TK	---	---	---	---	---	---	---	---	---	AM, CF or A	---
	Symbol SCM430TK	---	---	---	---	---	---	---	---	---	AM, CF or A	---

*: See "List of Standards" at the beginning of the chapter.

5.2 Alloy Steel Tubes for General and Structural Applications

5.2B Mechanical Properties of Alloy Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A519-06 (2012)*	Grade 4135	G41350	---	---	---	---	---	---	---	---	AM	---
	Grade 4137	G41370	---	---	---	---	---	---	---	---	AM	---
EN 10297-1:2003	34CrMo4	---	1.7220	t ≤ 8	---	800	---	1000	---	11 L; 9 T	QT	see standard for impact data
				8 < t ≤ 20	---	650	---	900	---	12 L; 10 T		
				20 < t ≤ 50	---	550	---	800	---	14 L; 12 T		
				50 < t ≤ 80	---	500	---	750	---	15 L; 13 T		
				---	---	---	---	---	---	---	A	223 HB
JIS G 3441:2012	Symbol SCM435TK	---	---	---	---	---	---	---	---	---	AM, CF or A	---
ASME SA-513*	Grade 4140	G41400	---	---	---	448	65	621	90	20	N	105 max HRB
				---	---	485	70	621	90	10	AW	85 min HRB
				---	---	655	95	724	105	10	MD SR	90 min HRB
				---	---	690	100	758	110	5	MD	90 min HRB
ASTM A513-15*	Grade 4140	G41400	---	---	---	450	65	620	90	20	N	105 max HRB
				---	---	485	70	620	90	10	AW	85 min HRB
				---	---	655	95	725	105	10	MD SR	90 min HRB
				---	---	690	100	760	110	5	MD	90 min HRB
ASTM A519-06 (2012)*	Grade 4140	G41400	---	---	---	414	60	552	80	25	A	85 HRB
				---	---	621	90	855	120	15	HR	100 HRB
				---	---	621	90	855	120	20	N	100 HRB
				---	---	689	100	855	120	10	SR	100 HRB
	Grade 4142	G41420	---	---	---	---	---	---	---	---	A, N, SR, QT, or none	---
EN 10297-1:2003	42CrMo4	---	1.7225	t ≤ 8	---	900	---	1100	---	10 L; 8 T	QT	see standard for impact data
				8 < t ≤ 20	---	750	---	1000	---	11 L; 9 T		
				20 < t ≤ 50	---	650	---	900	---	12 L; 10 T		
				50 < t ≤ 80	---	550	---	800	---	13 L; 11 T		
				---	---	---	---	---	---	---	A	241 HB
EN 10305-1:2010	42CrMo4	---	1.7225	---	---	---	---	720	---	4	C	---
				---	---	---	---	670	---	6	LC	---
				---	---	---	---	---	---	---	SR, or A, or N	---
JIS G 3441:2012	Symbol SCM440TK	---	---	---	---	---	---	---	---	---	AM, CF or A	---

*: See "List of Standards" at the beginning of the chapter.

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.1A Chemical Composition of Ferritic and Martensitic Stainless Steel Tubes for General and Structural Applications

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-268/SA-268M	Grade TP405	S40500	---	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.50	---	Al 0.10-0.30
ASTM A268/A268M-10	Grade TP405	S40500	---	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.50	---	Al 0.10-0.30
ASTM A511/A511M-15a	Grade MT 405	S40500	---	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.50	---	Al 0.10-0.30
EN 10297-2:2005 C1:2007	Grade X6CrAl13	---	1.4002	0.08	1.00	1.00	0.040	0.015	12.0-14.0	---	---	Al 0.10-0.30
ASME SA-268/SA-268M	Grade TP409	S40900	---	0.08	1.00	1.00	0.045	0.030	10.5-11.7	0.50	---	Ti 6xC to 0.75
ASTM A268/A268M-10	Grade TP409	S40900	---	0.08	1.00	1.00	0.045	0.030	10.5-11.7	0.50	---	Ti 6xC to 0.75
EN 10296-2:2005 C2:2007	Grade X2CrTi12	---	1.4512	0.030	1.00	1.00	0.040	0.015	10.5-12.5	---	---	Ti 6x(C+N) to 0.65; N 0.030
EN 10297-2:2005 C1:2007	Grade X2CrTi12	---	1.4512	0.030	1.00	1.00	0.040	0.015	10.5-12.5	---	---	Ti 6x(C+N) to 0.65
GB/T 12770-2002	Grade 00Cr12Ti	---	---	0.025	0.80	0.80	0.035	0.02	10.5-12.5	---	---	Ti 6xC to 0.75
ASME SA-268/SA-268M	Grade TP410	S41000	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	---	---	---
ASTM A268/A268M-10	Grade TP410	S41000	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	---	---	---
ASTM A511/A511M-15a	Grade MT 410	S41000	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.50	---	---
EN 10297-2:2005 C1:2007	Grade X12Cr13	---	1.4006	0.08-0.15	1.50	1.00	0.040	0.015	11.5-13.5	0.75	---	---
GB/T 12770-2002	Grade 0Cr13	---	---	0.08	1.00	1.00	0.035	0.03	11.50-13.50	0.6	---	---
	Grade 1Cr13	---	---	0.15	1.00	1.00	0.035	0.03	11.50-13.50	0.6	---	---
GB/T 14975-2002	Grade 0Cr13	---	---	0.08	1.00	1.00	0.035	0.03	11.50-13.50	0.6	---	---
	Grade 1Cr13	---	---	0.15	1.00	1.00	0.035	0.03	11.50-13.50	0.6	---	---
JIS G 3446:2012	Symbol SUS410TKA	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.60	---	---
	Symbol SUS410TKC	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.60	---	---
GB/T 14975-2002	Grade 2Cr13	---	---	0.16-0.25	1.00	1.00	0.035	0.03	12.00-14.00	0.6	---	---
JIS G 3446:2012	Symbol SUS420J1TKA	---	---	0.16-0.25	1.00	1.00	0.040	0.030	12.00-14.00	0.60	---	---
AFNOR NF A 49-647:1979	TS Z 8 C 17	---	---	0.10	1.0	1.00	0.040	0.030	16-18	0.50	---	---
ASME SA-268/SA-268M	Grade TP430	S43000	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	---	---
ASTM A268/A268M-10	Grade TP430	S43000	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	---	---
ASTM A554-15	Grade MT-430	---	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	0.50	---	---
ASTM A511/A511M-15a	Grade MT 430	---	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	0.50	---	---
EN 10296-2:2005 C2:2007	Grade X6Cr17	---	1.4016	0.08	1.00	1.00	0.040	0.015	16.0-18.0	---	---	---
EN 10297-2:2005 C1:2007	Grade X6Cr17	---	1.4016	0.08	1.00	1.00	0.040	0.015	16.0-18.0	---	---	---
GB/T 12770-2002	Grade 1Cr17	---	---	0.12	1.00	0.75	0.035	0.03	16.00-18.00	0.6	---	---
GB/T 14975-2002	Grade 1Cr17	---	---	0.12	1.00	0.75	0.035	0.03	16.00-18.00	0.6	---	---
JIS G 3446:2012	Symbol SUS430TKA	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	0.60	---	---
	Symbol SUS430TKC	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	0.60	---	---
ASME SA-268/SA-268M	Grade TP439	S43035	---	0.07	1.00	1.00	0.040	0.030	17.00-19.00	0.50	---	Al 0.15; N 0.04; Ti 0.20+4x(C+N) to 1.10
ASTM A268/A268M-10	Grade TP439	S43035	---	0.07	1.00	1.00	0.040	0.030	17.00-19.00	0.50	---	Al 0.15; N 0.04; Ti 0.20+4x(C+N) to 1.10
EN 10296-2:2005 C2:2007	Grade X3CrTi17	---	1.4510	0.05	1.00	1.00	0.040	0.015	16.0-18.0	---	---	Ti 4x(C+N)+0.15 to 0.80
EN 10297-2:2005 C1:2007	Grade X3CrTi17	---	1.4510	0.05	1.00	1.00	0.040	0.015	16.0-18.0	---	---	Ti 4x(C+N)+0.15 to 0.80

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.1B Mechanical Properties of Ferritic and Martensitic Stainless Steel Tubes for General and Structural Applications

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-268/SA-268M	Grade TP405	S40500	---	$t \geq 0.4$	$t \geq 0.015$	205	30	415	60	20	HT	207 max HB; 95 max HRB
ASTM A268/A268M-10	Grade TP405	S40500	---	$t \geq 0.4$	$t \geq 0.015$	205	30	415	60	20	HT	207 HB; 95 max HRB
ASTM A511/A511M-15a*	Grade MT 405	S40500	---	---	---	210	30	415	60	20	A	207 max HBW; 95 max HRB
EN 10297-2:2005 C1:2007	Grade X6CrAl13	---	1.4002	---	---	210	---	400	---	17 L, 17 T	A	---
ASME SA-268/SA-268M	Grade TP409	S40900	---	$t \geq 0.4$	$t \geq 0.015$	170	25	380	55	20	HT	207 max HB; 95 max HRB
ASTM A268/A268M-10	Grade TP409	S40900	---	$t \geq 0.4$	$t \geq 0.015$	170	25	380	55	20	HT	207 max HB; 95 max HRB
EN 10296-2:2005 C2:2007	Grade X2CrTi12	---	1.4512	$t \leq 30$	---	210	---	380	---	25 L, 23 T	AW or A	---
EN 10297-2:2005 C1:2007	Grade X2CrTi12	---	1.4512	---	---	210	---	380	---	25 L, 25 T	A	---
GB/T 12770-2002	Grade 00Cr12Ti	---	---	---	---	---	---	365-460	---	---	A	---
				---	---	---	---	365-460	---	35	W	---

*: See "List of Standards" at the beginning of the chapter.

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.1B Mechanical Properties of Ferritic and Martensitic Stainless Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-268/SA-268M	Grade TP410	S41000	---	$t \geq 0.4$	$t \geq 0.015$	205	30	415	60	20	HT	207 max HB; 95 max HRB
ASTM A268/A268M-10	Grade TP410	S41000	---	$t \geq 0.4$	$t \geq 0.015$	205	30	415	60	20	HT	207 max HB; 95 max HRB
ASTM A511/A511M-15a*	Grade MT 410	S41000	---	---	---	210	30	415	60	20	A	207 max HBW; 95 max HRB
EN 10297-2:2005 C1:2007	Grade X12Cr13	---	1.4006	---	---	400	---	550	---	15 L, 15 T	Q+T (QT 550)	---
				---	---	450	---	650	---	12 L, 12 T	Q+T (QT 650)	---
GB/T 12770-2002	Grade 0Cr13	---	---	---	---	---	---	410	---	---	A	---
				---	---	---	---	410	---	20	W	---
	Grade 1Cr13	---	---	---	---	---	---	410	---	---	A	---
				---	---	---	---	410	---	20	W	---
GB/T 14975-2002	Grade 0Cr13	---	---	---	---	180	---	370 T	---	22 T	BA	---
	Grade 1Cr13	---	---	---	---	205	---	410 T	---	20 T	BA	---
JIS G 3446:2012	Symbol SUS410TKA	---	---	$1 < t \leq 2$	---	205	---	410	---	11	A	---
				$2 < t \leq 3$	---	205	---	410	---	12	A	---
				$3 < t \leq 4$	---	205	---	410	---	14	A	---
				$4 < t \leq 5$	---	205	---	410	---	16	A	---
				$5 < t \leq 6$	---	205	---	410	---	17	A	---
				$6 < t \leq 7$	---	205	---	410	---	18	A	---
				$7 < t < 8$	---	205	---	410	---	20	A	---
				$t \geq 8$	---	205	---	410	---	20	A	---
	Symbol SUS410TKC	---	---	$1 < t \leq 2$	---	205	---	410	---	11	AM	---
				$2 < t \leq 3$	---	205	---	410	---	12	AM	---
				$3 < t \leq 4$	---	205	---	410	---	14	AM	---
				$4 < t \leq 5$	---	205	---	410	---	16	AM	---
				$5 < t \leq 6$	---	205	---	410	---	17	AM	---
				$6 < t \leq 7$	---	205	---	410	---	18	AM	---
				$7 < t < 8$	---	205	---	410	---	20	AM	---
				$t \geq 8$	---	205	---	410	---	20	AM	---

*: See "List of Standards" at the beginning of the chapter.

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.1B Mechanical Properties of Ferritic and Martensitic Stainless Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB/T 14975-2002	Grade 2Cr13	---	---	---	---	215	---	470 T	---	19 T	BA	---
JIS G 3446:2012	Symbol SUS420J1TKA	---	---	1 < t ≤ 2	---	215	---	470	---	10	A	---
				2 < t ≤ 3	---	215	---	470	---	12	A	---
				3 < t ≤ 4	---	215	---	470	---	13	A	---
				4 < t ≤ 5	---	215	---	470	---	14	A	---
				5 < t ≤ 6	---	215	---	470	---	16	A	---
				6 < t ≤ 7	---	215	---	470	---	18	A	---
				7 < t < 8	---	215	---	470	---	19	A	---
				t ≥ 8	---	215	---	470	---	19	A	---
AFNOR NF A 49-647:1979	TS Z 8 C 17	---	---	---	---	300	---	450	---	16	AM	---
ASME SA-268/SA-268M	Grade TP430	S43000	---	t ≥ 0.4	t ≥ 0.015	240	35	415	60	20	HT	190 max HB; 90 max HRB
ASTM A268/A268M-10	Grade TP430	S43000	---	t ≥ 0.4	t ≥ 0.015	240	35	415	60	20	HT	190 max HB; 90 max HRB
ASTM A554-15*	Grade MT 430	S43000	---	---	---	241	35	414	60	20	A	190 max HB; 90 max HRB
ASTM A511/A511M-15a*	Grade MT 430	S43000	---	---	---	240	35	415	60	20	A	190 max HBW; 90 max HRB
EN 10296-2:2005 C2:2007	Grade X6Cr17	---	1.4016	t ≤ 30	---	240	---	430	---	20 L, 18 T	AW or A	---
EN 10297-2:2005 C1:2007	Grade X6Cr17	---	1.4016	---	---	240	---	430	---	20 L, 20 T	A	---
GB/T 12770-2002	Grade 1Cr17	---	---	---	---	---	---	410	---	---	A	---
				---	---	---	---	410	---	20	W	---
GB/T 14975-2002	Grade 1Cr17	---	---	---	---	245	---	410 T	---	20 T	BA	---

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page.

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.1B Mechanical Properties of Ferritic and Martensitic Stainless Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 3446:2012	Symbol SUS430TKA	---	---	$1 < t \leq 2$	---	245	---	410	---	11	A	---
				$2 < t \leq 3$	---	245	---	410	---	12	A	---
				$3 < t \leq 4$	---	245	---	410	---	14	A	---
				$4 < t \leq 5$	---	245	---	410	---	16	A	---
				$5 < t \leq 6$	---	245	---	410	---	17	A	---
				$6 < t \leq 7$	---	245	---	410	---	18	A	---
				$7 < t < 8$	---	245	---	410	---	20	A	---
				$t \geq 8$	---	245	---	410	---	20	A	---
	Symbol SUS430TKC	---	---	$1 < t \leq 2$	---	245	---	410	---	11	AM	---
				$2 < t \leq 3$	---	245	---	410	---	12	AM	---
				$3 < t \leq 4$	---	245	---	410	---	14	AM	---
				$4 < t \leq 5$	---	245	---	410	---	16	AM	---
				$5 < t \leq 6$	---	245	---	410	---	17	AM	---
				$6 < t \leq 7$	---	245	---	410	---	18	AM	---
				$7 < t < 8$	---	245	---	410	---	20	AM	---
				$t \geq 8$	---	245	---	410	---	20	AM	---
ASME SA-268/SA-268M	Grade TP439	S43035	---	$t \geq 0.4$	$t \geq 0.015$	205	30	415	60	20	HT	190 max HB; 90 max HRB
ASTM A268/A268M-10	Grade TP439	S43035	---	$t \geq 0.4$	$t \geq 0.015$	205	30	415	60	20	HT	190 max HB; 90 max HRB
EN 10296-2:2005 C2:2007	Grade X3CrTi17	---	1.4510	$t \leq 30$	---	230	---	420	---	23 L, 21 T	AW or A	---
EN 10297-2:2005 C1:2007	Grade X3CrTi17	---	1.4510	---	---	230	---	420	---	23 L, 23 T	A	---

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.2A Chemical Composition of Austenitic Stainless Steel Tubes for General and Structural Applications

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 49-647:1979	TS Z 6 CN 18-09	---	---	0.07	2.0	1.0	0.040	0.030	18-20	8-12	---	---
ASME SA-249/SA-249M	Grade TP304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASME SA-409/SA-409M	Grade TP304	S30400	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.00-11.0	---	---
ASME SA-688/SA-688M	Grade TP 304	S30400	---	0.08	2.00	0.75	0.040	0.030	18.00-20.00	8.00-11.00	---	---
ASTM A269/A269M-14e1	Grade TP304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A511/A511M-15a	Grade MT 304	S30400	---	0.08	2.00	1.00	0.040	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A554-15	Grade MT-304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A632-04 (2014)	Grade TP 304	S30400	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A908-03 (2013)	Type 304	S30400	---	0.08	2.00	0.75	0.040	0.030	18.0-20.0	8.0-11.0	---	---
JIS G 3446:2012	Symbol SUS304TKA	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
	Symbol SUS304TKC	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
AFNOR NF A 49-647:1979	TS Z 2 CN 18-10	---	---	0.030	2.0	1.0	0.040	0.030	18-20	8-12	---	---
ASTM A269/A269M-14e1	Grade TP304L	S30403	---	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
ASTM A511/A511M-15a	Grade MT 304L	S30403	---	0.035	2.00	1.00	0.040	0.030	18.0-20.0	8.0-13.0	---	---
ASTM A554-15	Grade MT-304L	S30403	---	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.0-13.0	---	---
ASTM A632-04 (2014)	Grade TP 304L	S30403	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-13.0	---	---
ASTM A778-01 (2009)e1	Grade TP 304L	S30403	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-13.0	---	N 0.10
EN 10296-2:2005 C2:2007	Grade X2CrNi19-11	---	1.4306	0.030	2.00	1.00	0.045	0.015	18.0-20.0	10.0-12.0	---	N 0.11
EN 10297-2:2005 C1:2007	Grade X2CrNi19-11	---	1.4306	0.030	2.00	1.00	0.045	0.015	18.0-20.0	10.0-12.0	---	N 0.11
GB/T 12770-2002	Grade 00Cr19Ni10	---	---	0.03	2.00	1.00	0.035	0.03	18.00-20.00	8.00-12.00	---	---
GB/T 14975-2002	Grade 00Cr19Ni10	---	---	0.030	2.00	1.00	0.035	0.03	18.00-20.00	8.00-12.00	---	---
AFNOR NF A 49-647:1979	TS Z 6 CND 17-11	---	---	0.08	2.0	1.0	0.040	0.030	16-18	10-12.5	2-2.5	---
ASTM A269/A269M-14e1	Grade TP316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A511/A511M-15a	Grade MT 316	S31600	---	0.08	2.00	1.00	0.040	0.030	16.0-18.0	11.0-14.0	2.0-3.0	---
ASTM A554-15	Grade MT-316	---	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.0-3.0	---
ASTM A632-04 (2014)	Grade TP 316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
JIS G 3446:2012	Symbol SUS316TKA	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
	Symbol SUS316TKC	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
ASTM A269/A269M-14e1	Grade TP316L	S31603	---	0.035	2.00	1.00	0.045	0.030	16.0-18.0	10.0-15.0	2.00-3.00	---
ASTM A511/A511M-15a	Grade MT 316L	---	---	0.035	2.00	1.00	0.040	0.030	16.0-18.0	10.0-15.0	2.0-3.0	---
ASTM A554-15	Grade MT-316L	S31603	---	0.035	2.00	1.00	0.045	0.030	16.0-18.0	10.0-15.0	2.0-3.0	---
ASTM A632-04 (2014)	Grade TP 316L	S31603	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-15.0	2.00-3.00	---
ASTM A778-01 (2009)e1	Grade TP 316L	S31603	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10

Note: This section continued on next page.

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.2A Chemical Composition of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10296-2:2005 C2:2007	Grade X2CrNiMo17-12-2	---	1.4404	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-2.50	N 0.11
	Grade X2CrNiMo17-12-3	---	1.4432	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.0	2.50-3.00	N 0.11
	Grade X2CrNiMo18-14-3	---	1.4435	0.030	2.00	1.00	0.045	0.015	17.0-19.0	12.5-15.0	2.50-3.00	N 0.11
EN 10297-2:2005 C1:2007	Grade X2CrNiMo17-12-2	---	1.4404	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.0-14.5	2.00-2.50	N 0.11
	Grade X2CrNiMo18-14-3	---	1.4435	0.030	2.00	1.00	0.045	0.015	17.0-19.0	12.5-15.0	2.50-3.00	N 0.11
GB/T 12770-2002	Grade 00Cr17Ni14Mo2	---	---	0.030	2.00	1.00	0.035	0.03	16.00-18.00	12.00-15.00	2.00-3.00	---
GB/T 14975-2002	Grade 00Cr17Ni14Mo2	---	---	0.030	2.00	1.00	0.035	0.03	16.00-18.00	12.00-15.00	2.00-3.00	---
EN 10296-2:2005 C2:2007	Grade X3CrNiMo17-13-3	---	1.4436	0.05	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.0	2.50-3.00	N 0.11
	Grade X5CrNiMo17-12-2	---	1.4401	0.07	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-2.50	N 0.11
EN 10297-2:2005 C1:2007	Grade X3CrNiMo17-13-3	---	1.4436	0.05	2.00	1.00	0.045	0.015	16.5-18.5	10.5-14.0	2.50-3.00	N 0.11
	Grade X5CrNiMo17-12-2	---	1.4401	0.07	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-2.50	N 0.11
GB/T 12770-2002	Grade 0Cr17Ni12Mo2	---	---	0.08	2.00	1.00	0.035	0.03	16.00-18.00	10.00-14.00	2.00-3.00	---
GB/T 14975-2002	Grade 0Cr17Ni12Mo2	---	---	0.08	2.00	1.00	0.035	0.03	16.00-18.50	10.00-14.00	2.00-3.00	---
ASTM A269/A269M-14e1	Grade TP 304LN	S30453	---	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
EN 10296-2:2005 C2:2007	Grade X2CrNi18-10	---	1.4311	0.030	2.00	1.00	0.045	0.015	17.0-19.5	8.5-11.5	---	N 0.12-0.22
EN 10297-2:2005 C1:2007	Grade X2CrNi18-10	---	1.4311	0.030	2.00	1.00	0.045	0.015	17.0-19.5	8.5-11.5	---	N 0.12-0.22
GB/T 14975-2002	Grade 00Cr18Ni10N	---	---	0.030	2.00	1.00	0.035	0.03	17.00-19.00	8.50-11.50	---	N 0.12-0.22
ASTM A269/A269M-14e1	Grade TP316LN	S31653	---	0.035	2.00	1.00	0.045	0.030	16.0-18.0	10.0-13.0	2.00-3.00	N 0.10-0.16
EN 10296-2:2005 C2:2007	Grade X2CrNiMoN17-13-3	---	1.4429	0.030	2.00	1.00	0.045	0.015	16.5-18.5	11.0-14.0	2.50-3.00	N 0.12-0.22
EN 10297-2:2005 C1:2007	Grade X2CrNiMoN17-13-3	---	1.4429	0.030	2.00	1.00	0.045	0.015	16.5-18.5	11.0-15.0	2.50-3.00	N 0.12-0.22
GB/T 14975-2002	Grade 00Cr17Ni13Mo2N	---	---	0.030	2.00	1.00	0.035	0.03	16.00-18.50	10.50-14.50	2.0-3.0	N 0.12-0.22
EN 10296-2:2005 C2:2007	Grade X5CrNi18-10	---	1.4301	0.07	2.00	1.00	0.045	0.015	17.0-19.5	8.0-10.5	---	N 0.11
EN 10297-2:2005 C1:2007	Grade X5CrNi18-10	---	1.4301	0.07	2.00	1.00	0.045	0.015	17.0-19.5	8.0-10.5	---	N 0.11
GB/T 12770-2002	Grade 0Cr18Ni9	---	---	0.07	2.00	1.00	0.035	0.03	17.00-19.00	8.00-11.00	---	---
GB/T 14975-2002	Grade 0Cr18Ni9	---	---	0.07	2.00	1.00	0.035	0.03	17.00-19.00	8.00-11.00	---	---
ASTM A511/A511M-15a	Grade MT 302	S30200	---	0.08-0.20	2.00	1.00	0.040	0.030	17.0-19.0	8.0-10.0	---	---
ASTM A554-15	Grade MT-302	S30200	---	0.15	2.00	1.00	0.045	0.030	17.0-19.0	8.0-10.0	---	---
GB/T 12770-2002	Grade 1Cr18Ni9	---	---	0.15	2.00	1.00	0.035	0.03	17.00-19.00	8.00-10.00	---	---
GB/T 14975-2002	Grade 1Cr18Ni9	---	---	0.15	2.00	1.00	0.035	0.03	17.00-19.00	8.00-10.00	---	---
ASTM A511/A511M-15a	Grade MT 317	S31700	---	0.08	2.00	1.00	0.040	0.030	18.0-20.0	11.0-14.0	3.0-4.0	---
ASTM A554-15	Grade MT-317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-14.0	3.0-4.0	---
ASTM A632-04 (2014)	Grade TP 317	S31700	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	11.0-14.0	3.00-4.00	---
GB/T 14975-2002	Grade 0Cr19Ni13Mo3	---	---	0.08	2.00	1.00	0.035	0.03	18.00-20.00	11.00-15.00	3.00-4.00	---
ASME SA-213/SA-213M	Grade TP321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5x(C+N) to 0.70
ASME SA-249/SA-249M	Grade TP321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	N 0.10; Ti 5x(C+N) to 0.70

Note: This section continued on next page.

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.2A Chemical Composition of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A249/A249M-14a	Grade TP321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	N 0.10; Ti 5x(C+N) to 0.70
ASTM A269/A269M-14e1	Grade TP321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5x(C+N) to 0.70
ASTM A511/A511M-15a	Grade MT 321	S32100	---	0.08	2.00	1.00	0.040	0.030	17.0-20.0	9.0-13.0	---	Ti 5xC to 0.60
ASTM A554-15	Grade MT-321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Ti 5xC to 0.60
ASTM A632-04 (2014)	Grade TP 321	S32100	---	0.08	2.00	0.75	0.045	0.030	17.0-20.0	9.0-13.0	---	Ti 5xC to 0.60
ASTM A778-01 (2009)e1	Grade TP 321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70
EN 10296-2:2005 C2:2007	Grade X6CrNiTi18-10	---	1.4541	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70
EN 10297-2:2005 C1:2007	Grade X6CrNiTi18-10	---	1.4541	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70
GB/T 12770-2002	Grade 0Cr18Ni10Ti	---	---	0.08	2.00	1.00	0.035	0.03	17.00-19.00	9.00-12.00	---	Ti 5xC min.
GB/T 14975-2002	Grade 0Cr18Ni10Ti	---	---	0.08	2.00	1.00	0.035	0.03	17.00-19.00	9.00-12.00	---	Ti 5xC min.
JIS G 3446:2012	Symbol SUS321TKA	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5xC min
EN 10296-2:2005 C2:2007	Grade X6CrNiMoTi17-12-2	---	1.4571	0.08	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.5	2.00-2.50	Ti 5xC to 0.70
EN 10297-2:2005 C1:2007	Grade X6CrNiMoTi17-12-2	---	1.4571	0.08	2.00	1.00	0.045	0.015	16.5-18.5	10.5-14.0	2.00-2.50	Ti 5xC to 0.70
GB/T 14975-2002	Grade 0Cr18Ni12Mo2Ti	---	---	0.08	2.00	1.00	0.035	0.03	16.00-19.00	11.00-14.00	1.80-2.50	Ti 5xC to 0.70
ASTM A269/A269M-14e1	Grade TP347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 10xC to 1.10
ASTM A511/A511M-15a	Grade MT 347	S34700	---	0.08	2.00	1.00	0.040	0.030	17.0-20.0	9.0-13.0	---	Cb 10xC to 1.00
ASTM A554-15	Grade MT-347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Cb 10xC to 1.00
ASTM A632-04 (2014)	Grade TP 347	S34700	---	0.08	2.00	0.75	0.045	0.030	17.0-20.0	9.0-13.0	---	(Cb+Ta) 10xC to 1.0
ASTM A778-01 (2009)e1	Grade TP 347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	(Cb+Ta) 10xC to 1.10
EN 10296-2:2005 C2:2007	Grade X6CrNiNb18-10	---	1.4550	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Nb 10xC to 1.00
EN 10297-2:2005 C1:2007	Grade X6CrNiNb18-10	---	1.4550	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Nb 10xC to 1.00
GB/T 12770-2002	Grade 0Cr18Ni11Nb	---	---	0.08	2.00	1.00	0.035	0.03	17.00-19.00	9.00-13.00	---	Nb 10xC min.
GB/T 14975-2002	Grade 0Cr18Ni11Nb	---	---	0.08	2.00	1.00	0.035	0.03	17.00-19.00	9.00-13.00	---	Nb 10xC min.
JIS G 3446:2012	Symbol SUS347TKA	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min
ASME SA-249/SA-249M	---	S30415	---	0.04-0.06	0.80	1.00-2.00	0.045	0.030	18.0-19.0	9.0-10.0	---	N 0.12-0.18; Ce 0.03-0.08
ASME SA-312/SA-312M	---	S30415	---	0.04-0.06	0.80	1.00-2.00	0.045	0.030	18.0-19.0	9.0-10.0	---	N 0.12-0.18; Ce 0.03-0.08
ASME SA-358/SA-358M*	---	S30415	---	0.04-0.06	0.80	1.00-2.00	0.045	0.030	18.0-19.0	9.0-10.0	---	N 0.12-0.18; Ce 0.03-0.08
ASTM A249/A249M-14a	---	S30415	---	0.04-0.06	0.80	1.00-2.00	0.045	0.030	18.0-19.0	9.0-10.0	---	N 0.12-0.18; Ce 0.03-0.08
ASTM A312/A312M-15	---	S30415	---	0.04-0.06	0.80	1.00-2.00	0.045	0.030	18.0-19.0	9.0-10.0	---	N 0.12-0.18; Ce 0.03-0.08
ASTM A358/A358M-14a*	---	S30415	---	0.04-0.06	0.80	1.00-2.00	0.045	0.030	18.0-19.0	9.0-10.0	---	N 0.12-0.18; Ce 0.03-0.08
EN 10296-2:2005 C2:2007	Grade X6CrNiSiNc19-10	---	1.4818	0.04-0.08	1.00	1.00-2.00	0.045	0.015	18.0-20.0	9.0-11.0	---	N 0.12-0.20; Ce 0.03-0.08
GB/T 14975-2002	Grade 0Cr19Ni9N	---	---	0.08	2.00	1.00	0.035	0.03	18.00-20.00	7.00-10.50	---	N 0.10-0.25
ASME SA-213/SA-213M	Grade TP317LM	S31725	---	0.03	2.00	1.00	0.045	0.030	18.0-20.0	13.5-17.5	4.0-5.0	N 0.20 max; Cu 0.75 max
ASTM A213/A213M-15a	Grade TP317LM	S31725	---	0.03	2.00	1.00	0.045	0.030	18.0-20.0	13.5-17.5	4.0-5.0	N 0.20 max; Cu 0.75 max
ASTM A269/A269M-14e1	---	S31725	---	0.035	2.00	1.00	0.045	0.030	18.0-20.0	13.5-17.5	4.0-5.0	N 0.20 max
EN 10296-2:2005 C2:2007	Grade X2CrNiMoN17-13-5	---	1.4439	0.030	2.00	1.00	0.045	0.015	16.5-18.5	12.5-14.5	4.0-5.0	N 0.12-0.22
EN 10297-2:2005 C1:2007	Grade X2CrNiMoN17-13-5	---	1.4439	0.030	2.00	1.00	0.045	0.015	16.5-18.5	12.5-14.5	4.0-5.0	N 0.12-0.22

*: See "List of Standards" at the beginning of the chapter.

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
AFNOR NF A 49-647:1979	TS Z 6 CN 18-09	---	---	---	---	400	---	600	---	35	AM	---
ASME SA-249/SA-249M	Grade TP304	S30400	---	$0.4 \leq t < 8.1$	$0.015 \leq t < 0.320$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASME SA-409/SA-409M	Grade TP304	S30400	---	$t \geq 0.46$	$t \geq 0.018$	205	30	515 T	75 T	---	HT+Q or RC	---
ASME SA-688/SA-688M	Grade TP 304	S30400	---	$15.9 \leq \text{O.D.} \leq 25.4$	$0.625 \leq \text{O.D.} \leq 1$	205	30	515	75	35	SA	90 max HRB
ASTM A269/A269M-14e1	Grade TP304	S30400	---	$0.51 \leq t < 1.65$	$0.020 \leq t < 0.065$	---	---	---	---	---	HT	200 max HV 88 max HR15_T 74 max HR30_T
				$t \geq 1.65$	$t \geq 0.065$	---	---	---	---	---	HT	192 max HBW/ 200 max HV or 90 max HRB
ASTM A511/A511M-15a*	Grade MT 304	S30400	---	$\text{O.D.} \leq 325$	$\text{O.D.} \leq 12.75$	210	30	515	75	35	A	192 max HBW; 90 max HRB
ASTM A554-15*	Grade MT-304	S30400	---	$t \geq 0.51$	$t \geq 0.020$	207	30	517	75	35	A	192 max HB; 90 max HRB
ASTM A632-04 (2014)	Grade TP 304	S30400	---	$0.13 \leq t \leq 0.38$	$0.005 \leq t \leq 0.015$	---	---	515	75	25	HT	---
				$0.38 < t \leq 1.65$	$0.015 < t \leq 0.065$	205	30	515	75	35	HT	---
ASTM A908-03 (2013)	Type 304	S30400	---	$0.05 \leq t \leq 0.4$	$0.002 \leq t \leq 0.015$	---	---	1030-1370	150-200	---	---	---
JIS G 3446:2012	Symbol SUS304TKA	---	---	$1 < t \leq 2$	---	205	---	520	---	26	ST	---
				$2 < t \leq 3$	---	205	---	520	---	28	ST	---
				$3 < t \leq 4$	---	205	---	520	---	29	ST	---
				$4 < t \leq 5$	---	205	---	520	---	30	ST	---
				$5 < t \leq 6$	---	205	---	520	---	32	ST	---
				$6 < t \leq 7$	---	205	---	520	---	34	ST	---
				$7 < t < 8$	---	205	---	520	---	35	ST	---
				$t \geq 8$	---	205	---	520	---	35	ST	---
	Symbol SUS304TKC	---	---	$1 < t \leq 2$	---	205	---	520	---	26	AM	---
				$2 < t \leq 3$	---	205	---	520	---	28	AM	---
				$3 < t \leq 4$	---	205	---	520	---	29	AM	---
				$4 < t \leq 5$	---	205	---	520	---	30	AM	---
				$5 < t \leq 6$	---	205	---	520	---	32	AM	---
				$6 < t \leq 7$	---	205	---	520	---	34	AM	---
				$7 < t < 8$	---	205	---	520	---	35	AM	---
				$t \geq 8$	---	205	---	520	---	35	AM	---

*: See "List of Standards" at the beginning of the chapter.

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
AFNOR NF A 49-647:1979	TS Z 2 CN 18-10	---	---	---	---	400	---	600	---	35	AM	---
ASTM A269/A269M-14e1	Grade TP304L	S30403	---	$0.51 \leq t < 1.65$	$0.020 \leq t < 0.065$	---	---	---	---	---	HT	200 max HV 88 max HR15_T 74 max HR30_T
				$t \geq 1.65$	$t \geq 0.065$	---	---	---	---	---	HT	192 max HBW/ 200 max HV or 90 max HRB
ASTM A511/A511M-15a*	Grade MT 304L	S30403	---	O.D. ≤ 325	O.D. ≤ 12.75	210	30	515	75	35	A	192 max HBW; 90 max HRB
ASTM A554-15*	Grade MT-304L	S30403	---	$t \geq 0.51$	$t \geq 0.020$	172	25	483	70	35	A	192 max HB; 90 max HRB
ASTM A632-04 (2014)	Grade TP 304L	S30403	---	$0.13 \leq t \leq 0.38$	$0.005 \leq t \leq 0.015$	---	---	485	70	25	HT	---
				$0.38 < t \leq 1.65$	$0.015 < t \leq 0.065$	170	25	485	70	35	HT	---
ASTM A778-01 (2009)e1	Grade TP 304L	S30403	---	$1.5 \leq t \leq 12.5$	$0.062 \leq t \leq 0.500$	---	---	485 T	70 T	---	AM	---
EN 10296-2:2005 C2:2007	Grade X2CrNi19-11	---	1.4306	$t \leq 30$	---	180	---	460	---	40 L, 35 T	AW or SA	---
EN 10297-2:2005 C1:2007	Grade X2CrNi19-11	---	1.4306	---	---	180	---	460	---	40 L, 35 T	SA	---
GB/T 12770-2002	Grade 00Cr19Ni10	---	---	---	---	---	---	480	---	35	ST	---
				---	---	---	---	480	---	25	W	---
GB/T 14975-2002	Grade 00Cr19Ni10	---	---	---	---	175	---	480 T	---	35 T	BA	---

*: See "List of Standards" at the beginning of the chapter.

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
AFNOR NF A 49-647:1979	TS Z 6 CND 17-11	---	---	---	---	400	---	600	---	35	AM	---
ASTM A269/A269M-14e1	Grade TP316	S31600	---	$0.51 \leq t < 1.65$	$0.020 \leq t < 0.065$	---	---	---	---	---	HT	200 max HV 88 max HR15_T 74 max HR30_T
				$t \geq 1.65$	$t \geq 0.065$	---	---	---	---	---	HT	192 max HBW/ 200 max HV or 90 max HRB
ASTM A511/A511M-15a*	Grade MT 316	S31600	---	O.D. ≤ 325	O.D. ≤ 12.75	210	30	515	75	35	A	192 max HBW; 90 max HRB
ASTM A554-15*	Grade MT-316	---	---	$t \geq 0.51$	$t \geq 0.020$	207	30	517	75	35	A	192 max HB; 90 max HRB
ASTM A632-04 (2014)	Grade TP 316	S31600	---	$0.13 \leq t \leq 0.38$	$0.005 \leq t \leq 0.015$	---	---	515	75	25	HT	---
				$0.38 < t \leq 1.65$	$0.015 < t \leq 0.065$	205	30	515	75	35	HT	---
JIS G 3446:2012	Symbol SUS316TKA	---	---	$1 < t \leq 2$	---	205	---	520	---	26	ST	---
				$2 < t \leq 3$	---	205	---	520	---	28	ST	---
				$3 < t \leq 4$	---	205	---	520	---	29	ST	---
				$4 < t \leq 5$	---	205	---	520	---	30	ST	---
				$5 < t \leq 6$	---	205	---	520	---	32	ST	---
				$6 < t \leq 7$	---	205	---	520	---	34	ST	---
				$7 < t < 8$	---	205	---	520	---	35	ST	---
				$t \geq 8$	---	205	---	520	---	35	ST	---
	Symbol SUS316TKC	---	---	$1 < t \leq 2$	---	205	---	520	---	26	AM	---
				$2 < t \leq 3$	---	205	---	520	---	28	AM	---
				$3 < t \leq 4$	---	205	---	520	---	29	AM	---
				$4 < t \leq 5$	---	205	---	520	---	30	AM	---
				$5 < t \leq 6$	---	205	---	520	---	32	AM	---
				$6 < t \leq 7$	---	205	---	520	---	34	AM	---
				$7 < t < 8$	---	205	---	520	---	35	AM	---
				$t \geq 8$	---	205	---	520	---	35	AM	---

*: See "List of Standards" at the beginning of the chapter.

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A269/A269M-14e1	Grade TP316L	S31603	---	$0.51 \leq t < 1.65$	$0.020 \leq t < 0.065$	---	---	---	---	---	HT	200 max HV 88 max HR15_T 74 max HR30_T
				$t \geq 1.65$	$t \geq 0.065$	---	---	---	---	---	HT	192 max HBW/ 200 max HV or 90 max HRB
ASTM A511/A511M-15a*	Grade MT 316L	---	---	O.D. ≤ 325	O.D. ≤ 12.75	210	30	515	75	35	A	192 max HBW; 90 max HRB
ASTM A554-15*	Grade MT-316L	S31603	---	$t \geq 0.51$	$t \geq 0.020$	172	25	483	70	35	A	192 max HB; 90 max HRB
ASTM A632-04 (2014)	Grade TP 316L	S31603	---	$0.13 \leq t \leq 0.38$	$0.005 \leq t \leq 0.015$	---	---	485	70	25	HT	---
				$0.38 < t \leq 1.65$	$0.015 < t \leq 0.065$	170	25	485	70	35	HT	---
ASTM A778-01 (2009)e1	Grade TP 316L	S31603	---	$1.5 \leq t \leq 12.5$	$0.062 \leq t \leq 0.500$	---	---	485 T	70 T	---	AM	---
EN 10296-2:2005 C2:2007	Grade X2CrNiMo17-12-2	---	1.4404	$t \leq 30$	---	190	---	490	---	40 L, 30 T	AW or SA	---
	Grade X2CrNiMo17-12-3	---	1.4432	$t \leq 30$	---	190	---	490	---	40 L, 30 T	AW or SA	---
	Grade X2CrNiMo18-14-3	---	1.4435	$t \leq 30$	---	190	---	490	---	40 L, 35 T	AW or SA	---
EN 10297-2:2005 C1:2007	Grade X2CrNiMo17-12-2	---	1.4404	---	---	190	---	490	---	40 L, 30 T	SA	---
	Grade X2CrNiMo18-14-3	---	1.4435	---	---	190	---	490	---	40 L, 35 T	SA	---
GB/T 12770-2002	Grade 00Cr17Ni14Mo2	---	---	---	---	---	---	480	---	35	ST	---
				---	---	---	---	480	---	25	W	---
GB/T 14975-2002	Grade 00Cr17Ni14Mo2	---	---	---	---	175	---	480 T	---	35 T	BA	---
EN 10296-2:2005 C2:2007	Grade X3CrNiMo17-13-3	---	1.4436	$t \leq 30$	---	205	---	510	---	40 L, 30 T	AW or SA	---
	Grade X5CrNiMo17-12-2	---	1.4401	$t \leq 30$	---	205	---	510	---	40 L, 30 T	AW or SA	---
EN 10297-2:2005 C1:2007	Grade X3CrNiMo17-13-3	---	1.4436	---	---	205	---	510	---	40 L, 30 T	SA	---
	Grade X5CrNiMo17-12-2	---	1.4401	---	---	205	---	510	---	40 L, 30 T	SA	---
GB/T 12770-2002	Grade 0Cr17Ni12Mo2	---	---	---	---	---	---	520	---	35	ST	---
				---	---	---	---	520	---	25	W	---
GB/T 14975-2002	Grade 0Cr17Ni12Mo2	---	---	---	---	205	---	520 T	---	35 T	BA	---
ASTM A269/A269M-14e1	Grade TP 304LN	S30453	---	$0.51 \leq t < 1.65$	$0.020 \leq t < 0.065$	---	---	---	---	---	HT	200 max HV 88 max HR15_T 74 max HR30_T
				$t \geq 1.65$	$t \geq 0.065$	---	---	---	---	---	HT	192 max HBW/ 200 max HV or 90 max HRB
EN 10296-2:2005 C2:2007	Grade X2CrNiN18-10	---	1.4311	$t \leq 30$	---	270	---	550	---	35 L, 30 T	AW or SA	---
EN 10297-2:2005 C1:2007	Grade X2CrNiN18-10	---	1.4311	---	---	270	---	550	---	35 L, 30 T	SA	---
GB/T 14975-2002	Grade 00Cr18Ni10N	---	---	---	---	245	---	550 T	---	40 T	BA	---

*: See "List of Standards" at the beginning of the chapter.

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A269/A269M-14e1	Grade TP316LN	S31653	---	$0.51 \leq t < 1.65$	$0.020 \leq t < 0.065$	---	---	---	---	---	HT	200 max HV 88 max HR15_T 74 max HR30_T
				$t \geq 1.65$	$t \geq 0.065$	---	---	---	---	---	HT	192 max HBW/ 200 max HV or 90 max HRB
EN 10296-2:2005 C2:2007	Grade X2CrNiMoN17-13-3	---	1.4429	$t \leq 30$	---	295	---	580	---	35 L, 30 T	AW or SA	---
EN 10297-2:2005 C1:2007	Grade X2CrNiMoN17-13-3	---	1.4429	---	---	295	---	580	---	35 L, 30 T	SA	---
GB/T 14975-2002	Grade 00Cr17Ni13Mo2N	---	---	---	---	245	---	550 T	---	40 T	BA	---
EN 10296-2:2005 C2:2007	Grade X5CrNi18-10	---	1.4301	$t \leq 30$	---	195	---	500	---	40 L, 35 T	AW or SA	---
EN 10297-2:2005 C1:2007	Grade X5CrNi18-10	---	1.4301	---	---	195	---	500	---	40 L, 35 T	SA	---
GB/T 12770-2002	Grade 0Cr18Ni9	---	---	---	---	---	---	520	---	35	ST	---
				---	---	---	---	520	---	25	W	---
GB/T 14975-2002	Grade 0Cr18Ni9	---	---	---	---	205	---	520 T	---	35 T	BA	---
ASTM A511/A511M-15a*	Grade MT 302	S30200	---	O.D. ≤ 325	O.D. ≤ 12.75	210	30	515	75	35	A	192 max HBW; 90 max HRB
ASTM A554-15*	Grade MT-302	S30200	---	$t \geq 0.51$	$t \geq 0.020$	207	30	517	75	35	A	192 max HB; 90 max HRB
GB/T 12770-2002	Grade 1Cr18Ni9	---	---	---	---	---	---	520	---	35	ST	---
				---	---	---	---	520	---	25	W	---
GB/T 14975-2002	Grade 1Cr18Ni9	---	---	---	---	205	---	520 T	---	35 T	BA	---
ASTM A511/A511M-15a*	Grade MT 317	S31700	---	O.D. ≤ 325	O.D. ≤ 12.75	210	30	515	75	35	A+Q or RC	192 max HBW; 90 max HRB
ASTM A554-15*	Grade MT-317	S31700	---	$t \geq 0.51$	$t \geq 0.020$	207	30	517	75	35	A	192 max HB; 90 max HRB
ASTM A632-04 (2014)	Grade TP 317	S31700	---	$0.13 \leq t \leq 0.38$	$0.005 \leq t \leq 0.015$	---	---	515	75	25	HT+Q or RC	---
				$0.38 < t \leq 1.65$	$0.015 < t \leq 0.065$	205	30	515	75	35	HT+Q or RC	---
GB/T 14975-2002	Grade 0Cr19Ni13Mo3	---	---	---	---	205	---	520 T	---	35 T	BA	---

*: See "List of Standards" at the beginning of the chapter.

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP321	S32100	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP321	S32100	---	$0.4 \leq t < 8.1$	$0.015 \leq t < 0.320$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A249/A249M-14a	Grade TP321	S32100	---	$0.4 \leq t < 8.1$	$0.015 \leq t < 0.320$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A269/A269M-14e1	Grade TP321	S32100	---	$0.51 \leq t < 1.65$	$0.020 \leq t < 0.065$	---	---	---	---	---	HT	200 max HV 88 max HR15_T 74 max HR30_T
				$t \geq 1.65$	$t \geq 0.065$	---	---	---	---	---	HT	192 max HBW/ 200 max HV or 90 max HRB
ASTM A511/A511M-15a*	Grade MT 321	S32100	---	O.D. ≤ 325	O.D. ≤ 12.75	210	30	515	75	35	A	192 max HBW; 90 max HRB
ASTM A554-15*	Grade MT-321	S32100	---	$t \geq 0.51$	$t \geq 0.020$	207	30	517	75	35	A	192 max HB; 90 max HRB
ASTM A632-04 (2014)	Grade TP 321	S32100	---	$0.13 \leq t \leq 0.38$	$0.005 \leq t \leq 0.015$	---	---	515	75	25	HT	---
				$0.38 < t \leq 1.65$	$0.015 < t \leq 0.065$	205	30	515	75	35	HT	---
ASTM A778-01 (2009)e1	Grade TP 321	S32100	---	$1.5 \leq t \leq 12.5$	$0.062 \leq t \leq 0.500$	---	---	515 T	75 T	---	AM	---
EN 10296-2:2005 C2:2007	Grade X6CrNiTi18-10	---	1.4541	$t \leq 30$	---	200	---	500	---	35 L, 30 T	AW or SA	---
EN 10297-2:2005 C1:2007	Grade X6CrNiTi18-10	---	1.4541	---	---	200	---	500	---	35 L, 30 T	SA, CF	---
				---	---	180	---	460	---	35 L, 30 T	SA, HF	---
GB/T 12770-2002	Grade 0Cr18Ni10Ti	---	---	---	---	---	---	520	---	35	ST	---
				---	---	---	---	520	---	25	W	---
GB/T 14975-2002	Grade 0Cr18Ni10Ti	---	---	---	---	205	---	520 T	---	35 T	BA	---
JIS G 3446:2012	Symbol SUS321TKA	---	---	$1 < t \leq 2$	---	205	---	520	---	26	ST	---
				$2 < t \leq 3$	---	205	---	520	---	28	ST	---
				$3 < t \leq 4$	---	205	---	520	---	29	ST	---
				$4 < t \leq 5$	---	205	---	520	---	30	ST	---
				$5 < t \leq 6$	---	205	---	520	---	32	ST	---
				$6 < t \leq 7$	---	205	---	520	---	34	ST	---
				$7 < t < 8$	---	205	---	520	---	35	ST	---
				$t \geq 8$	---	205	---	520	---	35	ST	---
EN 10296-2:2005 C2:2007	Grade X6CrNiMoTi17-12-2	---	1.4571	$t \leq 30$	---	210	---	510	---	35 L, 30 T	AW or SA	---
EN 10297-2:2005 C1:2007	Grade X6CrNiMoTi17-12-2	---	1.4571	---	---	210	---	500	---	35 L, 30 T	SA, CF	---
				---	---	190	---	490	---	35 L, 30 T	SA, HF	---
GB/T 14975-2002	Grade 0Cr18Ni12Mo2Ti	---	---	---	---	205	---	530 T	---	35 T	BA	---

*: See "List of Standards" at the beginning of the chapter.

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A269/A269M-14e1	Grade TP347	S34700	---	$0.51 \leq t < 1.65$	$0.020 \leq t < 0.065$	---	---	---	---	---	HT	200 max HV 88 max HR15_T 74 max HR30_T
				$t \geq 1.65$	$t \geq 0.065$	---	---	---	---	---	HT	192 max HBW/ 200 max HV or 90 max HRB
ASTM A511/A511M-15a*	Grade MT 347	S34700	---	O.D. ≤ 325	O.D. ≤ 12.75	210	30	515	75	35	A	192 max HBW; 90 max HRB
ASTM A554-15*	Grade MT-347	S34700	---	$t \geq 0.51$	$t \geq 0.020$	207	30	517	75	35	A	192 max HB; 90 max HRB
ASTM A632-04 (2014)	Grade TP 347	S34700	---	$0.13 \leq t \leq 0.38$	$0.005 \leq t \leq 0.015$	---	---	515	75	25	HT	---
				$0.38 < t \leq 1.65$	$0.015 < t \leq 0.065$	205	30	515	75	35	HT	---
ASTM A778-01 (2009)e1	Grade TP 347	S34700	---	$1.5 \leq t \leq 12.5$	$0.062 \leq t \leq 0.500$	---	---	515 T	75 T	---	AM	---
EN 10296-2:2005 C2:2007	Grade X6CrNiNb18-10	---	1.4550	$t \leq 30$	---	205	---	510	---	35 L, 30 T	AW or SA	---
EN 10297-2:2005 C1:2007	Grade X6CrNiNb18-10	---	1.4550	---	---	205	---	510	---	35 L, 30 T	SA	---
GB/T 12770-2002	Grade 0Cr18Ni11Nb	---	---	---	---	---	---	520	---	35	ST	---
				---	---	---	---	520	---	25	W	---
GB/T 14975-2002	Grade 0Cr18Ni11Nb	---	---	---	---	205	---	520 T	---	35 T	BA	---
JIS G 3446:2012	Symbol SUS347TKA	---	---	$1 < t \leq 2$	---	205	---	520	---	26	ST	---
				$2 < t \leq 3$	---	205	---	520	---	28	ST	---
				$3 < t \leq 4$	---	205	---	520	---	29	ST	---
				$4 < t \leq 5$	---	205	---	520	---	30	ST	---
				$5 < t \leq 6$	---	205	---	520	---	32	ST	---
				$6 < t \leq 7$	---	205	---	520	---	34	ST	---
				$7 < t < 8$	---	205	---	520	---	35	ST	---
				$t \geq 8$	---	205	---	520	---	35	ST	---
ASME SA-249/SA-249M	---	S30415	---	$0.4 \leq t < 8.1$	$0.015 \leq t < 0.320$	290	42	600	87	35	ST+Q or RC	96 max HRB
ASME SA-312/SA-312M	---	S30415	---	---	---	290	42	600	87	35 L, 25 T	A+Q or RC	---
ASME SA-358/SA-358M*	---	S30415	---	---	---	290	42	600	87	40	A+Q or ST	217 max HBW or 95 max HRBW
ASTM A249/A249M-14a	---	S30415	---	$0.4 \leq t < 8.1$	$0.015 \leq t < 0.320$	290	42	600	87	35	ST+Q or RC	96 max HRB
ASTM A312/A312M-15	---	S30415	---	---	---	290	42	600	87	35 L, 25 T	A+Q or RC	---
ASTM A358/A358M-14a*	---	S30415	---	---	---	290	42	600	87	40	A+Q or ST	217 max HBW or 95 max HRBW
EN 10296-2:2005 C2:2007	Grade X6CrNiSiNc19-10	---	1.4818	---	---	290	---	600	---	40 L, 40 T	SA	---
GB/T 14975-2002	Grade 0Cr19Ni9N	---	---	---	---	275	---	550 T	---	35 T	BA	---

*: See "List of Standards" at the beginning of the chapter.

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP317LM	S31725	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A213/A213M-15a	Grade TP317LM	S31725	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A269/A269M-14e1	---	S31725	---	$0.51 \leq t < 1.65$	$0.020 \leq t < 0.065$	---	---	---	---	---	HT	200 max HV 88 max HR15_T 74 max HR30_T
				$t \geq 1.65$	$t \geq 0.065$	---	---	---	---	---	HT	192 max HBW/ 200 max HV or 90 max HRB
EN 10296-2:2005 C2:2007	Grade X2CrNiMoN17-13-5	---	1.4439	$t \leq 30$	---	285	---	580	---	35 L, 30 T	AW or SA	---
EN 10297-2:2005 C1:2007	Grade X2CrNiMoN17-13-5	---	1.4439	---	---	285	---	580	---	35 L, 30 T	SA	---

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.3A Chemical Composition of Duplex Stainless Steel Tubes and Pipes for General and Structural Applications

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-789/SA-789M	---	S31500	---	0.030	1.20-2.00	1.40-2.00	0.030	0.030	18.0-19.0	4.3-5.2	2.50-3.00	N 0.05-0.1
ASTM A789/A789M-14	---	S31500	---	0.030	1.20-2.00	1.40-2.00	0.030	0.030	18.0-19.0	4.3-5.2	2.50-3.00	N 0.05-0.1
EN 10297-2:2005 C1:2007	Grade X2CrNiMoSi18-5-3	---	1.4424	0.030	1.20-2.00	1.40-2.00	0.035	0.015	18.0-19.0	4.5-5.2	2.50-3.00	N 0.05-0.10
GB/T 14975-2002	Grade 00Cr18Ni5Mo3Si2	---	---	0.030	1.00-2.00	1.30-2.00	0.035	0.03	18.00-19.00	4.50-5.50	2.50-3.00	---
ASME SA-789/SA-789M	---	S31803	---	0.030	2.00	1.00	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
		S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
ASTM A270/A270M-15	Grade 2205	S31803	---	0.030	2.00	1.00	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
		S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
ASTM A789/A789M-14	---	S31803	---	0.030	2.00	1.00	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
		S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
EN 10296-2:2005 C2:2007	Grade X2CrNiMoN22-5-3	---	1.4462	0.030	2.00	1.00	0.035	0.015	21.0-23.0	4.5-6.5	2.50-3.5	N 0.10-0.22
EN 10297-2:2005 C1:2007	Grade X2CrNiMoN22-5-3	---	1.4462	0.030	2.00	1.00	0.035	0.015	21.0-23.0	4.5-6.5	2.5-3.5	N 0.10-0.22
ASME SA-789/SA-789M	---	S32304	---	0.030	2.50	1.00	0.040	0.040	21.5-24.5	3.0-5.5	0.05-0.60	Cu 0.05-0.60; N 0.05-0.20
ASTM A789/A789M-14	---	S32304	---	0.030	2.50	1.00	0.040	0.040	21.5-24.5	3.0-5.5	0.05-0.60	Cu 0.05-0.60; N 0.05-0.20
EN 10296-2:2005 C2:2007	Grade X2CrNiN23-4	---	1.4362	0.030	2.00	1.00	0.035	0.015	22.0-24.0	3.5-5.5	0.10-0.60	Cu 0.10-0.60; N 0.05-0.20
EN 10297-2:2005 C1:2007	Grade X2CrNiN23-4	---	1.4362	0.030	2.00	1.00	0.035	0.015	22.0-24.0	3.5-5.5	0.10-0.60	Cu 0.10-0.60; N 0.05-0.20
ASME SA-789/SA-789M	---	S32760	---	0.05	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 40 min.
ASTM A789/A789M-14	---	S32760	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 40 min.
EN 10297-2:2005 C1:2007	Grade X2CrNiMoCuWN25-7-4	---	1.4501	0.030	1.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30
ASME SA-789/SA-789M	---	S32750	---	0.030	1.20	0.80	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	Cu 0.50; N 0.24-0.32
ASTM A270/A270M-15	Grade 2507	S32750	---	0.030	1.20	0.80	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	Cu 0.50; N 0.24-0.32
ASTM A789/A789M-14	---	S32750	---	0.030	1.20	0.80	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	Cu 0.50; N 0.24-0.32; [Cr+(3.3xMo)+(16xN)] 41 min.
EN 10296-2:2005 C2:2007	Grade X2CrNiMoN25-7-4	---	1.4410	0.030	2.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.5	N 0.24-0.35
EN 10297-2:2005 C1:2007	Grade X2CrNiMoN25-7-4	---	1.4410	0.030	2.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.5	N 0.24-0.35
ASME SA-789/SA-789M	---	S32906	---	0.030	0.80-1.50	0.80	0.030	0.030	28.0-30.0	5.8-7.5	1.50-2.60	Cu 0.80; N 0.30-0.40
ASTM A789/A789M-14	---	S32906	---	0.030	0.80-1.50	0.80	0.030	0.030	28.0-30.0	5.8-7.5	1.50-2.60	Cu 0.80; N 0.30-0.40
EN 10297-2:2005 C1:2007	Grade X2CrNiMoN29-7-2	---	1.4477	0.030	0.80-1.50	0.50	0.030	0.015	28.0-30.0	5.8-7.5	1.50-2.60	N 0.30-0.40

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.3B Mechanical Properties of Duplex Stainless Steel Tubes and Pipes for General and Structural Applications

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-789/SA-789M	---	S31500	---	---	---	440	64	630	92	30	ST+Q	290 max HBW; 30 max HRC
ASTM A789/A789M-14	---	S31500	---	---	---	440	64	630	92	30	ST+Q	290 max HBW; 30 max HRC
EN 10297-2:2005 C1:2007	Grade X2CrNiMoSi18-5-3	---	1.4424	---	---	480	---	700	---	30 L, 30 T	SA	---
GB/T 14975-2002	Grade 00Cr18Ni5Mo3Si2	---	---	---	---	390	---	590 T	---	20 T	BA	---
ASME SA-789/SA-789M	---	S31803	---	---	---	450	65	620	90	25	ST+Q	290 max HBW; 30 max HRC
		S32205	---	---	---	485	70	655	95	25	ST+Q	290 max HBW; 30 max HRC
ASTM A270/A270M-15*	---	S31803	---	O.D. ≤ 300	O.D. ≤ 12	450	65	620	90	25	HT+Q or RC	30.5 max HRC
	Grade 2205	S32205	---	O.D. ≤ 300	O.D. ≤ 12	485	70	655	95	25	HT+Q or RC	30.5 max HRC
ASTM A789/A789M-14	---	S31803	---	---	---	450	65	620	90	25	ST+Q	290 max HBW; 30 max HRC
		S32205	---	---	---	485	70	655	95	25	ST+Q	290 max HBW; 30 max HRC
EN 10296-2:2005 C2:2007	Grade X2CrNiMoN22-5-3	---	1.4462	t ≤ 30	---	450	---	700	---	22 L	AW or SA	---
EN 10297-2:2005 C1:2007	Grade X2CrNiMoN22-5-3	---	1.4462	---	---	450	---	640	---	22 L	SA	---
ASME SA-789/SA-789M	---	S32304	---	O.D. ≤ 25	O.D. ≤ 1	450	65	690	100	25	ST+Q	---
				O.D. > 25	O.D. > 1	400	58	600	87	25	ST+Q	290 max HBW; 30 max HRC
ASTM A789/A789M-14	---	S32304	---	O.D. ≤ 25	O.D. ≤ 1	450	65	690	100	25	ST+Q	---
				O.D. > 25	O.D. > 1	400	58	600	87	25	ST+Q	290 max HBW; 30 max HRC
EN 10296-2:2005 C2:2007	Grade X2CrNiN23-4	---	1.4362	t ≤ 30	---	400	---	600	---	20 L	AW or SA	---
EN 10297-2:2005 C1:2007	Grade X2CrNiN23-4	---	1.4362	---	---	400	---	600	---	25 L, 25 T	SA	---
ASME SA-789/SA-789M	---	S32760	---	---	---	550	80	750	109	25	ST+Q	300 max HBW
ASTM A789/A789M-14	---	S32760	---	---	---	550	80	750	109	25	ST+Q	300 max HBW
EN 10297-2:2005 C1:2007	Grade X2CrNiMoCuWN25-7-4	---	1.4501	---	---	550	---	800	---	20 L, 20 T	SA	---

*: See "List of Standards" at the beginning of the chapter.

5.3 Stainless Steel Tubes for General and Structural Applications

5.3.3B Mechanical Properties of Duplex Stainless Steel Tubes and Pipes for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-789/SA-789M	---	S32750	---	---	---	550	80	800	116	15	ST+Q	300 max HBW; 32 max HRC
ASTM A270/A270M-15*	Grade 2507	S32750	---	O.D. ≤ 300	O.D. ≤ 12	550	80	800	116	15	HT+Q or RC	32 max HRC
ASTM A789/A789M-14	---	S32750	---	---	---	550	80	800	116	15	ST+Q	300 max HBW; 32 max HRC
EN 10296-2:2005 C2:2007	Grade X2CrNiMoN25-7-4	---	1.4410	t ≤ 30	---	550	---	800	---	15 L	AW or SA	---
EN 10297-2:2005 C1:2007	Grade X2CrNiMoN25-7-4	---	1.4410	---	---	550	---	800	---	20 L, 20 T	SA	---
ASME SA-789/SA-789M	---	S32906	---	t < 10	t < 0.40	650	94	800	116	25	ST+Q	300 max HBW; 32 max HRC
				t ≥ 10	t ≥ 0.40	550	80	750	109	25	ST+Q	300 max HBW; 32 max HRC
ASTM A789/A789M-14	---	S32906	---	t < 10	t < 0.40	650	94	800	116	25	ST+Q	300 max HBW; 32 max HRC
				t ≥ 10	t ≥ 0.40	550	80	750	109	25	ST+Q	300 max HBW; 32 max HRC
EN 10297-2:2005 C1:2007	Grade X2CrNiMoN29-7-2	---	1.4477	---	---	550	---	750	---	25 L, 25 T	SA	---

*: See "List of Standards" at the beginning of the chapter.

5.4 Carbon Steel Tubes and Pipes for Low-Temperature Service

5.4A Mechanical Properties of Carbon Steel Tubes and Pipes – With Impact Testing Below –20°C

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10216-4:2013	P215NL	---	1.0451	$t \leq 10$	---	215	---	360-480	---	25 L; 23 T	N	see standard for impact data
EN 10217-4:2002 A1:2005	P215NL	---	1.0451	$t \leq 10$	---	215	---	360-480	---	25 L; 23 T	see standard	see standard for impact data
EN 10217-6:2002 A1:2005	P215NL	---	1.0451	$t \leq 10$	---	215	---	360-480	---	25 L; 23 T	see standard	see standard for impact data
ISO 9329-3:1997	PL 21	---	---	$t \leq 13$	---	215	---	360-480	---	24	N	$t \leq 10$ mm L: 40 J at -40°C
				$13 < t \leq 25$	---	215	---	360-480	---	24	N	$t \leq 10$ mm L: 40 J at -40°C
ISO 9330-3:1997	PL 21	---	---	---	---	215	---	360-480	---	24	N	L: 40 J at -40°C
ISO 9330-5:2000	PL 21	---	---	$t \leq 13$	---	215	---	360-480	---	24	N	≤ 10 mm L: 40 J at -40°C
				$13 < t \leq 25$	---	215	---	360-480	---	24	N	≤ 10 mm L: 40 J at -40°C
EN 10216-4:2013	P255QL	---	1.0452	$t \leq 40$	---	255	---	360-490	---	23 L; 21 T	QT	see standard for impact data
ISO 9329-3:1997	PL 25	---	---	$t \leq 13$	---	255	---	360-490	---	21	QT	L: 40 J at -50°C
				$13 < t \leq 25$	---	255	---	360-490	---	21	QT	L: 40 J at -50°C
				$25 < t \leq 40$	---	235	---	360-490	---	21	QT	L: 40 J at -40°C
ISO 9330-3:1997	PL 25	---	---	---	---	255	---	360-490	---	21	QT	L: 40 J at -50°C
ISO 9330-5:2000	PL 25	---	---	$t \leq 13$	---	255	---	360-490	---	21	N	L: 40 J at -50°C
				$13 < t \leq 25$	---	255	---	360-490	---	21	N	L: 40 J at -50°C
				$25 < t \leq 40$	---	235	---	360-490	---	21	N	L: 40 J at -40°C
ASME SA-333/SA-333M	Grade 1	K03008	---	---	---	205	30	380	55	35 L, 25 T	N or N+T	see standard
ASME SA-334/SA-334M	Grade 1	K03008	---	$t \geq 0.4$	$t \geq 0.015$	205	30	380	55	35	N or N+T	163 max HB; 85 max HRB; see standard
ASTM A333/A333M-13	Grade 1	K03008	---	---	---	205	30	380	55	$t \geq 8$ mm (5/16 in.) 35 L; 25 T	N, NT	18 J at -45°C
ASTM A334/A334M-04a (2010)	Grade 1	K03008	---	$t \geq 0.4$	$t \geq 0.015$	205	30	380	55	$t \geq 5/16$ in. (8 mm): 35	N, NT	85 max HRB; 163 max HB; 18 J at -45°C
JIS G 3460:2013	Symbol STPL380	---	---	---	---	205	---	380	---	35	N, NT or QT	21 J at -45°C

Note: This section continued on next page.

5.4 Carbon Steel Tubes and Pipes for Low-Temperature Service

5.4A Mechanical Properties of Carbon Steel Tubes and Pipes – With Impact Testing Below –20°C (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 3464:2013	Symbol STBL380	---	---	O.D. < 10	---	205	---	380	---	27 L	N, NT or QT	21 J at -45°C
				10 ≤ O.D. < 20	---	205	---	380	---	30 L	N, NT or QT	21 J at -45°C
				O.D. ≥ 20	---	205	---	380	---	35 L	N, NT or QT	21 J at -45°C
GB/T 18984-2003	Grade 09DG	---	---	---	---	210	---	385 L	---	35 L	N	see standard
EN 10216-3:2013	P275NL2	---	1.1104	t ≤ 12	---	275	---	390-530	---	24 L; 22 T	N	see standard for impact data
				12 < t ≤ 20	---	275	---	390-530	---	24 L; 22 T	N	see standard for impact data
				20 < t ≤ 40	---	275	---	390-510	---	24 L; 22 T	N	see standard for impact data
				40 < t ≤ 50	---	265	---	390-510	---	24 L; 22 T	N	see standard for impact data
				50 < t ≤ 65	---	255	---	390-510	---	24 L; 22 T	N	see standard for impact data
				65 < t ≤ 80	---	245	---	360-480	---	24 L; 22 T	N	see standard for impact data
				80 < t ≤ 100	---	235	---	360-480	---	24 L; 22 T	N	see standard for impact data

5.4 Carbon Steel Tubes and Pipes for Low-Temperature Service

5.4A Mechanical Properties of Carbon Steel Tubes and Pipes – With Impact Testing Below –20°C (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB/T 18984-2003	Grade 10MnDG	---	---	---	---	240	---	400 L	---	35 L	N	see standard
	Grade 16MnDG	---	---	$t \leq 16$	---	325	---	490-665 L	---	30 L	N	see standard
				$t > 16$	---	315	---	490-665 L	---	30 L	N	see standard
ISO 9330-3:1997	PL 23	---	---	---	---	235	---	410-530	---	22	N	L: 27 J at -50°C
ISO 9330-5:2000	PL 23	---	---	$t \leq 13$	---	235	---	410-530	---	22	N	L: 27 J at -50°C
				$13 < t \leq 25$	---	235	---	410-530	---	22	N	L: 27 J at -50°C
ISO 9329-3:1997	PL 23	---	---	$t \leq 13$	---	235	---	410-530	---	22	N	L: 27 J at -50°C
				$13 < t \leq 25$	---	235	---	410-530	---	22	N	L: 27 J at -50°C
EN 10216-4:2013	P265NL	---	1.0453	$t \leq 25$	---	265	---	410-570	---	24 L; 22 T	N	see standard for impact data
EN 10217-4:2002 A1:2005	P265NL	---	1.0453	$t \leq 16$	---	265	---	410-570	---	24 L; 22 T	see standard	see standard for impact data
EN 10217-6:2002 A1:2005	P265NL	---	1.0453	$t \leq 25$	---	265	---	410-570	---	24 L; 22 T	see standard	see standard for impact data
ASME SA-334/SA-334M	Grade 6	K03006	---	$t \geq 0.4$	$t \geq 0.015$	240	35	415	60	30	N or N+T	190 max HB; 90 max HRB; see standard
ASTM A333/A333M-13	Grade 6	K03006	---	---	---	240	35	415	60	$t \geq 8\text{mm}$ (5/16 in.) 30 L; 16.5 T	N, NT	18 J at -45°C
ASTM A334/A334M-04a (2010)	Grade 6	K03006	---	$t \geq 0.4$	$t \geq 0.015$	240	35	415	60	$t \geq 5/16\text{ in.}$ (8 mm): 30	N, NT	90 max HRB 190 max HB 18 J at -45°C
ASME SA-333/SA-333M	Grade 6	K03006	---	---	---	240	35	415	60	30 L, 16.5 T	N or N+T	see standard
	Grade 3	K31918	---	---	---	240	35	450	65	30 L, 20 T	N or N+T	see standard
ASTM A333/A333M-13	Grade 3	K31918	---	---	---	240	35	450	65	$t \geq 8\text{mm}$ (5/16 in.) 30 L; 20 T	N, NT	18 J at -100°C
JIS G 3460:2013	Symbol STPL450	---	---	---	---	245	---	450	---	30	N, NT or QT	21 J at -100°C
ASME SA-333/SA-333M	Grade 8	K81340	---	---	---	515	75	690	100	22 L	Q+T or NN+T	---
ASTM A333/A333M-13	Grade 8	K81340	---	---	---	515	75	690	100	$t \geq 8\text{mm}$ (5/16 in.) 22 L	QT or NNT	---
JIS G 3460:2013	Symbol STPL690	---	---	---	---	520	---	690	---	21	NNT or QT	21 J at -196°C

5.4 Carbon Steel Tubes and Pipes for Low-Temperature Service

5.4B Chemical Composition of Carbon Steel Tubes and Pipes – With Impact Testing Below -20°C

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10216-4:2013	P215NL	---	1.0451	0.15	0.40-1.20	0.35	0.025	0.010	0.30	0.30	0.08	Al 0.020 min; Cu 0.30; Nb 0.010; Ti 0.040; V 0.02
EN 10217-4:2002 A1:2005	P215NL	---	1.0451	0.15	0.40-1.20	0.35	0.025	0.020	0.30	0.30	0.08	Al 0.020 min; Cu 0.30; Nb 0.010; Ti 0.03; V 0.02
EN 10217-6:2002 A1:2005	P215NL	---	1.0451	0.15	0.40-1.20	0.35	0.025	0.020	0.30	0.30	0.08	Al 0.020 min; Cu 0.30; Nb 0.010; Ti 0.03; V 0.02
ISO 9329-3:1997	PL 21	---	---	0.17	0.40-1.00	0.35	0.030	0.025	---	---	---	Al 0.015 min
ISO 9330-3:1997	PL 21	---	---	0.17	0.40-1.00	0.35	0.030	0.025	---	---	---	Al 0.015 min
ISO 9330-5:2000	PL 21	---	---	0.17	0.40-1.00	0.35	0.030	0.025	---	---	---	Al 0.015 min
EN 10216-4:2013	P255QL	---	1.0452	0.17	0.40-1.20	0.35	0.025	0.010	0.30	0.30	0.08	Al 0.020 min; Cu 0.30; Nb 0.010; Ti 0.040; V 0.02
ISO 9329-3:1997	PL 25	---	---	0.17	0.40-1.00	0.35	0.030	0.025	---	---	---	Al 0.015 min
ISO 9330-3:1997	PL 25	---	---	0.17	0.60-1.20	0.35	0.030	0.025	---	---	---	Al 0.015 min
ISO 9330-5:2000	PL 25	---	---	0.17	0.40-1.00	0.35	0.030	0.025	---	---	---	Al 0.015 min
ASME SA-333/SA-333M	Grade 1	K03008	---	0.30	0.40-1.06	---	0.025	0.025	---	---	---	---
ASME SA-334/SA-334M	Grade 1	K03008	---	0.30	0.40-1.06	---	0.025	0.025	---	---	---	---
ASTM A333/A333M-13	Grade 1	K03008	---	0.30	0.40-1.06	---	0.025	0.025	---	---	---	---
ASTM A334/A334M-04a (2010)	Grade 1	K03008	---	0.30	0.40-1.06	---	0.025	0.025	---	---	---	---
JIS G 3460:2013	Symbol STPL380	---	---	0.25	1.35	0.35	0.035	0.035	---	---	---	---
JIS G 3464:2013	Symbol STBL380	---	---	0.25	1.35	0.35	0.035	0.035	---	---	---	---
GB/T 18984-2003	Grade 09DG	---	---	0.12	0.95	0.17-0.37	0.025	0.025	---	---	---	V 0.07
EN 10216-3:2013	P275NL2	---	1.1104	0.16	0.50-1.50	0.40	0.025	0.005	0.30	0.50	0.08	Al 0.020 min; Cu 0.30; N 0.020; Nb 0.05; Ti 0.040; V 0.05; (Nb+Ti+V) 0.05; (Cr+Cu+Mo) 0.45

5.4 Carbon Steel Tubes and Pipes for Low-Temperature Service

5.4B Chemical Composition of Carbon Steel Tubes and Pipes – With Impact Testing Below -20°C (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB/T 18984-2003	Grade 10MnDG	---	---	0.13	1.35	0.17-0.37	0.025	0.025	---	---	---	V 0.07
	Grade 16MnDG	---	---	0.12-0.20	1.20-1.60	0.20-0.55	0.025	0.025	---	---	---	---
ISO 9329-3:1997	PL 23	---	---	0.19	0.60-1.20	0.35	0.030	0.025	---	---	---	Al 0.015 min
ISO 9330-3:1997	PL 23	---	---	0.19	0.60-1.20	0.35	0.030	0.025	---	---	---	Al 0.015 min
ISO 9330-5:2000	PL 23	---	---	0.19	0.60-1.20	0.35	0.030	0.025	---	---	---	Al 0.015 min
EN 10216-4:2013	P265NL	---	1.0453	0.20	0.60-1.40	0.40	0.025	0.010	0.30	0.30	0.08	Al 0.020 min; Cu 0.30; Nb 0.010; Ti 0.040; V 0.02
EN 10217-4:2002 A1:2005	P265NL	---	1.0453	0.20	0.60-1.40	0.40	0.025	0.020	0.30	0.30	0.08	Al 0.020 min; Cu 0.30; Nb 0.010; Ti 0.03; V 0.02
EN 10217-6:2002 A1:2005	P265NL	---	1.0453	0.20	0.60-1.40	0.40	0.025	0.020	0.30	0.30	0.08	Al 0.020 min; Cu 0.30; Nb 0.010; Ti 0.03; V 0.02
ASME SA-334/SA-334M	Grade 6	K03006	---	0.30	0.29-1.06	0.10 min.	0.025	0.025	---	---	---	---
ASTM A333/A333M-13	Grade 6	K03006	---	0.30	0.29-1.06	0.10 min	0.025	0.025	0.30	0.40	0.12	Cu 0.40; V 0.08; Cb 0.02
ASTM A334/A334M-04a (2010)	Grade 6	K03006	---	0.30	0.29-1.06	0.10 min	0.025	0.025	---	---	---	---
ASME SA-333/SA-333M	Grade 6	K03006	---	0.30	0.29-1.06	0.10 min.	0.025	0.025	---	---	---	---
	Grade 3	K31918	---	0.19	0.31-0.64	0.18-0.37	0.025	0.025	---	3.18-3.82	---	---
ASTM A333/A333M-13	Grade 3	K31918	---	0.19	0.31-0.64	0.18-0.37	0.025	0.025	---	3.18-3.82	---	---
JIS G 3460:2013	Symbol STPL450	---	---	0.18	0.30-0.60	0.10-0.35	0.030	0.030	---	3.20-3.80	---	---
ASME SA-333/SA-333M	Grade 8	K81340	---	0.13	0.90	0.13-0.32	0.025	0.025	---	8.40-9.60	---	---
ASTM A333/A333M-13	Grade 8	K81340	---	0.13	0.90	0.13-0.32	0.025	0.025	---	8.40-9.60	---	---
JIS G 3460:2013	Symbol STPL690	---	---	0.13	0.90	0.10-0.35	0.030	0.030	---	8.50-9.50	---	---

5.5 Alloy Steel Tubes and Pipes for Low-Temperature Service

5.5A Chemical Composition of Alloy Steel Tubes and Pipes for Low-Temperature Service

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
EN 10216-4:2013	11MnNi5-3	---	1.6212	0.14	0.70-1.50	0.50	0.025	0.010	---	0.30-0.80	---	Al 0.020 min; Cu 0.30; Nb 0.05; V 0.05
ISO 9329-3:1997	11 MnNi 5-3	---	---	0.14	0.70-1.50	0.50	0.030	0.025	---	0.30-0.80	---	Al 0.020 min; V 0.05; Nb 0.05
ISO 9330-3:1997	11 MnNi 5-3	---	---	0.14	0.70-1.50	0.50	0.030	0.025	---	0.30-0.80	---	Al 0.020 min; V 0.05; Nb 0.05
ISO 9330-5:2000	11 MnNi 5-3	---	---	0.14	0.70-1.50	0.50	0.030	0.025	---	0.30-0.80	---	Al 0.020 min; V 0.05; Nb 0.05
EN 10216-4:2013	13MnNi6-3	---	1.6217	0.16	0.85-1.70	0.50	0.025	0.010	---	0.30-0.85	---	Al 0.020 min; Cu 0.30; Nb 0.05; V 0.05
ISO 9329-3:1997	13 MnNi 6-3	---	---	0.18	0.85-1.65	0.50	0.030	0.025	---	0.30-0.85	---	Al 0.020 min; V 0.05; Nb 0.05
ISO 9330-3:1997	13 MnNi 6-3	---	---	0.18	0.85-1.65	0.50	0.030	0.025	---	0.30-0.80	---	Al 0.020 min; V 0.05; Nb 0.05
ISO 9330-5:2000	13 MnNi 6-3	---	---	0.18	0.85-1.65	0.50	0.030	0.025	---	0.30-0.85	---	Al 0.020 min; V 0.05; Nb 0.05
ASME SA-334/SA-334M	Grade 3	K31918	---	0.19	0.31-0.64	0.18-0.37	0.025	0.025	---	3.18-3.82	---	---
ASTM A333/A333M-13	Grade 3	K31918	---	0.19	0.31-0.64	0.18-0.37	0.025	0.025	---	3.18-3.82	---	---
ASTM A334/A334M-04a (2010)	Grade 3	K31918	---	0.19	0.31-0.64	0.18-0.37	0.025	0.025	---	3.18-3.82	---	---
EN 10216-4:2013	12Ni14	---	1.5637	0.15	0.30-0.80	0.15-0.35	0.025	0.005	---	3.25-3.75	---	Cu 0.30; V 0.05
GB/T 18984-2003	Grade 06Ni3MoDG	---	---	0.08	0.85	0.17-0.37	0.025	0.025	---	2.5-3.7	0.15-0.30	V 0.05
ISO 9329-3:1997	12 Ni 14	---	---	0.15	0.30-0.85	0.15-0.35	0.025	0.020	---	3.25-3.75	---	V 0.05
ISO 9330-3:1997	12 Ni 14	---	---	0.15	0.30-0.85	0.15-0.35	0.025	0.020	---	3.25-3.75	---	V 0.05
ISO 9330-5:2000	12 Ni 14	---	---	0.15	0.3-0.8	0.35	0.025	0.020	---	3.25-3.75	---	V 0.05
JIS G 3460:2013	Symbol STPL450	---	---	0.18	0.30-0.60	0.10-0.35	0.030	0.030	---	3.20-3.80	---	---
JIS G 3464:2013	Symbol STBL450	---	---	0.18	0.30-0.60	0.10-0.35	0.030	0.030	---	3.20-3.80	---	---
EN 10216-4:2013	X12Ni5	---	1.5680	0.15	0.30-0.80	0.35	0.020	0.005	---	4.5-5.3	---	Cu 0.30; V 0.05
ISO 9329-3:1997	X 12 Ni 5	---	---	0.15	0.30-0.80	0.35	0.025	0.020	---	4.50-5.30	---	V 0.05
ISO 9330-3:1997	X 12 Ni 5	---	---	0.15	0.30-0.80	0.35	0.025	0.020	---	4.50-5.30	---	V 0.05
ISO 9330-5:2000	X 12 Ni 5	---	---	0.15	0.3-0.8	0.35	0.025	0.020	---	4.50-5.30	---	V 0.05
ASME SA-334/SA-334M	Grade 8	K81340	---	0.13	0.90	0.13-0.32	0.025	0.025	---	8.40-9.60	---	---
ASTM A333/A333M-13	Grade 8	K81340	---	0.13	0.90	0.13-0.32	0.025	0.025	---	8.40-9.60	---	---
ASTM A334/A334M-04a (2010)	Grade 8	K81340	---	0.13	0.90	0.13-0.32	0.025	0.025	---	8.40-9.60	---	---
EN 10216-4:2013	X10Ni9	---	1.5682	0.13	0.30-0.80	0.15-0.35	0.020	0.005	---	8.5-9.5	0.10	Cu 0.30; V 0.05
ISO 9329-3:1997	X 10 Ni 9	---	---	0.13	0.30-0.80	0.15-0.35	0.025	0.020	---	8.50-9.50	0.10	V 0.05
ISO 9330-5:2000	X 10 Ni 9	---	---	0.13	0.3-0.8	0.35	0.025	0.020	---	8.50-9.50	0.10	V 0.05
JIS G 3460:2013	Symbol STPL690	---	---	0.13	0.90	0.10-0.35	0.030	0.030	---	8.50-9.50	---	---
JIS G 3464:2013	Symbol STBL690	---	---	0.13	0.90	0.10-0.35	0.030	0.030	---	8.50-9.50	---	---
EN 10216-4:2013	26CrMo4-2	---	1.7219	0.22-0.29	0.50-0.80	0.35	0.025	0.010	0.90-1.20	---	0.15-0.30	Cu 0.30
ISO 9329-3:1997	26 CrMo 4	---	---	0.22-0.29	0.50-0.80	0.35	0.030	0.025	0.90-1.20	---	0.15-0.30	---

5.5 Alloy Steel Tubes and Pipes for Low-Temperature Service

5.5B Mechanical Properties of Alloy Steel Tubes and Pipes for Low-Temperature Service

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10216-4:2013	11MnNi5-3	---	1.6212	$t \leq 40$	---	285	---	410-530	---	24 L; 22 T	N	see standard for impact data
ISO 9329-3:1997	11 MnNi 5-3	---	---	$t \leq 13$	---	285	---	410-530	---	22	N	L: 40 J at -60°C
				$13 < t \leq 25$	---	275	---	410-530	---	22	N	L: 40 J at -60°C
				$25 < t \leq 40$	---	265	---	410-530	---	22	N	L: 40 J at -60°C
ISO 9330-3:1997	11 MnNi 5-3	---	---	$t \leq 13$	---	285	---	410-530	---	22	N	L: 40 J at -60°C
ISO 9330-5:2000	11 MnNi 5-3	---	---	$t \leq 13$	---	285	---	410-530	---	22	N	L: 40 J at -60°C
				$13 < t \leq 25$	---	275	---	410-530	---	22	N	L: 40 J at -60°C
				$25 < t \leq 40$	---	265	---	410-530	---	22	N	L: 40 J at -60°C
EN 10216-4:2013	13MnNi6-3	---	1.6217	$t \leq 40$	---	355	---	490-610	---	22 L; 20 T	N	see standard for impact data
ISO 9329-3:1997	13 MnNi 6-3	---	---	$t \leq 13$	---	355	---	490-610	---	20	N	L: 40 J at -60°C
				$13 < t \leq 25$	---	345	---	490-610	---	20	N	L: 40 J at -60°C
				$25 < t \leq 40$	---	335	---	490-610	---	20	N	L: 40 J at -60°C
ISO 9330-3:1997	13 MnNi 6-3	---	---	$t \leq 13$	---	355	---	490-610	---	20	N	L: 40 J at -60°C
ISO 9330-5:2000	13 MnNi 6-3	---	---	$t \leq 13$	---	355	---	490-610	---	20	N	L: 40 J at -60°C
				$13 < t \leq 25$	---	345	---	490-610	---	20	N	L: 40 J at -60°C
				$25 < t \leq 40$	---	335	---	490-610	---	20	N	L: 40 J at -60°C

5.5 Alloy Steel Tubes and Pipes for Low-Temperature Service

5.5B Mechanical Properties of Alloy Steel Tubes and Pipes for Low-Temperature Service (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-334/SA-334M	Grade 3	K31918	---	$t \geq 0.4$	$t \geq 0.015$	240	35	450	65	30	N or N+T	190 max.HB; 90 max.HRB; see standard
ASTM A333/A333M-13	Grade 3	K31918	---	---	---	240	35	450	65	30 L; 20 T	N, NT	18 J at -100°C
ASTM A334/A334M-04a (2010)	Grade 3	K31918	---	$t \geq 0.4$	$t \geq 0.015$	240	35	450	65	$t \geq 5/16$ in. (8 mm): 30	N, NT	90 max HRB 190 max HB 18 J at -100°C
EN 10216-4:2013	12Ni14	---	1.5637	$t \leq 40$	---	345	---	440-620	---	22 L; 20 T	NT, QT	see standard for impact data
GB/T 18984-2003	Grade 06Ni3MoDG	---	---	---	---	250	---	455 L	---	30 L	N	see standard
ISO 9329-3:1997	12 Ni 14	---	---	$t \leq 13$	---	245	---	440-590	---	16	QT	L: 40 J at -100°C
				$13 < t \leq 25$	---	245	---	440-590	---	16	QT	L: 40 J at -100°C
				$25 < t \leq 40$	---	245	---	440-590	---	16	QT	L: 40 J at -90°C
ISO 9330-3:1997	12 Ni 14	---	---	$t \leq 13$	---	245	---	440-590	---	16	QT	L: 40 J at -100°C
ISO 9330-5:2000	12 Ni 14	---	---	$t \leq 13$	---	245	---	440-590	---	16	QT	L: 40 J at -100°C
				$13 < t \leq 25$	---	245	---	440-590	---	16	QT	L: 40 J at -100°C
				$25 < t \leq 40$	---	245	---	440-590	---	16	QT	L: 40 J at -90°C
JIS G 3460:2013	Symbol STPL450	---	---	---	---	245	---	450	---	see standard	N, NT or QT	21 J at -100°C
JIS G 3464:2013	Symbol STBL450	---	---	O.D. < 10	---	245	---	450	---	22	N, NT or QT	21 J at -100°C
				$10 \leq \text{O.D.} < 20$	---	245	---	450	---	25	N, NT or QT	21 J at -100°C
				O.D. ≥ 20	---	245	---	450	---	30	N, NT or QT	21 J at -100°C
EN 10216-4:2013	X12Ni5	---	1.5680	$t \leq 40$	---	390	---	510-710	---	21 L; 19 T	NT, QT	see standard for impact data
ISO 9329-3:1997	X 12 Ni 5	---	---	$t \leq 13$	---	390	---	510-710	---	17	QT	L: 40 J at -120°C
				$13 < t \leq 25$	---	390	---	510-710	---	17	QT	L: 40 J at -120°C
				$25 < t \leq 40$	---	380	---	510-710	---	17	QT	L: 40 J at -110°C
ISO 9330-3:1997	X 12 Ni 5	---	---	$t \leq 13$	---	390	---	510-710	---	17	QT	L: 40 J at -120°C
ISO 9330-5:2000	X 12 Ni 5	---	---	$t \leq 13$	---	390	---	510-710	---	17	QT	L: 40 J at -120°C
				$13 < t \leq 25$	---	390	---	510-710	---	17	QT	L: 40 J at -120°C
				$25 < t \leq 40$	---	380	---	510-710	---	17	QT	L: 40 J at -110°C

5.5 Alloy Steel Tubes and Pipes for Low-Temperature Service

5.5B Mechanical Properties of Alloy Steel Tubes and Pipes for Low-Temperature Service (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-334/SA-334M	Grade 8	K81340	---	$t \geq 0.4$	$t \geq 0.015$	520	75	690	100	22	Q+T or NN+T	---
ASTM A333/A333M-13	Grade 8	K81340	---	---	----	515	75	690	100	22 L	QT or NNT	---
ASTM A334/A334M-04a (2010)	Grade 8	K81340	---	$t \geq 0.4$	$t \geq 0.015$	520	75	690	100	$t \geq 5/16$ in. (8 mm): 22	QT or NNT	---
EN 10216-4:2013	X10Ni9	---	1.5682	$t \leq 40$	---	510	---	690-840	---	20 L; 18 T	QT, N, NT	see standard for impact data
ISO 9329-3:1997	X 10 Ni 9	---	---	$t \leq 13$	---	510	---	690-840	---	15	QT	L: 40 J at -196°C
				$13 < t \leq 25$	---	510	---	690-840	---	15	QT	L: 40 J at -196°C
				$25 < t \leq 40$	---	510	---	690-840	---	15	QT	L: 40 J at -196°C
ISO 9330-5:2000	X 10 Ni 9	---	---	$t \leq 13$	---	510	---	690-840	---	15	QT	L: 40 J at -196°C
				$13 < t \leq 25$	---	510	---	690-840	---	15	QT	L: 40 J at -196°C
				$25 < t \leq 40$	---	510	---	690-840	---	15	QT	L: 40 J at -196°C
JIS G 3460:2013	Symbol STPL690	---	---	---	---	520	---	690	---	see standard	NNT or QT	21 J at -196°C
JIS G 3464:2013	Symbol STBL 690	---	---	O.D. < 10	---	520	---	690	---	13	NNT or QT	21 J at -196°C
				$10 \leq \text{O.D.} < 20$	---	520	---	690	---	16	NNT or QT	21 J at -196°C
				O.D. ≥ 20	---	520	---	690	---	21	NNT or QT	21 J at -196°C
EN 10216-4:2013	26CrMo4-2	---	1.7219	$t \leq 40$	---	440	---	560-740	---	18 L; 16 T	QT	see standard for impact data
ISO 9329-3:1997	26 CrMo 4	---	---	$t \leq 13$	---	440	---	560-740	---	16	QT	L: 40 J at -60°C
				$13 < t \leq 25$	---	440	---	560-740	---	16	QT	L: 40 J at -60°C
				$25 < t \leq 40$	---	420	---	560-740	---	16	QT	L: 40 J at -60°C

5.6 Carbon Steel Tubes and Pipes for Pressure Purposes

5.6A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10216-1:2013	P195TR1	---	1.0107	$t \leq 16$	---	195	---	320-440	---	27 L; 25 T	HF: AF, N or NF; HFCF: N	---
				$16 < t \leq 40$	---	185	---	320-440	---	27 L; 25 T	HF: AF, N or NF; HFCF: N	---
				$40 < t \leq 60$	---	175	---	320-440	---	27 L; 25 T	HF: AF, N or NF; HFCF: N	---
	P195TR2	---	1.0108	$t \leq 16$	---	195	---	320-440	---	27 L; 25 T	HF: N or NF; HFCF: N	see standard for impact data
				$16 < t \leq 40$	---	185	---	320-440	---	27 L; 25 T	HF: N or NF; HFCF: N	
				$40 < t \leq 60$	---	175	---	320-440	---	27 L; 25 T	HF: N or NF; HFCF: N	
EN 10217-1:2002 A1:2005	P195TR1	---	1.0107	$t \leq 16$	---	195	---	320-440	---	27 L; 25 T	see standard	---
				$16 < t \leq 40$	---	185	---	320-440	---	27 L; 25 T	see standard	---
	P195TR2	---	1.0108	$t \leq 16$	---	195	---	320-440	---	27 L; 25 T	see standard	see standard for impact data
				$16 < t \leq 40$	---	185	---	320-440	---	27 L; 25 T	see standard	
ASME SA-53/SA-53M	Grade A Type E	---	---	---	---	205	30	330 L	48 L	see standard	---	---
	Grade A Type F	---	---	---	---	205	30	330 L	48 L	see standard	---	---
	Grade A Type S	---	---	---	---	205	30	330 L	48 L	see standard	---	---
ASME SA-135	Grade A	K02509	---	$2.11 \leq t \leq 12.70$	$0.083 \leq t \leq 0.500$	207	30	331 L	48 L	35 L	---	---
ASTM A53/A53M-12	Type E Grade A	K02504	---	---	---	205	30	330	48	see standard	AM	---
	Type F Grade A	---	---	---	---	205	30	330	48	see standard	AM	---
	Type S Grade A	K02504	---	---	---	205	30	330	48	see standard	AM	---
ASTM A139/A139M-04 (2010)	Grade A	---	---	$t \leq 25.4$	$t \leq 1.0$	205	30	330	48	$t \geq 7.9$ mm (5/16 in.) 35 L	see standard	---
ASTM A135/A135M-09 (2014)	Grade A	K02509	---	---	---	205	30	330	48	$t \geq 7.9$ mm (5/16 in.) 35 L	AM	---
GB 6479-2000	Grade 10	---	---	---	---	205	---	335-490 L	---	24 L	N	see standard

5.6 Carbon Steel Tubes and Pipes for Pressure Purposes

5.6A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10216-1:2013	P235TR1	---	1.0254	$t \leq 16$	---	235	---	360-500	---	25L; 23 T	HF: AF, N or NF; HFCF: N	---
				$16 < t \leq 40$	---	225	---	360-500	---	25L; 23 T	HF: AF, N or NF; HFCF: N	---
				$40 < t \leq 60$	---	215	---	360-500	---	25L; 23 T	HF: AF, N or NF; HFCF: N	---
	P235TR2	---	1.0255	$t \leq 16$	---	235	---	360-500	---	25 L; 23 T	HF: N or NF; HFCF: N	see standard for impact data
				$16 < t \leq 40$	---	225	---	360-500	---	25 L; 23 T	HF: N or NF; HFCF: N	
				$40 < t \leq 60$	---	215	---	360-500	---	25 L; 23 T	HF: N or NF; HFCF: N	
EN 10217-1:2002 A1:2005	P235TR1	---	1.0254	$t \leq 16$	---	235	---	360-500	---	25 L; 23 T	see standard	---
				$16 < t \leq 40$	---	225	---	360-500	---	25 L; 23 T	see standard	---
	P235TR2	---	1.0255	$t \leq 16$	---	235	---	360-500	---	25 L; 23 T	see standard	see standard for impact data
				$16 < t \leq 40$	---	225	---	360-500	---	25 L; 23 T	see standard	
JIS G 3454:2012	Symbol STPG370	---	---	---	---	215	---	370	---	28 L; 23 T	AM or CF+A	---
JIS G 3457:2012	Symbol STPY400	---	---	---	---	225	---	400	---	18 T	AW or ACE	---
GB 6479-2000	Grade 20	---	---	---	---	245	---	410-550 L	---	24 L	N	see standard
EN 10216-1:2013	P265TR1	---	1.0258	$t \leq 16$	---	265	---	410-570	---	21 L; 19 T	HF: AF, N or NF; HFCF: N	---
				$16 < t \leq 40$	---	255	---	410-570	---	21 L; 19 T	HF: AF, N or NF; HFCF: N	---
				$40 < t \leq 60$	---	245	---	410-570	---	21 L; 19 T	HF: AF, N or NF; HFCF: N	---
	P265TR2	---	1.0259	$t \leq 16$	---	265	---	410-570	---	21 L; 19 T	HF: N or NF; HFCF: N	see standard for impact data
				$16 < t \leq 40$	---	255	---	410-570	---	21 L; 19 T	HF: N or NF; HFCF: N	
				$40 < t \leq 60$	---	245	---	410-570	---	21 L; 19 T	HF: N or NF; HFCF: N	
EN 10217-1:2002 A1:2005	P265TR1	---	1.0258	$t \leq 16$	---	265	---	410-570	---	21 L; 19 T	see standard	---
				$16 < t \leq 40$	---	255	---	410-570	---	21 L; 19 T	see standard	---
	P265TR2	---	1.0259	$t \leq 16$	---	265	---	410-570	---	21 L; 19 T	see standard	see standard for impact data
				$16 < t \leq 40$	---	255	---	410-570	---	21 L; 19 T	see standard	

Note: This section continued on next page.

5.6 Carbon Steel Tubes and Pipes for Pressure Purposes

5.6A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 3454:2012	Symbol STPG410	---	---	---	---	245	---	410	---	24 L; 19 T	AM or CF+A	---
ASME SA-135	Grade B	K03018	---	$2.11 \leq t \leq 12.70$	$0.083 \leq t \leq 0.500$	241	35	414 L	60 L	30 L	---	---
ASME SA-53/SA-53M	Grade B Type E	---	---	---	---	240	35	415 L	60 L	see standard	---	---
	Grade B Type S	---	---	---	---	240	35	415 L	60 L	see standard	---	---
ASTM A135/A135M-09 (2014)	Grade B	---	---	---	---	240	35	415	60	$t \geq 7.9\text{mm}$ (5/16 in.) 30 L	T	---
ASTM A53/A53M-12	Type E Grade B	K03005	---	---	---	240	35	415	60	see standard	T	---
	Type S Grade B	K03005	---	---	---	240	35	415	60	see standard	AM	---
ASTM A139/A139M-04 (2010)	Grade B	K03003	---	$t \leq 25.4$	$t \leq 1.0$	240	35	415	60	$t \geq 7.9\text{mm}$ (5/16 in.) 30 L	see standard	---
	Grade C	K03004	---	$t \leq 25.4$	$t \leq 1.0$	290	42	415	60	$t \geq 7.9\text{mm}$ (5/16 in.) 25 L	see standard	---
	Grade D	K03010	---	$t \leq 25.4$	$t \leq 1.0$	315	46	415	60	$t \geq 7.9\text{mm}$ (5/16 in.) 23 L	see standard	---
	Grade E	K03012	---	$t \leq 25.4$	$t \leq 1.0$	360	52	455	66	$t \geq 7.9\text{mm}$ (5/16 in.) 22 L	see standard	---

5.6 Carbon Steel Tubes and Pipes for Pressure Purposes

5.6B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Purposes

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
EN 10216-1:2013	P195TR1	---	1.0107	0.13	0.70	0.35	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70
	P195TR2	---	1.0108	0.13	0.70	0.35	0.025	0.015	0.30	0.30	0.08	Al 0.02 min; Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70
EN 10217-1:2002 A1:2005	P195TR1	---	1.0107	0.13	0.70	0.35	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70
	P195TR2	---	1.0108	0.13	0.70	0.35	0.025	0.020	0.30	0.30	0.08	Al 0.02 min; Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70
ASME SA-53/SA-53M	Grade A Type E	K02504	---	0.25	0.95	---	0.05	0.045	0.40	0.40	0.15	V 0.08; Cu 0.40; (Cu+Ni+Cr+Mo+V) 1.00
	Grade A Type F	---	---	0.30	1.20	---	0.05	0.045	0.40	0.40	0.15	V 0.08; Cu 0.40; (Cu+Ni+Cr+Mo+V) 1.00
	Grade A Type S	K02504	---	0.25	0.95	---	0.05	0.045	0.40	0.40	0.15	V 0.08; Cu 0.40; (Cu+Ni+Cr+Mo+V) 1.00
ASME SA-135	Grade A	K02509	---	0.25	0.95	---	0.035	0.035	---	---	---	---
ASTM A53/A53M-12	Type E Grade A	K02504	---	0.25	0.95	---	0.05	0.045	0.40	0.40	0.15	Cu 0.40; V 0.08; (Cu+Ni+Cr+Mo+V) 1.00
	Type F Grade A	---	---	0.30	1.20	---	0.05	0.045	0.40	0.40	0.15	Cu 0.40; V 0.08; (Cu+Ni+Cr+Mo+V) 1.00
	Type S Grade A	K02504	---	0.25	0.95	---	0.05	0.045	0.40	0.40	0.15	Cu 0.40; V 0.08; (Cu+Ni+Cr+Mo+V) 1.00
ASTM A139/A139M-04 (2010)	Grade A	---	---	0.25	1.00	---	0.035	0.035	---	---	---	---
ASTM A135/A135M-09 (2014)	Grade A	K02509	---	0.25	0.95	---	0.035	0.035	---	---	---	---
GB 6479-2000	Grade 10	---	---	0.07-0.14	0.35-0.65	0.17-0.37	0.03	0.03	0.15	0.25	---	Cu 0.20
EN 10216-1:2013	P235TR1	---	1.0254	0.16	1.20	0.35	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70
	P235TR2	---	1.0255	0.16	1.20	0.35	0.025	0.015	0.30	0.30	0.08	Al 0.02 min; Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70
EN 10217-1:2002 A1:2005	P235TR1	---	1.0254	0.16	1.20	0.35	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70
	P235TR2	---	1.0255	0.16	1.20	0.35	0.025	0.020	0.30	0.30	0.08	Al 0.02 min; Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70
JIS G 3454:2012	Symbol STPG370	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---

5.6 Carbon Steel Tubes and Pipes for Pressure Purposes

5.6B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Purposes (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3457:2012	Symbol STPY400	---	---	0.25	---	---	0.040	0.040	---	---	---	---
GB 6479-2000	Grade 20	---	---	0.17-0.24	0.35-0.65	0.17-0.37	0.03	0.03	0.25	0.25	0.15	V 0.08; Cu 0.20
EN 10216-1:2013	P265TR1	---	1.0258	0.20	1.40	0.40	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70
	P265TR2	---	1.0259	0.20	1.40	0.40	0.025	0.015	0.30	0.30	0.08	Al 0.02 min; Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70
EN 10217-1:2002 A1:2005	P265TR1	---	1.0258	0.20	1.40	0.40	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70
	P265TR2	---	1.0259	0.20	1.40	0.40	0.025	0.020	0.30	0.30	0.08	Al 0.02 min; Cu 0.30; Nb 0.010; Ti 0.04; V 0.02; (Cr+Cu+Mo+Ni) 0.70
JIS G 3454:2012	Symbol STPG410	---	---	0.30	0.30-1.00	0.35	0.040	0.040	---	---	---	---
ASME SA-135	Grade B	K03018	---	0.30	1.20	---	0.035	0.035	---	---	---	---
ASME SA-53/SA-53M	Grade B Type E	---	---	0.30	1.20	---	0.05	0.045	0.40	0.40	0.15	V 0.08; Cu 0.40; (Cu+Ni+Cr+Mo+V) 1.00
	Grade B Type S	---	---	0.30	1.20	---	0.05	0.045	0.40	0.40	0.15	V 0.08; Cu 0.40; (Cu+Ni+Cr+Mo+V) 1.00
ASTM A135/A135M-09 (2014)	Grade B	---	---	0.30	1.20	---	0.035	0.035	---	---	---	---
ASTM A53/A53M-12	Type E Grade B	K03005	---	0.30	1.20	---	0.05	0.045	0.40	0.40	0.15	Cu 0.40; V 0.08; (Cu+Ni+Cr+Mo+V) 1.00
	Type S Grade B	K03005	---	0.30	1.20	---	0.05	0.045	0.40	0.40	0.15	Cu 0.40; V 0.08; (Cu+Ni+Cr+Mo+V) 1.00
ASTM A139/A139M-04 (2010)	Grade B	K03003	---	0.26	1.00	---	0.035	0.035	---	---	---	---
	Grade C	K03004	---	0.28	1.20	---	0.035	0.035	---	---	---	---
	Grade D	K03010	---	0.30	1.30	---	0.035	0.035	---	---	---	---
	Grade E	K03012	---	0.30	1.40	---	0.035	0.035	---	---	---	---

5.7 Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.7A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-214/SA-214M	---	K01807	---	$t \geq 0.4$	$t \geq 0.015$	---	---	---	---	---	see standard	72 max HRB
ASME SA-556/SA-556M	Grade A2	---	---	$t \geq 1.1$	$t \geq 0.045$	180	26	320	47	35	HT	72 max HRB
ASTM A214/A214M-96 (2012)	---	K01807	---	$t \geq 0.4$	$t \geq 0.015$	---	---	---	---	---	see standard	72 max HRB
ASTM A556/A556M-96 (2012)	Grade A2	K01807	---	$t \geq 1.1$	$t \geq 0.045$	180	26	320	47	35	CD+1200°F min	72 max HRB
EN 10216-2:2013	P195GH	---	1.0348	$t \leq 16$	---	195	---	320-440	---	27 L; 25 T	N, NF	L: 40 J at 0°C L: 28 J at -10°C T: 27 J at 0°C
				$16 < t \leq 100$	---	---	---	320-440	---	27 L; 25 T	N, NF	L: 40 J at 0°C L: 28 J at -10°C T: 27 J at 0°C
EN 10217-2:2002 A1:2005	P195GH	---	1.0348	$t \leq 16$	---	195	---	320-440	---	27 L; 25 T	see standard	see standard for impact data
ASME SA-178/SA-178M*	Grade A	K01200	---	$t \geq 0.4$	$t \geq 0.015$	180	26	325	47	35	see standard	---
ASME SA-179/SA-179M*	---	---	---	$t \geq 0.4$	$t \geq 0.015$	180	26	325	47	35	HT	72 max HRB
ASME SA-192/SA-192M*	---	K01201	---	$0.4 \leq t < 5.1$	$0.015 \leq t < 0.200$	180	26	325	47	35	CF	77 max HRB
				$t \geq 5.1$	$t \geq 0.200$	180	26	325	47	35	CF	137 max HB
ASTM A178/A178M-02 (2012)*	Grade A	K01200	---	$t \geq 0.4$	$t \geq 0.015$	180	26	325	47	35	see standard	---
ASTM A179/A179M-90a (2012)*	---	K01200	---	$t \geq 0.4$	$t \geq 0.015$	180	26	325	47	35	CD+1200°F min	72 max HRB
ASTM A192/A192M-02 (2012)*	---	K01201	---	$0.4 \leq t < 5.1$	$0.015 \leq t < 0.200$	180	26	325	47	35	HF or CF + 1200°F min	77 max HRB
				$t \geq 5.1$	$t \geq 0.200$	180	26	325	47	35	HF or CF + 1200°F min	137 max HB
ASME SA-106	Grade A	---	---	---	---	205	30	330 L	48 L	28 L, 20 T	CF+HT or HF	---
ASTM A106/A106M-14	Grade A	K02501	---	---	---	205	30	330 L	48 L	28 L; 20 T	HF or CD + 1200°F min	---
GB 3087-1999	Grade 10	---	---	---	---	195	---	335-475 L	---	24 L	HF, CF or HT	---
JIS G 3461:2012	Symbol STB340	---	---	$d < 10$	---	175	---	340	---	27	see standard	77 max HRBW
				$10 \leq d < 20$	---	175	---	340	---	30	see standard	77 max HRBW
				$d \geq 20$	---	175	---	340	---	35	see standard	77 max HRBW

*: See "List of Standards" at the beginning of the chapter.

5.7 Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.7A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
AFNOR NF A 49-220:1990	TU 37 C	---	---	---	---	220	---	360-460	---	---	N	32 J at 0°C
EN 10216-2:2013	P235GH	---	1.0345	$t \leq 16$	---	235	---	360-500	---	25 L; 23 T	N, NF	L: 40 J at 0°C L: 28 J at -10°C T: 27 J at 0°C
				$16 < t \leq 40$	---	225	---	360-500	---	25 L; 23 T	N, NF	L: 40 J at 0°C L: 28 J at -10°C T: 27 J at 0°C
				$40 < t \leq 60$	---	215	---	360-500	---	25 L; 23 T	N, NF	L: 40 J at 0°C L: 28 J at -10°C T: 27 J at 0°C
				$60 < t \leq 100$	---	---	---	360-500	---	25 L; 23 T	N, NF	L: 40 J at 0°C L: 28 J at -10°C T: 27 J at 0°C
EN 10217-2:2002 A1:2005	P235GH	---	1.0345	$t \leq 16$	---	235	---	360-500	---	25 L; 23 T	see standard	see standard for impact data
EN 10217-5:2002 A1:2005	P235GH	---	1.0345	$t \leq 16$	---	235	---	360-500	---	25 L; 23 T	see standard	see standard for impact data
				$16 < t \leq 40$	---	225	---	360-500	---	25 L; 23 T	see standard	
JIS G 3455:2012	Symbol STS370	---	---	---	---	215	---	370	---	28 L; 23 T	see standard	---
JIS G 3456:2014	Symbol STPT370	---	---	---	---	215	---	370	---	30 L; 25 T	see standard	---
AFNOR NF A 49-220:1990	TU 42 C	---	---	---	---	235	---	410-510	---	---	N	32 J at 0°C
JIS G 3455:2012	Symbol STS410	---	---	---	---	245	---	410	---	24 L; 19 T	see standard	---
JIS G 3456:2014	Symbol STPT410	---	---	---	---	245	---	410	---	25 L; 20 T	see standard	---
JIS G 3467:2013	Symbol STF410	---	---	---	---	245	---	410	---	25 L; 20 T	HFS: AM CFS: LTA, N	---
GB 3087-1999	Grade 20	---	---	$t < 15$	---	245	---	410-550 L	---	20 L	HF, CF or HT	---
				$t \geq 15$	---	225	---	410-550 L	---	20 L	HF, CF or HT	---
GB 5310-1995	Grade 20G	---	---	---	---	245	---	410-550 L, 400 T	---	24 L, 22 T	N	see standard
	Grade 20MnG	---	---	---	---	240	---	415 L	---	22 L	N	see standard
JIS G 3461:2012	Symbol STB410	---	---	$d < 10$	---	255	---	410	---	17	see standard	---
				$10 \leq d < 20$	---	255	---	410	---	20	see standard	---
				$d \geq 20$	---	255	---	410	---	25	see standard	---
ASME SA-556/SA-556M	Grade B2	K02707	---	$t \geq 1.1$	$t \geq 0.045$	260	37	410	60	30	HT	79 max HRB
ASTM A556/A556M-96 (2012)	Grade B2	K02707	---	$t \geq 1.1$	$t \geq 0.045$	260	37	410	60	30	CD+1200°F min	79 max HRB

Note: This section continued on next page.

5.7 Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.7A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10216-2:2013	P265GH	---	1.0425	$t \leq 16$	---	265	---	410-570	---	23 L; 21 T	N, NF	L: 40 J at 0°C L: 28 J at -10°C T: 27 J at 0°C
				$16 < t \leq 40$	---	255	---	410-570	---	23 L; 21 T	N, NF	L: 40 J at 0°C L: 28 J at -10°C T: 27 J at 0°C
				$40 < t \leq 60$	---	245	---	410-570	---	23 L; 21 T	N, NF	L: 40 J at 0°C L: 28 J at -10°C T: 27 J at 0°C
				$60 < t \leq 100$	---	---	---	410-570	---	23 L; 21 T	N, NF	L: 40 J at 0°C L: 28 J at -10°C T: 27 J at 0°C
EN 10217-2:2002 A1:2005	P265GH	---	1.0425	$t \leq 16$	---	265	---	410-570	---	23 L; 21 T	see standard	see standard for impact data
EN 10217-5:2002 A1:2005	P265GH	---	1.0425	$t \leq 16$	---	265	---	410-570	---	23 L; 21 T	see standard	see standard for impact data
				$16 < t \leq 40$	---	255	---	410-570	---	23 L; 21 T	see standard	
ASME SA-106	Grade B	---	---	---	---	240	35	415 L	60 L	22 L, 12 T	CF+HT or HF	---
ASME SA-178/SA-178M*	Grade C	K03503	---	$t \geq 0.4$	$t \geq 0.015$	255	37	415	60	30	see standard	---
ASME SA-210/SA-210M	Grade A-1	K02707	---	$t \geq 0.4$	$t \geq 0.015$	255	37	415	60	30	HF or CF+A or CF+N	143 max HB; 79 max HRB
ASTM A106/A106M-14	Grade B	K03006	---	---	---	240	35	415	60	22 L; 12 T	HF or CD + 1200°F min	---
ASTM A178/A178M-02 (2012)*	Grade C	K03503	---	$t \geq 0.4$	$t \geq 0.015$	255	37	415	60	30	see standard	---
ASTM A210/A210M-02 (2012)	Grade A-1	K02707	---	$t \geq 0.4$	$t \geq 0.015$	255	37	415	60	30	HF or CF + SA, A, N	79 max HRB; 143 max HB

*: See "List of Standards" at the beginning of the chapter.

5.7 Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.7A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
AFNOR NF A 49-220:1990	TU 48 C	---	---	---	---	275	---	470-570	---	---	N	40 J at 0°C
JIS G 3455:2012	Symbol STS480	---	---	---	---	275	---	480	---	22 L; 17 T	see standard	---
JIS G 3456:2014	Symbol STPT480	---	---	---	---	275	---	480	---	25 L; 20 T	see standard	---
ASME SA-556/SA-556M	Grade C2	K03006	---	$t \geq 1.1$	$t \geq 0.045$	280	40	480	70	30	HT	89 max HRB
ASTM A556/A556M-96 (2012)	Grade C2	K03006	---	$t \geq 1.1$	$t \geq 0.045$	280	40	480	70	30	CD+1200°F min	89 max HRB
ASTM A178/A178M-02 (2012)*	Grade D	K02709	---	$t \geq 0.4$	$t \geq 0.015$	275	40	485	70	30	see standard	---
ASTM A210/A210M-02 (2012)	Grade C	K03501	---	$t \geq 0.4$	$t \geq 0.015$	275	40	485	70	30	HF or CF + SA, A, N	89 max HRB 179 max HB
ASME SA-106	Grade C	K03501	---	---	---	275	40	485 L	70 L	20 L, 12 T	CF+HT or HF	---
ASTM A106/A106M-14	Grade C	K03501	---	---	---	275	40	485	70	20 L; 12 T	HF or CD + 1200°F min	---
ASME SA-178/SA-178M*	Grade D	K02709	---	$t \geq 0.4$	$t \geq 0.015$	275	40	485	70	30	see standard	---
ASME SA-210/SA-210M*	Grade C	K03501	---	$t \geq 0.4$	$t \geq 0.015$	275	40	485	70	30	HF or CF+A or CF+N	179 max HB; 89 max HRB
GB 5310-1995	Grade 25MnG	---	---	---	---	275	---	485 L	---	20 L	N	see standard
JIS G 3461:2012	Symbol STB510	---	---	$d < 10$	---	295	---	510	---	17	N	---
				$10 \leq d < 20$	---	295	---	510	---	20	N	---
				$d \geq 20$	---	295	---	510	---	25	N	---
AFNOR NF A 49-220:1990	TU 52 C	---	---	---	---	350	---	510-630	---	---	N	40 J at 0°C

*: See "List of Standards" at the beginning of the chapter.

5.7 Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.7B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-214/SA-214M	---	K01807	---	0.18	0.27-0.63	---	0.035	0.035	---	---	---	---
ASME SA-556/SA-556M	Grade A2	---	---	0.18	0.27-0.63	---	0.035	0.035	---	---	---	---
ASTM A214/A214M-96 (2012)	---	K01807	---	0.18	0.27-0.63	---	0.035	0.035	---	---	---	---
ASTM A556/A556M-96 (2012)	Grade A2	K01807	---	0.18	0.27-0.63	---	0.035	0.035	---	---	---	---
EN 10216-2:2013	P195GH	---	1.0348	0.13	0.70	0.35	0.025	0.010	0.30	0.30	0.08	Al 0.020 min; Cu 0.30; Nb 0.010; Ti 0.040; V 0.02; (Cr+Cu+Mo+Ni) 0.70
EN 10217-2:2002 A1:2005	P195GH	---	1.0348	0.13	0.70	0.35	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al 0.020 min; (Cr+Cu+Mo+Ni) 0.70
ASME SA-178/SA-178M*	Grade A	K01200	---	0.06-0.18	0.27-0.63	---	0.035	0.035	---	---	---	---
ASME SA-179/SA-179M*	---	---	---	0.06-0.18	0.27-0.63	---	0.035	0.035	---	---	---	---
ASME SA-192/SA-192M*	---	K01201	---	0.06-0.18	0.27-0.63	0.25	0.035	0.035	---	---	---	---
ASTM A178/A178M-02 (2012)*	Grade A	K01200	---	0.06-0.18	0.27-0.63	---	0.035	0.035	---	---	---	---
ASTM A179/A179M-90a (2012)*	---	K01200	---	0.06-0.18	0.27-0.63	---	0.035	0.035	---	---	---	---
ASTM A192/A192M-02 (2012)*	---	K01201	---	0.06-0.18	0.27-0.63	0.25	0.035	0.035	---	---	---	---
ASME SA-106	Grade A	---	---	0.25	0.27-0.93	0.10 min.	0.035	0.035	0.40	0.40	0.15	V 0.08; Cu 0.40; (Cr+Cu+Mo+Ni+V) 1.00
ASTM A106/A106M-14	Grade A	K02501	---	0.25	0.27-0.93	0.10 min.	0.035	0.035	0.40	0.40	0.15	Cu 0.40; V 0.08; (Cu+Ni+Cr+Mo+V) 1.0
GB 3087-1999	Grade 10	---	---	0.07-0.13	0.35-0.65	0.17-0.37	0.035	0.035	0.15	0.30	---	Cu 0.25
JIS G 3461:2012	Symbol STB340	---	---	0.18	0.30-0.60	0.35	0.035	0.035	---	---	---	---
AFNOR NF A 49-220:1990	TU 37 C	---	---	0.16	0.35-0.75	0.06-0.30	0.025	0.025	---	---	---	---
EN 10216-2:2013	P235GH	---	1.0345	0.16	1.20	0.35	0.025	0.010	0.30	0.30	0.08	Al 0.020 min; Cu 0.30; Nb 0.020; Ti 0.040; V 0.02; (Cr+Cu+Mo+Ni) 0.70
EN 10217-2:2002 A1:2005	P235GH	---	1.0345	0.16	1.20	0.35	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al 0.020 min; (Cr+Cu+Mo+Ni) 0.70
EN 10217-5:2002 A1:2005	P235GH	---	1.0345	0.16	1.20	0.35	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al 0.020 min; (Cr+Cu+Mo+Ni) 0.70
JIS G 3455:2012	Symbol STS370	---	---	0.25	0.30-1.10	0.10-0.35	0.035	0.035	---	---	---	---
JIS G 3456:2014	Symbol STPT370	---	---	0.25	0.30-0.90	0.10-0.35	0.035	0.035	---	---	---	---

*: See "List of Standards" at the beginning of the chapter.

5.7 Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.7B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 49-220:1990	TU 42 C	---	---	0.20	0.45-1.00	0.08-0.35	0.025	0.025	---	---	---	---
JIS G 3455:2012	Symbol STS410	---	---	0.30	0.30-1.40	0.10-0.35	0.035	0.035	---	---	---	---
JIS G 3456:2014	Symbol STPT410	---	---	0.30	0.30-1.00	0.10-0.35	0.035	0.035	---	---	---	---
JIS G 3467:2013	Symbol STF410	---	---	0.30	0.30-1.00	0.10-0.35	0.035	0.035	---	---	---	---
GB 3087-1999	Grade 20	---	---	0.17-0.23	0.35-0.65	0.17-0.37	0.035	0.035	0.25	0.30	---	Cu 0.25
GB 5310-1995	Grade 20G	---	---	0.17-0.24	0.35-0.65	0.17-0.37	0.03	0.03	0.25	0.25	0.15	V 0.08; Cu 0.20
	Grade 20MnG	---	---	0.17-0.24	0.70-1.00	0.17-0.37	0.03	0.03	0.25	0.25	0.15	V 0.08; Cu 0.20
JIS G 3461:2012	Symbol STB410	---	---	0.32	0.30-0.80	0.35	0.035	0.035	---	---	---	---
ASME SA-556/SA-556M	Grade B2	K02707	---	0.27	0.29-0.93	0.10 min.	0.035	0.035	---	---	---	---
ASTM A556/A556M-96 (2012)	Grade B2	K02707	---	0.27	0.29-0.93	0.10 min.	0.035	0.035	---	---	---	---
EN 10216-2:2013	P265GH	---	1.0425	0.20	1.40	0.40	0.025	0.010	0.30	0.30	0.08	Al 0.020 min; Cu 0.30; Nb 0.020; Ti 0.040; V 0.02; (Cr+Cu+Mo+Ni) 0.70
EN 10217-2:2002 A1:2005	P265GH	---	1.0425	0.20	1.40	0.40	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al 0.020 min; (Cr+Cu+Mo+Ni) 0.70
EN 10217-5:2002 A1:2005	P265GH	---	1.0425	0.20	1.40	0.40	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al 0.020 min; (Cr+Cu+Mo+Ni) 0.70
ASME SA-106	Grade B	---	---	0.30	0.29-1.06	0.10 min.	0.035	0.035	0.40	0.40	0.15	V 0.08; Cu 0.40; (Cr+Cu+Mo+Ni+V) 1.00
ASME SA-178/SA-178M*	Grade C	K03503	---	0.35	0.80	---	0.035	0.035	---	---	---	---
ASME SA-210/SA-210M	Grade A-1	K02707	---	0.27	0.93	0.10 min.	0.035	0.035	---	---	---	---
ASTM A106/A106M-14	Grade B	K03006	---	0.30	0.29-1.06	0.10 min.	0.035	0.035	0.40	0.40	0.15	Cu 0.40; V 0.08; (Cu+Ni+Cr+Mo+V) 1.0
ASTM A178/A178M-02 (2012)*	Grade C	K03503	---	0.35	0.80	---	0.035	0.035	---	---	---	---
ASTM A210/A210M-02 (2012)	Grade A-1	K02707	---	0.27	0.93	0.10 min.	0.035	0.035	---	---	---	---

*: See "List of Standards" at the beginning of the chapter.

5.7 Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.7B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 49-220:1990	TU 48 C	---	---	0.22	0.65-1.25	0.10-0.35	0.025	0.025	---	---	---	---
JIS G 3455:2012	Symbol STS480	---	---	0.33	0.30-1.50	0.10-0.35	0.035	0.035	---	---	---	---
JIS G 3456:2014	Symbol STPT480	---	---	0.33	0.30-1.00	0.10-0.35	0.035	0.035	---	---	---	---
ASME SA-556/SA-556M	Grade C2	K03006	---	0.30	0.29-1.06	0.10 min.	0.035	0.035	---	---	---	---
ASTM A556/A556M-96 (2012)	Grade C2	K03006	---	0.30	0.29-1.06	0.10 min.	0.035	0.035	---	---	---	---
ASTM A178/A178M-02 (2012)*	Grade D	K02709	---	0.27	1.00-1.50	0.10 min.	0.030	0.015	---	---	---	---
ASTM A210/A210M-02 (2012)	Grade C	K03501	---	0.35	0.29-1.06	0.10 min.	0.035	0.035	---	---	---	---
ASME SA-106	Grade C	K03501	---	0.35	0.29-1.06	0.10 min.	0.035	0.035	0.40	0.40	0.15	V 0.08; Cu 0.40; (Cr+Cu+Mo+Ni+V) 1.00
ASTM A106/A106M-14	Grade C	K03501	---	0.35	0.29-1.06	0.10 min.	0.035	0.035	0.40	0.40	0.15	Cu 0.40; V 0.08; (Cu+Ni+Cr+Mo+V) 1.0
ASME SA-178/SA-178M*	Grade D	K02709	---	0.27	1.00-1.50	0.10 min.	0.030	0.015	---	---	---	---
ASME SA-210/SA-210M	Grade C	K03501	---	0.35	0.29-1.06	0.10 min.	0.035	0.035	---	---	---	---
GB 5310-1995	Grade 25MnG	---	---	0.22-0.30	0.70-1.00	0.17-0.37	0.03	0.03	0.25	0.25	0.15	V 0.08; Cu 0.20
AFNOR NF A 49-220:1990	TU 52 C	---	---	0.20	1.00-1.50	0.15-0.50	0.025	0.025	---	---	---	---
JIS G 3461:2012	Symbol STB510	---	---	0.25	1.00-1.50	0.35	0.035	0.035	---	---	---	---

*: See "List of Standards" at the beginning of the chapter.

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.1A Chemical Composition of ¼ Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 49-220:1990	TU 15 D 3	---	---	0.12-0.20	0.50-0.80	0.15-0.35	0.025	0.025	0.30	---	0.25-0.35	---
EN 10216-2:2013	16Mo3	---	1.5415	0.12-0.20	0.40-0.90	0.35	0.025	0.010	0.30	0.30	0.25-0.35	Al 0.040; Cu 0.30
EN 10217-2:2002 A1:2005	16Mo3	---	1.5415	0.12-0.20	0.40-0.90	0.35	0.025	0.020	0.30	0.30	0.25-0.35	Cu 0.30; Al 0.040
EN 10217-5:2002 A1:2005	16Mo3	---	1.5415	0.12-0.20	0.40-0.90	0.35	0.025	0.020	0.30	0.30	0.25-0.35	Cu 0.30; Al 0.040
GB 5310-1995	Grade 15MoG	---	---	0.12-0.20	0.40-0.80	0.17-0.37	0.03	0.03	0.3	0.3	0.25-0.35	Cu 0.20
ISO 9329-2:1997	Grade 16 Mo 3	---	---	0.12-0.20	0.40-0.80	0.15-0.35	0.035	0.035	---	---	0.25-0.35	Al 0.020

5.8.1B Mechanical Properties of ¼Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
AFNOR NF A 49-220:1990	TU 15 D 3	---	---	---	---	265	---	430-550	---	22	heat + air cool	---
EN 10216-2:2013	16Mo3	---	1.5415	t ≤ 16	---	280	---	450-600	---	22 L; 20 T	N, NF	L: 40 J at 20°C T: 27 J at 20°C
				16 < t ≤ 40	---	270	---	450-600	---	22 L; 20 T	N, NF	L: 40 J at 20°C T: 27 J at 20°C
				40 < t ≤ 60	---	260	---	450-600	---	22 L; 20 T	N, NF	L: 40 J at 20°C T: 27 J at 20°C
				60 < t ≤ 100	---	---	---	450-600	---	22 L; 20 T	N, NF	L: 40 J at 20°C T: 27 J at 20°C
EN 10217-2:2002 A1:2005	16Mo3	---	1.5415	t ≤ 16	---	280	---	450-600	---	22 L; 20 T	see standard	L: 40 J at 20°C T: 27 J at 20°C
EN 10217-5:2002 A1:2005	16Mo3	---	1.5415	t ≤ 16	---	280	---	450-600	---	22 L; 20 T	see standard	L: 40 J at 20°C T: 27 J at 20°C
				16 < t ≤ 40	---	270	---	450-600	---	22 L; 20 T	see standard	L: 40 J at 20°C T: 27 J at 20°C
GB 5310-1995	Grade 15MoG	---	---	---	---	270	---	450-600 L	---	22 L, 20 T	N	see standard
ISO 9329-2:1997	Grade 16 Mo 3	---	---	t ≤ 10	---	280	---	450-600	---	22 L, 20 T	N	L: 35 J @ RT
				10 < t ≤ 40	---	270	---	450-600	---	22 L, 20 T	N	see standard
				40 < t ≤ 60	---	260	---	450-600	---	22 L, 20 T	N	see standard

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.2A Chemical Composition of ½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-209/SA-209M	Grade T1	K11522	---	0.10-0.20	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	Grade T1a	K12023	---	0.15-0.25	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	Grade T1b	K11422	---	0.14	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
ASME SA-250/SA-250M	Grade T1	K11522	---	0.10-0.20	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	Grade T1a	K12023	---	0.15-0.25	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	Grade T1b	K11422	---	0.14	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
ASME SA-335/SA-335M	Grade P1	K11522	---	0.10-0.20	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
ASTM A209/A209M-03 (2012)	Grade T1	K11522	---	0.10-0.20	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	Grade T1a	K12023	---	0.15-0.25	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	Grade T1b	K11422	---	0.14	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
ASTM A250/A250M-05 (2014)	Grade T1	K11522	---	0.10-0.20	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	Grade T1a	K12023	---	0.15-0.25	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	Grade T1b	K11422	---	0.14	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
ASTM A335/A335M-15	Grade P1	K11522	---	0.10-0.20	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
EN 10216-2:2013	8MoB5-4	---	1.5450	0.06-0.10	0.60-0.80	0.10-0.35	0.025	0.010	0.30	---	0.40-0.50	Al 0.060; Cu 0.30; Ti 0.060; B 0.002-0.006
GB 5310-1995	Grade 20MoG	---	---	0.15-0.25	0.40-0.80	0.17-0.37	0.03	0.03	0.3	0.3	0.44-0.65	Cu 0.20
JIS G 3458:2013	Symbol STPA12	---	---	0.10-0.20	0.30-0.80	0.10-0.50	0.035	0.035	---	---	0.45-0.65	---
JIS G 3462:2014	Symbol STBA12	---	---	0.10-0.20	0.30-0.80	0.10-0.50	0.035	0.035	---	---	0.45-0.65	---
JIS G 3467:2013	Symbol STFA12	---	---	0.10-0.20	0.30-0.80	0.10-0.50	0.035	0.035	---	---	0.45-0.65	---
JIS G 3462:2014	Symbol STBA13	---	---	0.15-0.25	0.30-0.80	0.10-0.50	0.035	0.035	---	---	0.45-0.65	---

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.2B Mechanical Properties of ½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-209/SA-209M	Grade T1	K11522	---	$0.9 \leq t < 5.1$	$0.035 \leq t < 0.200$	205	30	380	55	30	HF or CF+IA, FA or N+T	80 max HRB
				$5.1 < t \leq 12.7$	$0.200 < t \leq 0.500$	205	30	380	55	30	HF or CF+IA, FA or N+T	146 max HBW
	Grade T1a	K12023	---	$0.9 \leq t < 5.1$	$0.035 \leq t < 0.200$	220	32	415	60	30	HF or CF+IA, FA or N+T	81 max HRB
				$5.1 < t \leq 12.7$	$0.200 < t \leq 0.500$	220	32	415	60	30	HF or CF+IA, FA or N+T	153 max HBW
	Grade T1b	K11422	---	$0.9 \leq t < 5.1$	$0.035 \leq t < 0.200$	195	28	365	53	30	HF or CF+IA, FA or N+T	77 max HRB
				$5.1 < t \leq 12.7$	$0.200 < t \leq 0.500$	195	28	365	53	30	HF or CF+IA, FA or N+T	137 max HBW
ASME SA-250/SA-250M	Grade T1	K11522	---	$0.4 \leq t < 5.1$	$0.015 \leq t < 0.200$	205	30	380	55	30	FA, IA, N or N+T	80 max HRB
				$t \geq 5.1$	$t \geq 0.200$	205	30	380	55	30	FA, IA, N or N+T	146 max HBW
	Grade T1a	K12023	---	$0.4 \leq t < 5.1$	$0.015 \leq t < 0.200$	220	32	415	60	30	FA, IA, N or N+T	81 max HRB
				$t \geq 5.1$	$t \geq 0.200$	220	32	415	60	30	FA, IA, N or N+T	153 max HBW
	Grade T1b	K11422	---	$0.4 \leq t < 5.1$	$0.015 \leq t < 0.200$	195	28	365	53	30	FA, IA, N or N+T	77 max HRB
				$t \geq 5.1$	$t \geq 0.200$	195	28	365	53	30	FA, IA, N or N+T	137 max HBW
ASME SA-335/SA-335M	Grade P1	K11522	---	---	---	205	30	380	55	30 L, 20 T	A, N+T or SA	---
ASTM A209/A209M-03 (2012)	Grade T1	K11522	---	$0.9 \leq t < 5.1$	$0.035 \leq t < 0.200$	205	30	380	55	30	see standard	80 max HRB
				$5.1 < t \leq 12.7$	$0.200 < t \leq 0.500$	205	30	380	55	30	see standard	146 max HBW
	Grade T1a	K12023	---	$0.9 \leq t < 5.1$	$0.035 \leq t < 0.200$	220	32	415	60	30	see standard	81 max HRB
				$5.1 < t \leq 12.7$	$0.200 < t \leq 0.500$	220	32	415	60	30	see standard	153 max HBW
	Grade T1b	K11422	---	$0.9 \leq t < 5.1$	$0.035 \leq t < 0.200$	195	28	365	53	30	see standard	77 max HRB
				$5.1 < t \leq 12.7$	$0.200 < t \leq 0.500$	195	28	365	53	30	see standard	137 max HBW
ASTM A250/A250M-05 (2014)	Grade T1	K11522	---	$0.4 \leq t < 5.1$	$0.015 \leq t < 0.200$	205	30	380	55	30	A, IA, N or NT	80 max HRB
				$t \geq 5.1$	$t \geq 0.200$	205	30	380	55	30	A, IA, N or NT	146 max HBW
	Grade T1a	K12023	---	$0.4 \leq t < 5.1$	$0.015 \leq t < 0.200$	220	32	415	60	30	A, IA, N or NT	81 max HRB
				$t \geq 5.1$	$t \geq 0.200$	220	32	415	60	30	A, IA, N or NT	153 max HBW
	Grade T1b	K11422	---	$0.4 \leq t < 5.1$	$0.015 \leq t < 0.200$	195	28	365	53	30	A, IA, N or NT	77 max HRB
				$t \geq 5.1$	$t \geq 0.200$	195	28	365	53	30	A, IA, N or NT	137 max HBW
ASTM A335/A335M-15	Grade P1	K11522	---	---	---	205	30	380	55	$t \geq 8\text{mm}$ (5/16 in.) 30 L; 20 T	FA, IA, NT or SA	---

Note: This section continued on next page.

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.2B Mechanical Properties of ½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10216-2:2013	8MoB5-4	---	1.5450	$t \leq 16$	---	400	---	540-690	---	19 L; 17 T	N, NF	L: 40 J at 20°C T: 27 J at 20°C
				$16 < t \leq 100$	---	---	---	540-690	---	19 L; 17 T	N, NF	L: 40 J at 20°C T: 27 J at 20°C
GB 5310-1995	Grade 20MoG	---	---	---	---	220	---	415 L	---	22 L	N	see standard
JIS G 3458:2013	Symbol STPA12	---	---	---	---	205	---	380	---	24 L; 19 T	LTA, IA, FA, N, or NT	---
JIS G 3462:2014	Symbol STBA12	---	---	$d < 10$	---	205	---	380	---	22 L	LTA, IA, A, N or NT	---
				$10 \leq d < 20$	---	205	---	380	---	25 L	LTA, IA, A, N or NT	---
				$d \geq 20$	---	205	---	380	---	30 L	LTA, IA, A, N or NT	---
JIS G 3467:2013	Symbol STFA12	---	---	---	---	205	---	380	---	30	LTA, IA, A, N or NT	---
JIS G 3462:2014	Symbol STBA13	---	---	$d < 10$	---	205	---	410	---	22	LTA, IA, A, N or NT	---
				$10 \leq d < 20$	---	205	---	410	---	25	LTA, IA, A, N or NT	---
				$d \geq 20$	---	205	---	410	---	30	LTA, IA, A, N or NT	---

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.3A Chemical Composition of ½Cr-½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 49-220:1990	TU 15 CD 2-05	---	---	0.10-0.18	0.50-0.90	0.10-0.35	0.025	0.025	0.40-0.65	---	0.45-0.60	---
ASME SA-213/SA-213M	Grade T2	K11547	---	0.10-0.20	0.30-0.61	0.10-0.30	0.025	0.025	0.50-0.81	---	0.44-0.65	---
ASME SA-250/SA-250M	Grade T2	K11547	---	0.10-0.20	0.30-0.61	0.10-0.30	0.025	0.020	0.50-0.81	---	0.44-0.65	---
ASME SA-335/SA-335M	Grade P2	K11547	---	0.10-0.20	0.30-0.61	0.10-0.30	0.025	0.025	0.50-0.81	---	0.44-0.65	---
ASTM A213/A213M-15a	Grade T2	K11547	---	0.10-0.20	0.30-0.61	0.10-0.30	0.025	0.025	0.50-0.81	---	0.44-0.65	---
ASTM A250/A250M-05 (2014)	Grade T2	K11547	---	0.10-0.20	0.30-0.61	0.10-0.30	0.025	0.020	0.50-0.81	---	0.44-0.65	---
ASTM A335/A335M-15	Grade P2	K11547	---	0.10-0.20	0.30-0.61	0.10-0.30	0.025	0.025	0.50-0.81	---	0.44-0.65	---
GB 5310-1995	Grade 12CrMoG	---	---	0.08-0.15	0.40-0.70	0.17-0.37	0.03	0.03	0.40-0.70	0.3	0.40-0.55	Cu 0.20
GB 6479-2000	Grade 12CrMo	---	---	0.08-0.15	0.40-0.70	0.17-0.37	0.03	0.03	0.40-0.70	0.3	0.40-0.55	Cu 0.20
JIS G 3458:2013	Symbol STPA20	---	---	0.10-0.20	0.30-0.60	0.10-0.50	0.035	0.035	0.50-0.80	---	0.40-0.65	---
JIS G 3462:2014	Symbol STBA20	---	---	0.10-0.20	0.30-0.60	0.10-0.50	0.035	0.035	0.50-0.80	---	0.40-0.65	---
EN 10216-2:2013	14MoV6-3	---	1.7715	0.10-0.15	0.40-0.70	0.15-0.35	0.025	0.010	0.30-0.60	0.30	0.50-0.70	Al 0.040; Cu 0.30; V 0.22-0.28
ISO 9329-2:1997	Grade 12 MoCrV 6-2	---	---	0.10-0.15	0.40-0.70	0.15-0.35	0.035	0.035	0.30-0.60	---	0.50-0.70	V 0.22-0.28; Al 0.020

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.3B Mechanical Properties of ½Cr–½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
AFNOR NF A 49-220:1990	TU 15 CD 2-05	---	---	---	---	275	---	440-570	---	22	heat + air cool + T	32 J at 0°C
ASME SA-213/SA-213M	Grade T2	K11547	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	415	60	30	A+N+T+SCA	163 max HB/ 170 max HV; 85 max HRB
ASME SA-250/SA-250M	Grade T2	K11547	---	$0.4 \leq t < 5.1$	$0.015 \leq t < 0.200$	205	30	415	60	30	FA, IA, N or N+T	85 max HRB
				$t \geq 5.1$	$t \geq 0.200$	205	30	415	60	30	FA, IA, N or N+T	163 max HBW
ASME SA-335/SA-335M	Grade P2	K11547	---	---	---	205	30	380	55	30 L, 20 T	A, N+T or SA	---
ASTM A213/A213M-15a	Grade T2	K11547	---	$0.4 < t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	415	60	30	A, IA, NT, SA	163 max HB/ 170 max HV; 85 max HRB
ASTM A250/A250M-05 (2014)	Grade T2	K11547	---	$0.4 \leq t < 5.1$	$0.015 \leq t < 0.200$	205	30	415	60	30	A, IA, N or NT	85 max HRB
				$t \geq 5.1$	$t \geq 0.200$	205	30	415	60	30	A, IA, N or NT	163 max HBW
ASTM A335/A335M-15	Grade P2	K11547	---	---	---	205	30	380	55	$t \geq 8\text{mm}$ (5/16 in.) 30 L; 20 T	FA, IA, NT or SA	---
GB 5310-1995	Grade 12CrMoG	---	---	---	---	205	---	410-560 L	---	21 L	N+T	see standard
GB 6479-2000	Grade 12CrMo	---	---	---	---	205	---	410-560 L	---	21 L	N+T	L: 55 J @ RT
JIS G 3458:2013	Symbol STPA20	---	---	---	---	205	---	410	---	24 L; 19 T	LTA, IA, FA, or NT	---
JIS G 3462:2014	Symbol STBA20	---	---	$d < 10$	---	205	---	410	---	22 L	LTA, IA, A, or NT	---
				$10 \leq d < 20$	---	205	---	410	---	25 L	LTA, IA, A, or NT	---
				$d \geq 20$	---	205	---	410	---	30 L	LTA, IA, A, or NT	---
EN 10216-2:2013	14MoV6-3	---	1.7715	$t \leq 16$	---	320	---	460-610	---	20 L; 18 T	NT, NF, QT	L: 40 J at 20°C T: 27 J at 20°C
				$16 < t \leq 40$	---	320	---	460-610	---	20 L; 18 T	NT, NF, QT	L: 40 J at 20°C T: 27 J at 20°C
				$40 < t \leq 60$	---	310	---	460-610	---	20 L; 18 T	NT, NF, QT	L: 40 J at 20°C T: 27 J at 20°C
				$60 < t \leq 100$	---	---	---	460-610	---	20 L; 18 T	NT, NF, QT	L: 40 J at 20°C T: 27 J at 20°C
ISO 9329-2:1997	Grade 12 MoCrV 6-2	---	---	$t \leq 40$	---	320	---	460-610	---	20 L, 18 T	N+T	see standard
				$40 < t \leq 60$	---	310	---	460-610	---	20 L, 18 T	N+T	see standard

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.4A Chemical Composition of 1/2 Cr – 1 Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
ASME SA-335/SA-335M	Grade P911	K91061	---	0.09-0.13	0.30-0.60	0.10-0.50	0.020	0.010	8.50-9.50	0.40	0.90-1.10	V 0.18-0.25; Al 0.02; Ti 0.01; Cb 0.060-0.10; W 0.90-1.10; N 0.04-0.09; B 0.0003-0.006; Zr 0.01
ASTM A213/A213M-15a	Grade T36 Class 1	K21001	---	0.10-0.17	0.80-1.20	0.25-0.50	0.030	0.025	0.30	1.00-1.30	0.25-0.50	V 0.02; Al 0.050; Cu 0.50-0.80; Nb 0.015-0.045; N 0.02
	Grade T36 Class 2	K21001	---	0.10-0.17	0.80-1.20	0.25-0.50	0.030	0.025	0.30	1.00-1.30	0.25-0.50	V 0.02; Al 0.050; Cu 0.50-0.80; Nb 0.015-0.045; N 0.02
ASTM A335/A335M-15	Grade P911	K91061	---	0.09-0.13	0.30-0.60	0.10-0.50	0.020	0.010	8.5-9.5	0.40	0.90-1.10	V 0.18-0.25; Al 0.02; Ti 0.01; W 0.90-1.10; Cb 0.060-0.10; N 0.04-0.09; B 0.0003-0.006; Zr 0.01
EN 10216-2:2013	15NiCuMoNb5-6-4	---	1.6368	0.17	0.80-1.20	0.25-0.50	0.025	0.010	0.30	1.00-1.30	0.25-0.50	Al 0.050; Cu 0.50-0.80; Nb 0.015-0.045
ISO 9329-2:1997	Grade 9 NiMnMoNb 5-4-4	---	---	0.17	0.80-1.20	0.25-0.50	0.03	0.03	0.3	1.00-1.30	0.25-0.40	Al 0.020; Cu 0.05-0.80; Nb 0.015-0.045

5.8.4B Mechanical Properties of 1/2 Cr – 1 Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-335/SA-335M	Grade P911	K91061	---	---	---	440	64	620	90	20 L	N+T	---
ASTM A213/A213M-15a	Grade T36 Class 1	K21001	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	440	64	620	90	15	NT	250 max HBW/ 265 max HV; 25 max HRC
	Grade T36 Class 2	K21001	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	460	66.5	660	95.5	15	NT	250 max HBW/ 265 max HV; 25 max HRC
ASTM A335/A335M-15	Grade P911	K91061	---	---	---	440	64	620	90	20 L	NT	---
EN 10216-2:2013	15NiCuMoNb5-6-4	---	1.6368	$t \leq 16$	---	440	---	610-780	---	19 L, 17 T	NT	L: 40 J at 20°C T: 27 J at 20°C
				$16 < t \leq 40$	---	440	---	610-780	---	19 L, 17 T	NT	L: 40 J at 20°C T: 27 J at 20°C
				$40 < t \leq 60$	---	440	---	610-780	---	19 L, 17 T	NT	L: 40 J at 20°C T: 27 J at 20°C
				$60 < t \leq 80$	---	440	---	610-780	---	19 L, 17 T	NT	L: 40 J at 20°C T: 27 J at 20°C
ISO 9329-2:1997	Grade 9 NiMnMoNb 5-4-4	---	---	$t \leq 60$	---	440	---	610-780	---	19 L, 17 T	N+T	see standard

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.5A Chemical Composition of 1Cr-½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 49-220:1990	TU 13 CD 4-04	---	---	0.10-0.18	0.40-0.70	0.10-0.35	0.025	0.025	0.70-1.10	---	0.45-0.65	---
ASME SA-213/SA-213M	Grade T12	K11562	---	0.05-0.15	0.30-0.61	0.50	0.025	0.025	0.80-1.25	---	0.44-0.65	---
ASME SA-250/SA-250M	Grade T12	K11562	---	0.05-0.15	0.30-0.61	0.50	0.030	0.020	0.80-1.25	---	0.44-0.65	---
ASME SA-335/SA-335M	Grade P12	K11562	---	0.05-0.15	0.30-0.61	0.50	0.025	0.025	0.80-1.25	---	0.44-0.65	---
ASTM A213/A213M-15a	Grade T12	K11562	---	0.05-0.15	0.30-0.61	0.50	0.025	0.025	0.80-1.25	---	0.44-0.65	---
ASTM A250/A250M-05 (2014)	Grade T12	K11562	---	0.05-0.15	0.30-0.61	0.50	0.030	0.020	0.80-1.25	---	0.44-0.65	---
ASTM A335/A335M-15	Grade P12	K11562	---	0.05-0.15	0.30-0.61	0.50	0.025	0.025	0.80-1.25	---	0.44-0.65	---
BS 3604-2:1991	620	---	---	0.09-0.18	0.40-0.65	0.15-0.40	0.025	0.015	0.80-1.15	0.30	0.45-0.60	Cu 0.30; Al 0.02
EN 10216-2:2013	13CrMo4-5	---	1.7335	0.10-0.17	0.40-0.70	0.35	0.025	0.010	0.70-1.15	0.30	0.40-0.60	Al 0.040; Cu 0.30
GB 5310-1995	Grade 15CrMoG	---	---	0.12-0.18	0.40-0.70	0.17-0.37	0.03	0.03	0.80-1.10	0.3	0.40-0.55	Cu 0.20
GB 6479-2000	Grade 15CrMo	---	---	0.12-0.18	0.40-0.70	0.17-0.37	0.03	0.03	0.80-1.10	0.3	0.40-0.55	Cu 0.20
ISO 9329-2:1997	Grade 13 CrMo 4-5	---	---	0.10-0.17	0.40-0.70	0.15-0.35	0.035	0.035	0.70-1.10	---	0.45-0.65	Al 0.020
	Grade 8 CrMo 4-5	---	---	0.15	0.30-0.60	0.50	0.035	0.035	0.80-1.25	---	0.45-0.65	Al 0.020
JIS G 3458:2013	Symbol STPA22	---	---	0.15	0.30-0.60	0.50	0.035	0.035	0.80-1.25	---	0.45-0.65	---
JIS G 3462:2014	Symbol STBA22	---	---	0.15	0.30-0.60	0.50	0.035	0.035	0.80-1.25	---	0.45-0.65	---
JIS G 3467:2013	Symbol STFA22	---	---	0.15	0.30-0.60	0.50	0.035	0.035	0.80-1.25	---	0.45-0.65	---

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.5B Mechanical Properties of 1Cr–½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
AFNOR NF A 49-220:1990	TU 13 CD 4-04	---	---	---	---	290	---	440-590	---	22	heat + air cool + T	32 J at 0°C
ASME SA-213/SA-213M	Grade T12	K11562	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	220	32	415	60	30	A+N+T+SCA	163 max HBW/ 170 max HV; 85 max HRB
ASME SA-250/SA-250M	Grade T12	K11562	---	$0.4 \leq t < 5.1$	$0.015 \leq t < 0.200$	220	32	415	60	30	FA, IA, N or N+T	85 max HRB
				$t \geq 5.1$	$t \geq 0.200$	220	32	415	60	30	FA, IA, N or N+T	163 max HBW
ASME SA-335/SA-335M	Grade P12	K11562	---	---	---	220	32	415	60	30 L, 20 T	A, N+T or SA	---
ASTM A213/A213M-15a	Grade T12	K11562	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	220	32	415	60	30	A, IA, NT, SA	163 max HBW/ 170 max HV; 85 max HRB
ASTM A250/A250M-05 (2014)	Grade T12	K11562	---	$0.4 \leq t < 5.1$	$0.015 \leq t < 0.200$	220	32	415	60	30	A, IA, N or NT	85 max HRB
				$t \geq 5.1$	$t \geq 0.200$	220	32	415	60	30	A, IA, N or NT	163 max HBW
ASTM A335/A335M-15	Grade P12	K11562	---	---	---	220	32	415	60	$t \geq 8\text{mm}$ (5/16 in.) 30 L; 20 T	FA, IA, NT or SA	---
BS 3604-2:1991	620	---	---	---	---	340	---	480-600	---	18	see standard	---
EN 10216-2:2013	13CrMo4-5	---	1.7335	$t \leq 16$	---	290	---	440-590	---	22 L; 20 T	NT, NF, QT	L: 40 J at 20°C T: 27 J at 20°C
				$16 < t \leq 40$	---	290	---	440-590	---	22 L; 20 T	NT, NF, QT	L: 40 J at 20°C T: 27 J at 20°C
				$40 < t \leq 60$	---	280	---	440-590	---	22 L; 20 T	NT, NF, QT	L: 40 J at 20°C T: 27 J at 20°C
				$60 < t \leq 100$	---	---	---	440-590	---	22 L; 20 T	NT, NF, QT	L: 40 J at 20°C T: 27 J at 20°C
GB 5310-1995	Grade 15CrMoG	---	---	---	---	235	---	440-640 L, 440 T	---	21 L, 20 T	N+T	see standard
GB 6479-2000	Grade 15CrMo	---	---	---	---	235	---	440-640 L	---	21 L	N+T	L: 47 J @ RT
ISO 9329-2:1997	Grade 13 CrMo 4-5	---	---	$t \leq 10$	---	300	---	440-590	---	22 L, 20 T	N+T	L: 35 J @ RT
				$10 < t \leq 40$	---	290	---	440-590	---	22 L, 20 T	N+T	see standard
				$40 < t \leq 60$	---	280	---	440-590	---	22 L, 20 T	N+T	see standard
	Grade 8 CrMo 4-5	---	---	$t \leq 60$	---	205	---	410-560	---	22 L, 20 T	N+T	see standard
JIS G 3458:2013	Symbol STPA22	---	---	---	---	205	---	410	---	24 L; 19 T	LTA, IA, FA, or NT	---
JIS G 3462:2014	Symbol STBA22	---	---	$d < 10$	---	205	---	410	---	22 L	LTA, IA, A, or NT	---
				$10 \leq d < 20$	---	205	---	410	---	25 L	LTA, IA, A, or NT	---
				$d \geq 20$	---	205	---	410	---	30 L	LTA, IA, A, or NT	---
JIS G 3467:2013	Symbol STFA22	---	---	---	---	205	---	410	---	30	LTA, IA, A or NT	---

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.6A Chemical Composition of 1¼ Cr–½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 49-220:1990	TU 10 CD 5-05	---	---	0.15	0.30-0.60	0.50-1.00	0.025	0.025	1.00-1.50	---	0.45-0.65	---
ASME SA-213/SA-213M	Grade T11	K11597	---	0.05-0.15	0.30-0.60	0.50-1.00	0.025	0.025	1.00-1.50	---	0.44-0.65	---
ASME SA-250/SA-250M	Grade T11	K11597	---	0.05-0.15	0.30-0.60	0.50-1.00	0.025	0.020	1.00-1.50	---	0.44-0.65	---
ASME SA-335/SA-335M	Grade P11	K11597	---	0.05-0.15	0.30-0.60	0.50-1.00	0.025	0.025	1.00-1.50	---	0.44-0.65	---
ASTM A213/A213M-15a	Grade T11	K11597	---	0.05-0.15	0.30-0.60	0.50-1.00	0.025	0.025	1.00-1.50	---	0.44-0.65	---
ASTM A250/A250M-05 (2014)	Grade T11	K11597	---	0.05-0.15	0.30-0.60	0.50-1.00	0.025	0.020	1.00-1.50	---	0.44-0.65	---
ASTM A335/A335M-15	Grade P11	K11597	---	0.05-0.15	0.30-0.60	0.50-1.00	0.025	0.025	1.00-1.50	---	0.45-0.65	---
BS 3604-2:1991	621	---	---	0.09-0.17	0.40-0.65	0.50-0.80	0.025	0.015	1.00-1.50	0.30	0.45-0.60	Cu 0.30; Al 0.02
EN 10216-2:2013	10CrMo5-5	---	1.7338	0.15	0.30-0.60	0.50-1.00	0.025	0.010	1.00-1.50	0.30	0.45-0.65	Al 0.040; Cu 0.30
ISO 9329-2:1997	Grade 8 CrMo 5-5	---	---	0.15	0.30-0.60	0.50-1.00	0.03	0.03	1.00-1.50	---	0.45-0.65	Al 0.020
JIS G 3462:2014	Symbol STBA23	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	---
JIS G 3467:2013	Symbol STFA23	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	---
JIS G 3458:2013	Symbol STPA23	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	---

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.6B Mechanical Properties of 1¼Cr–½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
AFNOR NF A 49-220:1990	TU 10 CD 5-05	---	---	---	---	225	---	440-590	---	22	see standard	---
				---	---	325	---	440-640	---	20	heat + air cool + T	32 J at 0°C
ASME SA-213/SA-213M	Grade T11	K11597	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	415	60	30	A+N+T	163 max HB/ 170 max HV; 85 max HRB
ASME SA-250/SA-250M	Grade T11	K11597	---	$0.4 \leq t < 5.1$	$0.015 \leq t < 0.200$	205	30	415	60	30	FA, IA, N or N+T	85 max HRB
				$t \geq 5.1$	$t \geq 0.200$	205	30	415	60	30	FA, IA, N or N+T	163 max HBW
ASME SA-335/SA-335M	Grade P11	K11597	---	---	---	205	30	415	60	30 L, 20 T	A or N+T	---
ASTM A213/A213M-15a	Grade T11	K11597	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	415	60	30	A, IA, NT	163 max HB/ 170 max HV; 85 max HRB
ASTM A250/A250M-05 (2014)	Grade T11	K11597	---	$0.4 \leq t < 5.1$	$0.015 \leq t < 0.200$	205	30	415	60	30	A, IA, N or NT	85 max HRB
				$t \geq 5.1$	$t \geq 0.200$	205	30	415	60	30	A, IA, N or NT	163 max HBW
ASTM A335/A335M-15	Grade P11	K11597	---	---	---	205	30	415	60	$t \geq 8\text{mm}$ (5/16 in.) 30 L; 20 T	FA, IA or NT	---
BS 3604-2:1991	621	---	---	---	---	340	---	515-690	---	18	see standard	---
EN 10216-2:2013	10CrMo5-5	---	1.7338	$t \leq 16$	---	275	---	410-560	---	22 L; 20 T	NT, NF, QT	L: 40 J at 20°C T: 27 J at 20°C
				$16 < t \leq 40$	---	275	---	410-560	---	22 L; 20 T	NT, NF, QT	L: 40 J at 20°C T: 27 J at 20°C
				$40 < t \leq 60$	---	265	---	410-560	---	22 L; 20 T	NT, NF, QT	L: 40 J at 20°C T: 27 J at 20°C
				$60 < t \leq 100$	---	---	---	410-560	---	22 L; 20 T	NT, NF, QT	L: 40 J at 20°C T: 27 J at 20°C
ISO 9329-2:1997	Grade 8 CrMo 5-5	---	---	$t \leq 60$	---	205	---	410-560	---	22 L, 20 T	N+T	see standard
JIS G 3462:2014	Symbol STBA23	---	---	$d < 10$	---	205	---	410	---	22 L	IA, A or NT	---
				$10 \leq d < 20$	---	205	---	410	---	25 L	IA, A or NT	---
				$d \geq 20$	---	205	---	410	---	30 L	IA, A or NT	---
JIS G 3467:2013	Symbol STFA23	---	---	---	---	205	---	410	---	30	IA, A or NT	---
JIS G 3458:2013	Symbol STPA23	---	---	---	---	205	---	410	---	24 L; 19 T	IA, FA or NT	---

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.7A Chemical Composition of 2¼Cr-1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 49-220:1990	TU 10 CD 9-10	---	---	0.15	0.30-0.60	0.10-0.50	0.025	0.025	2.00-2.50	---	0.90-1.10	---
ASME SA-213/SA-213M	Grade T22	K21590	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	1.90-2.60	---	0.87-1.13	---
ASME SA-250/SA-250M	Grade T22	K21590	---	0.15	0.30-0.60	0.50	0.025	0.020	1.90-2.60	---	0.87-1.13	---
ASME SA-335/SA-335M	Grade P22	K21590	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	1.90-2.60	---	0.87-1.13	---
ASTM A213/A213M-15a	Grade T22	K21590	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	1.90-2.60	---	0.87-1.13	---
ASTM A250/A250M-05 (2014)	Grade T22	K21590	---	0.15	0.30-0.60	0.50	0.025	0.020	1.90-2.60	---	0.87-1.13	---
ASTM A335/A335M-15	Grade P22	K21590	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	1.90-2.60	---	0.87-1.13	---
BS 3604-2:1991	622	---	---	0.09-0.15	0.30-0.60	0.50	0.025	0.015	2.00-2.50	0.30	0.90-1.10	Cu 0.30; Al 0.02
EN 10216-2:2013	10CrMo9-10	---	1.7380	0.08-0.14	0.30-0.70	0.50	0.020	0.010	2.00-2.50	0.30	0.90-1.10	Al 0.040; Cu 0.30
	11CrMo9-10	---	1.7383	0.08-0.15	0.40-0.80	0.50	0.025	0.010	2.00-2.50	0.30	0.90-1.10	Al 0.040; Cu 0.30
GB 5310-1995	Grade 12Cr2MoG	---	---	0.08-0.15	0.40-0.70	0.50	0.03	0.03	2.00-2.50	0.3	0.90-1.20	Cu 0.20
GB 6479-2000	Grade 12Cr2Mo	---	---	0.08-0.15	0.40-0.70	0.50	0.03	0.03	2.0-2.50	0.3	0.90-1.20	Cu 0.20
ISO 9329-2:1997	Grade 11 CrMo 9-10 TA	---	---	0.08-0.15	0.30-0.70	0.15-0.40	0.035	0.035	2.00-2.50	---	0.90-1.20	Al 0.020
	Grade 11 CrMo 9-10 TN+TT	---	---	0.08-0.15	0.30-0.70	0.15-0.40	0.035	0.035	2.00-2.50	---	0.90-1.20	Al 0.020
JIS G 3458:2013	Symbol STPA24	---	---	0.15	0.30-0.60	0.50	0.030	0.030	1.90-2.60	---	0.87-1.13	---
JIS G 3462:2014	Symbol STBA24	---	---	0.15	0.30-0.60	0.50	0.030	0.030	1.90-2.60	---	0.87-1.13	---
JIS G 3467:2013	Symbol STFA24	---	---	0.15	0.30-0.60	0.50	0.030	0.030	1.90-2.60	---	0.87-1.13	---

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.7B Mechanical Properties of 2¼Cr–1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
AFNOR NF A 49-220:1990	TU 10 CD 9-10	---	---	---	---	225	---	410-560	---	22	see standard	---
				---	---	325	---	490-640	---	20	heat + air cool + T	32 J at 0°C
ASME SA-213/SA-213M	Grade T22	K21590	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	415	60	30	A+N+T	163 max HB/ 170 max HV; 85 max HRB
ASME SA-250/SA-250M	Grade T22	K21590	---	$0.4 \leq t < 5.1$	$0.015 \leq t < 0.200$	205	30	415	60	30	FA, IA, N or N+T	85 max HRB
				$t \geq 5.1$	$t \geq 0.200$	205	30	415	60	30	FA, IA, N or N+T	163 max HBW
ASME SA-335/SA-335M	Grade P22	K21590	---	---	---	205	30	415	60	30 L, 20 T	A or N+T	---
ASTM A213/A213M-15a	Grade T22	K21590	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	415	60	30	A, IA, NT	163 max HB/ 170 max HV; 85 max HRB
ASTM A250/A250M-05 (2014)	Grade T22	K21590	---	$0.4 \leq t < 5.1$	$0.015 \leq t < 0.200$	205	30	415	60	30	A, IA, N or NT	85 max HRB
				$t \geq 5.1$	$t \geq 0.200$	205	30	415	60	30	A, IA, N or NT	163 max HBW
ASTM A335/A335M-15	Grade P22	K21590	---	---	---	205	30	415	60	$t \geq 8\text{mm}$ (5/16 in.) 30 L; 20 T	FA, IA or NT	---
BS 3604-2:1991	622	---	---	---	---	310	---	515-690	---	16	see standard	---
EN 10216-2:2013	10CrMo9-10	---	1.7380	$t \leq 16$	---	280	---	480-630	---	22 L; 20 T	NT, NF, QT	L: 40 J at 20°C T: 27 J at 20°C
				$16 < t \leq 40$	---	280	---	480-630	---	22 L; 20 T	NT, NF, QT	L: 40 J at 20°C T: 27 J at 20°C
				$40 < t \leq 60$	---	270	---	480-630	---	22 L; 20 T	NT, NF, QT	L: 40 J at 20°C T: 27 J at 20°C
	11CrMo9-10	---	1.7383	$t \leq 16$	---	355	---	540-680	---	20 L; 18 T	QT	L: 40 J at 20°C T: 27 J at 20°C
				$16 < t \leq 40$	---	355	---	540-680	---	20 L; 18 T	QT	L: 40 J at 20°C T: 27 J at 20°C
				$40 < t \leq 60$	---	355	---	540-680	---	20 L; 18 T	QT	L: 40 J at 20°C T: 27 J at 20°C
GB 5310-1995	Grade 12Cr2MoG	---	---	---	---	280	---	450-600 L	---	20 L, 18 T	N+T	see standard
GB 6479-2000	Grade 12Cr2Mo	---	---	---	---	280	---	450-600 L	---	20 L	N+T	L: 38 J @ RT
ISO 9329-2:1997	Grade 11 CrMo 9-10 TA	---	---	$t \leq 60$	---	205	---	410-560	---	22 L, 20 T	A	see standard
	Grade 11 CrMo 9-10 TN+TT	---	---	$t \leq 60$	---	280	---	480-630	---	20 L, 18 T	N+T	see standard
JIS G 3458:2013	Symbol STPA24	---	---	---	---	205	---	410	---	24 L; 19 T	IA, FA or NT	---
JIS G 3462:2014	Symbol STBA24	---	---	$d < 10$	---	205	---	410	---	22 L	IA, A or NT	---
				$10 \leq d < 20$	---	205	---	410	---	25 L	IA, A or NT	---
				$d \geq 20$	---	205	---	410	---	30 L	IA, A or NT	---
JIS G 3467:2013	Symbol STFA24	---	---	---	---	205	---	410	---	30	IA, A or NT	---

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.8A Chemical Composition of 5Cr-½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-213/SA-213M	Grade T5	K41545	---	0.15	0.30-0.60	0.50	0.025	0.025	4.00-6.00	---	0.45-0.65	---
	Grade T5b	K51545	---	0.15	0.30-0.60	1.00-2.00	0.025	0.025	4.00-6.00	---	0.45-0.65	---
ASME SA-335/SA-335M	Grade P5	K41545	---	0.15	0.30-0.60	0.50	0.025	0.025	4.00-6.00	---	0.45-0.65	---
ASTM A213/A213M-15a	Grade T5	K41545	---	0.15	0.30-0.60	0.50	0.025	0.025	4.00-6.00	---	0.45-0.65	---
	Grade T5b	K51545	---	0.15	0.30-0.60	1.00-2.00	0.025	0.025	4.00-6.00	---	0.45-0.65	---
ASTM A335/A335M-15	Grade P5	K41545	---	0.15	0.30-0.60	0.50	0.025	0.025	4.00-6.00	---	0.45-0.65	---
EN 10216-2:2013	X11CrMo5+I	---	1.7362+I	0.08-0.15	0.30-0.60	0.15-0.50	0.025	0.010	4.0-6.0	---	0.45-0.65	Al 0.040; Cu 0.30
	X11CrMo5+NT1	---	1.7362+NT1	0.08-0.15	0.30-0.60	0.15-0.50	0.025	0.010	4.0-6.0	---	0.45-0.65	Al 0.040; Cu 0.30
	X11CrMo5+NT2	---	1.7362+NT2	0.08-0.15	0.30-0.60	0.15-0.50	0.025	0.010	4.0-6.0	---	0.45-0.65	Al 0.040; Cu 0.30
GB 6479-2000	Grade 1Cr5Mo	---	---	0.15	0.60	0.50	0.03	0.03	4.00-6.00	0.6	0.45-0.60	Cu 0.20
ISO 9329-2:1997	Grade X11 CrMo 5 TA	---	---	0.08-0.15	0.30-0.60	0.15-0.50	0.03	0.03	4.00-6.00	---	0.45-0.65	Al 0.020
	Grade X11 CrMo 5 TN+TT	---	---	0.08-0.15	0.30-0.60	0.15-0.50	0.03	0.03	4.00-6.00	---	0.45-0.65	Al 0.020
JIS G 3458:2013	Symbol STPA25	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
JIS G 3462:2014	Symbol STBA25	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
JIS G 3467:2013	Symbol STFA25	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.8B Mechanical Properties of 5Cr–½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade T5	K41545	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	415	60	30	A+N+T	163 max HB/ 170 max HV; 85 max HRB
	Grade T5b	K51545	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	415	60	30	A+N+T	179 max HBW/ 190 max HV; 89 max HRB
ASME SA-335/SA-335M	Grade P5	K41545	---	---	---	205	30	415	60	30 L, 20 T	A or N+T	---
ASTM A213/A213M-15a	Grade T5	K41545	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	415	60	30	A, IA, NT	163 max HB/ 170 max HV; 85 max HRB
	Grade T5b	K51545	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	415	60	30	A, IA, NT	179 max HBW/ 190 max HV 89 max HRB
ASTM A335/A335M-15	Grade P5	K41545	---	---	---	205	30	415	60	$t \geq 8\text{mm}$ (5/16 in.) 30 L; 20 T	FA, IA or NT	---
EN 10216-2:2013	X11CrMo5+I	---	1.7362+ I	$t \leq 16$	---	175	---	430-580	---	22 L; 20 T	I	L: 40 J at 20°C T: 27 J at 20°C
				$16 < t \leq 40$	---	175	---	430-580	---	22 L; 20 T	I	L: 40 J at 20°C T: 27 J at 20°C
				$40 < t \leq 60$	---	175	---	430-580	---	22 L; 20 T	I	L: 40 J at 20°C T: 27 J at 20°C
				$60 < t \leq 100$	---	175	---	430-580	---	22 L; 20 T	I	L: 40 J at 20°C T: 27 J at 20°C
	X11CrMo5+NT1	---	1.7362+ NT1	$t \leq 16$	---	280	---	480-640	---	20 L; 18 T	NT	L: 40 J at 20°C T: 27 J at 20°C
				$16 < t \leq 40$	---	280	---	480-640	---	20 L; 18 T	NT	L: 40 J at 20°C T: 27 J at 20°C
				$40 < t \leq 60$	---	280	---	480-640	---	20 L; 18 T	NT	L: 40 J at 20°C T: 27 J at 20°C
				$60 < t \leq 100$	---	280	---	480-640	---	20 L; 18 T	NT	L: 40 J at 20°C T: 27 J at 20°C
	X11CrMo5+NT2	---	1.7362+ NT2	$t \leq 16$	---	390	---	570-740	---	18 L; 16 T	NT, QT	L: 40 J at 20°C T: 27 J at 20°C
				$16 < t \leq 40$	---	390	---	570-740	---	18 L; 16 T	NT, QT	L: 40 J at 20°C T: 27 J at 20°C
				$40 < t \leq 60$	---	390	---	570-740	---	18 L; 16 T	NT, QT	L: 40 J at 20°C T: 27 J at 20°C
				$60 < t \leq 100$	---	390	---	570-740	---	18 L; 16 T	NT, QT	L: 40 J at 20°C T: 27 J at 20°C

Note: This section continued on next page.

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.8B Mechanical Properties of 5Cr–½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 6479-2000	Grade 1Cr5Mo	---	---	---	---	195	---	390-590 L	---	22 L	A	L: 94 J @ RT
ISO 9329-2:1997	Grade X11 CrMo 5 TA	---	---	$t \leq 60$	---	175	---	430-580	---	22 L, 18 T	A	see standard
	Grade X11 CrMo 5 TN+TT	---	---	$t \leq 60$	---	280	---	480-640	---	20 L, 18 T	N+T	see standard
JIS G 3458:2013	Symbol STPA25	---	---	---	---	205	---	410	---	24 L; 19 T	IA, FA or NT	---
JIS G 3462:2014	Symbol STBA25	---	---	$d < 10$	---	205	---	410	---	22 L	IA, A or NT	---
				$10 \leq d < 20$	---	205	---	410	---	25 L	IA, A or NT	---
				$d \geq 20$	---	205	---	410	---	30 L	IA, A or NT	---
JIS G 3467:2013	Symbol STFA25	---	---	---	---	205	---	410	---	30	IA, A or NT	---

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.9A Chemical Composition of 9Cr-1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
ASME SA-213/SA-213M	Grade T9	K90941	---	0.15	0.30-0.60	0.25-1.00	0.025	0.025	8.00-10.00	---	0.90-1.10	---
ASME SA-335/SA-335M	Grade P9	S50400	---	0.15	0.30-0.60	0.25-1.00	0.025	0.025	8.00-10.00	---	0.90-1.10	---
ASTM A213/A213M-15a	Grade T9	K90941	---	0.15	0.30-0.60	0.25-1.00	0.025	0.025	8.00-10.00	---	0.90-1.10	---
ASTM A335/A335M-15	Grade P9	S50400	---	0.15	0.30-0.60	0.25-1.00	0.025	0.025	8.00-10.00	---	0.90-1.10	---
EN 10216-2:2013	X11CrMo9-1+I	---	1.7386+I	0.08-0.15	0.30-0.60	0.25-1.00	0.025	0.010	8.0-10.0	---	0.90-1.10	Al 0.040; Cu 0.30
	X11CrMo9-1+NT	---	1.7386+NT	0.08-0.15	0.30-0.60	0.25-1.00	0.025	0.010	8.0-10.0	---	0.90-1.10	Al 0.040; Cu 0.30
ISO 9329-2:1997	Grade X11 CrMo 9-1 TA	---	---	0.08-0.15	0.30-0.60	0.25-1.00	0.03	0.03	8.00-10.00	---	0.90-1.10	Al 0.020
	Grade X11 CrMo 9-1 TN+TT	---	---	0.08-0.15	0.30-0.60	0.25-1.00	0.03	0.03	8.00-10.00	---	0.90-1.10	Al 0.020
JIS G 3458:2013	Symbol STPA26	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	---
JIS G 3462:2014	Symbol STBA26	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	---
JIS G 3467:2013	Symbol STFA26	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	---
ASME SA-213/SA-213M	Grade T91	K90901	---	0.07-0.14	0.30-0.60	0.20-0.50	0.020	0.010	8.0-9.5	0.40	0.85-1.05	V 0.18-0.25; Al 0.02; Nb 0.06-0.10; N 0.030-0.070; Ti 0.01; Zr 0.01
ASTM A213/A213M-15a	Grade T91	K90901	---	0.07-0.14	0.30-0.60	0.20-0.50	0.020	0.010	8.0-9.5	0.40	0.85-1.05	V 0.18-0.25; Nb 0.06-0.10; Zr 0.01 N 0.030-0.070; Al 0.02; Ti 0.01
EN 10216-2:2013	X10CrMoVNb9-1	---	1.4903	0.08-0.12	0.30-0.60	0.20-0.50	0.020	0.005	8.0-9.5	0.40	0.85-1.05	V 0.18-0.25; Nb 0.06-0.10; Zr 0.01 N 0.030-0.070; Al 0.02; Cu 0.30
ISO 9329-2:1997	Grade X10 CrMoVNb 9-1	---	---	0.08-0.12	0.30-0.60	0.20-0.50	0.02	0.02	8.00-9.50	0.4	0.85-1.05	V 0.18-0.25; Al 0.020; Nb 0.06-0.10; N 0.030-0.070
ASME SA-335/SA-335M	Grade P91	K91560	---	0.08-0.12	0.30-0.60	0.20-0.50	0.020	0.010	8.00-9.50	0.40	0.85-1.05	V 0.18-0.25; Cb 0.06-0.10; Al 0.02; N 0.030-0.070; Ti 0.01; Zr 0.01
	Grade P92	K92460	---	0.07-0.13	0.30-0.60	0.50	0.020	0.010	8.50-9.50	0.40	0.30-0.60	V 0.15-0.25; Cb 0.04-0.09; Al 0.02; N 0.03-0.07; B 0.001-0.006; W 1.5-2.00; Ti 0.01; Zr 0.01
ASTM A335/A335M-15	Grade P91	K91560	---	0.08-0.12	0.30-0.60	0.20-0.50	0.020	0.010	8.00-9.50	0.40	0.85-1.05	V 0.18-0.25; Al 0.02; Cb 0.06-0.10; N 0.030-0.070; Zr 0.01; Ti 0.01
	Grade P92	K92460	---	0.07-0.13	0.30-0.60	0.50	0.020	0.010	8.50-9.50	0.40	0.30-0.60	V 0.15-0.25; Al 0.02; Ti 0.01; W 1.5-2.00; Cb 0.04-0.09; Zr 0.01 N 0.03-0.07; B 0.001-0.006
GB 5310-1995	Grade 10Cr9Mo1VNb	---	---	0.08-0.12	0.30-0.60	0.20-0.50	0.02	0.01	8.00-9.50	0.4	0.85-1.05	V 0.18-0.25; Al 0.040; Cu 0.20; Nb 0.06-0.10; N 0.030-0.070

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.9B Mechanical Properties of 9Cr-1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade T9	K90941	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	415	60	30	A+N+T	179 max HBW/ 190 max HV; 89 max HRB
ASME SA-335/SA-335M	Grade P9	K50400	---	---	---	205	30	415	60	30 L, 20 T	A or N+T	---
ASTM A213/A213M-15a	Grade T9	K90941	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	415	60	30	A, IA, NT	179 max HBW/ 190 max HV; 89 max HRB
ASTM A335/A335M-15	Grade P9	S50400	---	---	---	205	30	415	60	$t \geq 8\text{mm}$ (5/16 in.) 30 L; 20 T	FA, IA or NT	---
EN 10216-2:2013	X11CrMo9-1+I	---	1.7386+I	$t \leq 16$	---	210	---	460-640	---	20 L; 18 T	I	L: 40 J at 20°C T: 27 J at 20°C
				$16 < t \leq 40$	---	210	---	460-640	---	20 L; 18 T	I	L: 40 J at 20°C T: 27 J at 20°C
				$40 < t \leq 60$	---	210	---	460-640	---	20 L; 18 T	I	L: 40 J at 20°C T: 27 J at 20°C
	X11CrMo9-1+NT	---	1.7386+N T	$t \leq 16$	---	390	---	590-740	---	18 L; 16 T	NT, QT	L: 40 J at 20°C T: 27 J at 20°C
				$16 < t \leq 40$	---	390	---	590-740	---	18 L; 16 T	NT, QT	L: 40 J at 20°C T: 27 J at 20°C
				$40 < t \leq 60$	---	390	---	590-740	---	18 L; 16 T	NT, QT	L: 40 J at 20°C T: 27 J at 20°C
ISO 9329-2:1997	Grade X11 CrMo 9-1 TA	---	---	$t \leq 60$	---	205	---	440-620	---	20 L, 18 T	A	see standard
	Grade X11 CrMo 9-1 TN+TT	---	---	$t \leq 60$	---	390	---	590-740	---	18 L, 16 T	N+T	see standard
JIS G 3458:2013	Symbol STPA26	---	---	---	---	205	---	410	---	24 L; 19 T	IA, FA or NT	---
JIS G 3462:2014	Symbol STBA26	---	---	$d < 10$	---	205	---	410	---	22 L	IA, A or NT	---
				$10 \leq d < 20$	---	205	---	410	---	25 L	IA, A or NT	---
				$d \geq 20$	---	205	---	410	---	30 L	IA, A or NT	---
JIS G 3467:2013	Symbol STFA26	---	---	---	---	205	---	410	---	30	IA, A or NT	---

5.8 Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

5.8.9B Mechanical Properties of 9Cr-1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade T91	K90901	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	415	60	585	85	20	N+T	250 max HBW/ 265 max HV; 25 max HRC
ASTM A213/A213M-15a	Grade T91	K90901	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	415	60	585	85	20	NT	190-250 HBW/ 196-265 HV; 90 HRB to 25 HRC
EN 10216-2:2013	X10CrMoVNb9-1	---	1.4903	$t \leq 16$	---	450	---	630-830	---	19 L; 17 T	NT, QT	L: 40 J at 20°C T: 27 J at 20°C
				$16 < t \leq 40$	---	450	---	630-830	---	19 L; 17 T	NT, QT	L: 40 J at 20°C T: 27 J at 20°C
				$40 < t \leq 60$	---	450	---	630-830	---	19 L; 17 T	NT, QT	L: 40 J at 20°C T: 27 J at 20°C
				$60 < t \leq 100$	---	450	---	630-830	---	19 L; 17 T	NT, QT	L: 40 J at 20°C T: 27 J at 20°C
ISO 9329-2:1997	Grade X10 CrMoVNb 9-1	---	---	$t \leq 60$	---	415	---	590-770	---	20 L, 16 T	N+T	see standard
ASME SA-335/SA-335M	Grade P91	K91560	---	---	---	415	60	585	85	20 L	N+T or Q+T	250 max HB/ 265 max HV; 25 max HRC
	Grade P92	K92460	---	---	---	440	64	620	90	20 L	N+T	250 max HB/ 265 max HV; 25 max HRC
ASTM A335/A335M-15	Grade P91	K91560	---	---	---	415	60	585	85	20 L	NT or QT	190-250 HBW/ 196-265 HV; 91 HRB to 25 HRC
	Grade P92	K92460	---	---	---	440	64	620	90	20 L	NT	250 max HBW/ 265 max HV; 25 max HRC
GB 5310-1995	Grade 10Cr9Mo1VNb	---	---	---	---	415	---	585 L	---	20 L	N+T	see standard

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.1A Chemical Composition of Ferritic and Martensitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-268/SA-268M	Grade TP409	S40900	---	0.08	1.00	1.00	0.045	0.030	10.5-11.7	0.50	---	Ti 6xC to 0.75
ASME SA-803/SA-803M	Grade TP409	S40900	---	0.08	1.00	1.00	0.045	0.030	10.5-11.7	0.50	---	Ti 6xC to 0.75
ASTM A268/A268M-10	Grade TP409	S40900	---	0.08	1.00	1.00	0.045	0.030	10.5-11.7	0.50	---	Ti 6xC to 0.75
ASTM A803/A803M-12	Grade TP409	S40900	---	0.08	1.00	1.00	0.045	0.030	10.5-11.7	0.50	---	Ti 6xC to 0.75
JIS G 3463:2012	Symbol SUS409TB	---	---	0.08	1.00	1.00	0.040	0.030	10.50-11.75	0.60	---	Ti 6xC to 0.75
ASME SA-268/SA-268M	Grade TP410	S41000	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	---	---	---
ASTM A268/A268M-10	Grade TP410	S41000	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	---	---	---
JIS G 3463:2012	Symbol SUS410TB	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.60	---	---
ASME SA-268/SA-268M	Grade TP430	S43000	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	---	---
ASTM A268/A268M-10	Grade TP430	S43000	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	---	---
JIS G 3463:2012	Symbol SUS430TB	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	0.60	---	---
	Symbol SUS430LXTB	---	---	0.030	1.00	0.75	0.040	0.030	16.00-19.00	0.60	---	Ti or Nb 0.10-1.00
ASME SA-803/SA-803M	Grade TP XM-27	S44627	---	0.01	0.40	0.40	0.02	0.02	25.0-27.5	---	0.75-1.50	Cu 0.20; Cb 0.05-0.20; N 0.015; (Ni+Cu) 0.5
ASTM A803/A803M-12	Grade TP XM-27	S44627	---	0.01	0.40	0.40	0.02	0.02	25.0-27.5	---	0.75-1.50	Cu 0.20; N 0.015; Cb 0.05-0.20; (Ni+Cu) 0.5
JIS G 3463:2012	Symbol SUSXM27TB	---	---	0.010	0.40	0.40	0.030	0.020	25.00-27.50	0.50	0.75-1.50	Cu 0.20; N 0.015; (Ni+Cu) 0.50

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.1B Mechanical Properties of Ferritic and Martensitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-268/SA-268M	Grade TP409	S40900	---	$t \geq 0.4$	$t \geq 0.015$	170	25	380	55	20	HT	207 max HB; 95 max HRB
ASME SA-803/SA-803M	Grade TP409	S40900	---	$t \geq 0.7$	$t \geq 0.028$	205	30	380	55	20 L	SA	207 max HB; 95 max HRB
ASTM A268/A268M-10	Grade TP409	S40900	---	$t \geq 0.4$	$t \geq 0.015$	170	25	380	55	20	HT	207 max HB; 95 max HRB
ASTM A803/A803M-12	Grade TP409	S40900	---	$t \geq 0.7$	$t \geq 0.028$	205	30	380	55	20 L	SA	207 max HB; 95 max HRB
JIS G 3463:2012	Symbol SUS409TB	---	---	$d < 10$	---	205	---	410	---	12 L	A	---
				$10 \leq d < 20$	---	205	---	410	---	15 L	A	---
				$d \geq 20$	---	205	---	410	---	20 L	A	---
ASME SA-268/SA-268M	Grade TP410	S41000	---	$t \geq 0.4$	$t \geq 0.015$	205	30	415	60	20	HT	207 max HB; 95 max HRB
ASTM A268/A268M-10	Grade TP410	S41000	---	$t \geq 0.4$	$t \geq 0.015$	205	30	415	60	20	HT	207 max HB; 95 max HRB
JIS G 3463:2012	Symbol SUS410TB	---	---	$d < 10$	---	205	---	410	---	12 L	A	---
				$10 \leq d < 20$	---	205	---	410	---	15 L	A	---
				$d \geq 20$	---	205	---	410	---	20 L	A	---
ASME SA-268/SA-268M	Grade TP430	S43000	---	$t \geq 0.4$	$t \geq 0.015$	240	35	415	60	20	HT	190 max HB; 90 max HRB
ASTM A268/A268M-10	Grade TP430	S43000	---	$t \geq 0.4$	$t \geq 0.015$	240	35	415	60	20	HT	190 max HB; 90 max HRB
JIS G 3463:2012	Symbol SUS430TB	---	---	$d < 10$	---	245	---	410	---	12 L	A	---
				$10 \leq d < 20$	---	245	---	410	---	15 L	A	---
				$d \geq 20$	---	245	---	410	---	20 L	A	---
	Symbol SUS430LXTB	---	---	$d < 10$	---	175	---	360	---	12 L	A	---
				$10 \leq d < 20$	---	175	---	360	---	15 L	A	---
				$d \geq 20$	---	175	---	360	---	20 L	A	---
ASME SA-803/SA-803M	Grade TP XM-27	S44627	---	$t \geq 0.7$	$t \geq 0.028$	275	40	450	65	20 L	SA	241 max HB; 100 max HRB
ASTM A803/A803M-12	Grade TP XM-27	S44627	---	$t \geq 0.7$	$t \geq 0.028$	275	40	450	65	20	SA	241 max HB; 100 max HRB
JIS G 3463:2012	Symbol SUSXM27TB	---	---	$d < 10$	---	245	---	410	---	12 L	A	---
				$10 \leq d < 20$	---	245	---	410	---	15 L	A	---
				$d \geq 20$	---	245	---	410	---	20 L	A	---

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-213/SA-213M	Grade TP304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASME SA-249/SA-249M	Grade TP304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASME SA-312/SA-312M	Grade TP304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASME SA-358/SA-358M*	Grade 304	S30400	---	0.07	2.00	0.75	0.045	0.030	17.5-19.5	8.0-10.5	---	N 0.10
ASME SA-376/SA-376M	Grade TP304	S30400	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASME SA-409/SA-409M	Grade TP304	S30400	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASME SA-688/SA-688M	Grade TP 304	S30400	---	0.08	2.00	0.75	0.040	0.030	18.00-20.00	8.00-11.00	---	---
ASTM A213/A213M-15a	Grade TP304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.00-11.0	---	---
ASTM A249/A249M-14a	Grade TP304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A270/A270M-15	Grade TP 304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A312/A312M-15	Grade TP304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A358/A358M-14a*	Grade 304	S30400	---	0.07	2.00	0.75	0.045	0.030	17.5-19.5	8.0-10.5	---	N 0.10
ASTM A376/A376M-14	Grade TP304	S30400	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A409/A409M-15	Grade TP304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A688/A688M-15	Grade TP304	S30400	---	0.08	2.00	0.75	0.040	0.030	18.00-20.00	8.00-11.00	---	---
ASTM A908-03 (2013)	Type 304	S30400	---	0.08	2.00	0.75	0.040	0.030	18.0-20.0	8.0-11.0	---	---
EN 10216-5:2013	X5CrNi18-10	---	1.4301	0.07	2.00	1.00	0.040	0.015	17.0-19.5	8.0-10.5	---	N 0.10
EN 10217-7:2014	X5CrNi18-10	---	1.4301	0.07	2.00	1.00	0.045	0.015	17.5-19.5	8.0-10.5	---	N 0.10
JIS G 3459:2012	Symbol SUS304TP	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-11.00	---	---
JIS G 3463:2012	Symbol SUS304TB	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	8.00-11.00	---	---
JIS G 3467:2013	Symbol SUS304TF	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	8.00-11.00	---	---
JIS G 3468:2011	Symbol SUS304TPY	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
ASME SA-213/SA-213M	Grade TP304L	S30403	---	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
ASME SA-249/SA-249M	Grade TP304L	S30403	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
	Grade TP304N	S30451	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
ASME SA-312/SA-312M	Grade TP304L	S30403	---	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.0-13.0	---	---
ASME SA-358/SA-358M*	Grade 304L	S30403	---	0.030	2.00	0.75	0.045	0.030	17.5-19.5	8.0-12.0	---	N 0.10
ASME SA-409/SA-409M	Grade TP304L	S30403	---	0.035	2.00	0.75	0.045	0.030	18.0-20.0	8.00-13.0	---	---
ASME SA-688/SA-688M	Grade TP 304L	S30403	---	0.035	2.00	0.75	0.040	0.030	18.00-20.00	8.00-13.00	---	---
ASTM A213/A213M-15a	Grade TP304L	S30403	---	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
ASTM A249/A249M-14	Grade TP304L	S30403	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
	Grade TP304N	S30451	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
ASTM A312/A312M-15	Grade TP304L	S30403	---	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.0-13.0	---	---

*: See "List of Standards" at the beginning of the chapter.

Note: This section continued on next page.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A358/A358M-14a*	Grade 304L	S30403	---	0.030	2.00	0.75	0.045	0.030	17.5-19.5	8.0-12.0	---	N 0.10
ASTM A409/A409M-15	Grade TP304L	S30403	---	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
ASTM A688/A688M-15	Grade TP304L	S30403	---	0.035	2.00	0.75	0.040	0.030	18.00-20.00	8.00-13.00	---	---
EN 10216-5:2013	X2CrNi18-9	---	1.4307	0.030	2.00	1.00	0.040	0.015	17.5-19.5	8.0-10.0	---	N 0.10
	X2CrNi19-11	---	1.4306	0.030	2.00	1.00	0.040	0.015	18.0-20.0	10.0-12.0	---	N 0.10
EN 10217-7:2014	X2CrNi18-9	---	1.4307	0.030	2.00	1.00	0.045	0.015	17.5-19.5	8.0-10.5	---	N 0.10
	X2CrNi19-11	---	1.4306	0.030	2.00	1.00	0.045	0.015	18.0-20.0	10.0-12.0	---	N 0.10
JIS G 3459:2012	Symbol SUS304LTP	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	9.00-13.00	---	---
JIS G 3463:2012	Symbol SUS304LTB	---	---	0.030	2.00	1.00	0.040	0.030	18.00-20.00	9.00-13.00	---	---
JIS G 3468:2011	Symbol SUS304LTPY	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	9.00-13.00	---	---
ASME SA-213/SA-213M	Grade TP304LN	S30453	---	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
ASME SA-249/SA-249M	Grade TP304LN	S30453	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
ASME SA-376/SA-376M	Grade TP304LN	S30453	---	0.035	2.00	0.75	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
ASME SA-688/SA-688M	Grade TP 304LN	S30453	---	0.035	2.00	0.75	0.040	0.030	18.00-20.00	8.00-13.00	---	N 0.10-0.16
ASTM A213/A213M-15a	Grade TP304LN	S30453	---	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
ASTM A249/A249M-14a	Grade TP304LN	S30453	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
ASTM A376/A376M-14	Grade TP304LN	S30453	---	0.035	2.00	0.75	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
ASTM A688/A688M-15	Grade TP304LN	S30453	---	0.035	2.00	0.75	0.040	0.030	18.00-20.00	8.00-13.00	---	N 0.10-0.16
EN 10216-5:2013	X2CrNi18-10	---	1.4311	0.030	2.00	1.00	0.040	0.015	17.0-19.5	8.5-11.5	---	N 0.12-0.22
EN 10217-7:2014	X2CrNi18-10	---	1.4311	0.030	2.00	1.00	0.045	0.015	17.5-19.5	8.5-11.5	---	N 0.12-0.22
ASME SA-213/SA-213M	Grade TP304H	S30409	---	0.04-0.10	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASME SA-249/SA-249M	Grade TP304H	S30409	---	0.04-0.10	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASME SA-312/SA-312M	Grade TP304H	S30409	---	0.04-0.10	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASME SA-358/SA-358M*	Grade 304H	S30409	---	0.04-0.10	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	---
ASME SA-376/SA-376M	Grade TP304H	S30409	---	0.04-0.10	2.00	0.75	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A213/A213M-15a	Grade TP304H	S30409	---	0.04-0.10	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A249/A249M-14a	Grade TP304H	S30409	---	0.04-0.10	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A312/A312M-15	Grade TP304H	S30409	---	0.04-0.10	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A358/A358M-14a*	Grade 304H	S30409	---	0.04-0.10	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	---
ASTM A376/A376M-14	Grade TP304H	S30409	---	0.04-0.10	2.00	0.75	0.045	0.030	18.0-20.0	8.0-11.0	---	---
EN 10216-5:2013	X6CrNi18-10	---	1.4948	0.04-0.08	2.00	1.00	0.035	0.015	17.0-19.0	8.0-11.0	---	N 0.10
GB 5310-1995	Grade 1Cr18Ni9	---	---	0.15	2.00	1.00	0.035	0.03	17.00-19.00	8.00-10.00	---	Cu 0.20
JIS G 3459:2012	Symbol SUS304HTP	---	---	0.04-0.10	2.00	0.75	0.040	0.030	18.00-20.00	8.00-11.00	---	---
JIS G 3463:2012	Symbol SUS304HTB	---	---	0.04-0.10	2.00	0.75	0.040	0.030	18.00-20.00	8.00-11.00	---	---
JIS G 3467:2013	Symbol SUS304HTF	---	---	0.04-0.10	2.00	0.75	0.040	0.030	18.00-20.00	8.00-11.00	---	---

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-213/SA-213M	Grade TP309S	S30908	---	0.08	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASME SA-249/SA-249M	Grade TP309S	S30908	---	0.08	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASME SA-312/SA-312M	Grade TP309S	S30908	---	0.08	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	0.75	---
ASME SA-358/SA-358M*	Grade 309S	S30908	---	0.08	2.00	0.75	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASTM A213/A213M-15a	Grade TP309S	S30908	---	0.08	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASTM A249/A249M-14a	Grade TP309S	S30908	---	0.08	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASTM A312/A312M-15	Grade TP309S	S30908	---	0.08	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	0.75	---
ASTM A358/A358M-14a*	Grade 309S	S30908	---	0.08	2.00	0.75	0.045	0.030	22.0-24.0	12.0-15.0	---	---
JIS G 3459:2012	Symbol SUS309STP	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 3463:2012	Symbol SUS309STB	---	---	0.08	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 3468:2011	Symbol SUS309STPY	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
ASME SA-213/SA-213M	Grade TP309H	S30909	---	0.04-0.10	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASME SA-249/SA-249M	Grade TP309H	S30909	---	0.04-0.10	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASTM A213/A213M-15a	Grade TP309H	S30909	---	0.04-0.10	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASTM A249/A249M-14a	Grade TP309H	S30909	---	0.04-0.10	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
JIS G 3459:2012	Symbol SUS309TP	---	---	0.15	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 3463:2012	Symbol SUS309TB	---	---	0.15	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---
ASME SA-213/SA-213M	Grade TP310S	S31008	---	0.08	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASME SA-249/SA-249M	Grade TP310S	S31008	---	0.08	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASME SA-312/SA-312M	Grade TP310S	S31008	---	0.08	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	0.75	---
ASME SA-358/SA-358M*	Grade 310S	S31008	---	0.08	2.00	1.50	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A213/A213M-15a	Grade TP310S	S31008	---	0.08	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A249/A249M-14a	Grade TP310S	S31008	---	0.08	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A312/A312M-15	Grade TP310S	S31008	---	0.08	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	0.75	---
ASTM A358/A358M-14a*	Grade 310S	S31008	---	0.08	2.00	1.50	0.045	0.030	24.0-26.0	19.0-22.0	---	---
JIS G 3459:2012	Symbol SUS310STP	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 3463:2012	Symbol SUS310STB	---	---	0.08	2.00	1.50	0.040	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 3468:2011	Symbol SUS310STPY	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
ASME SA-213/SA-213M	Grade TP310H	S31009	---	0.04-0.10	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A213/A213M-15a	Grade TP310H	S31009	---	0.04-0.10	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
JIS G 3463:2012	Symbol SUS310TB	---	---	0.15	2.00	1.50	0.040	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 3467:2013	Symbol SUS310TF	---	---	0.15	2.00	1.50	0.040	0.030	24.00-26.00	19.00-22.00	---	---

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-213/SA-213M	Grade TP316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASME SA-249/SA-249M	Grade TP316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASME SA-312/SA-312M	Grade TP316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
ASME SA-358/SA-358M*	Grade 316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASME SA-376/SA-376M	Grade TP316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
ASME SA-409/SA-409M	Grade TP316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.0-3.0	---
ASME SA-688/SA-688M	Grade TP 316	S31600	---	0.08	2.00	0.75	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
ASTM A213/A213M-15a	Grade TP316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A249/A249M-14a	Grade TP316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A312/A312M-15	Grade TP316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
ASTM A358/A358M-14a*	Grade 316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASTM A376/A376M-14	Grade TP316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
ASTM A409/A409M-15	Grade TP316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A688/A688M-15	Grade TP316	S31600	---	0.08	2.00	0.75	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
EN 10216-5:2013	X5CrNiMo17-12-2	---	1.4401	0.07	2.00	1.00	0.040	0.015	16.5-18.5	10.0-13.0	2.0-2.5	N 0.10
	X3CrNiMo17-13-3	---	1.4436	0.05	2.00	1.00	0.040	0.015	16.5-18.5	10.5-13.0	2.50-3.0	N 0.10
EN 10217-7:2014	X5CrNiMo17-12-2	---	1.4401	0.07	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-2.50	N 0.10
	X3CrNiMo17-13-3	---	1.4436	0.05	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.0	2.50-3.0	N 0.10
JIS G 3459:2012	Symbol SUS316TP	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 3463:2012	Symbol SUS316TB	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 3467:2013	Symbol SUS316TF	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 3468:2011	Symbol SUS316TPY	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-213/SA-213M	Grade TP316L	S31603	---	0.035	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASME SA-249/SA-249M	Grade TP316L	S31603	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASME SA-312/SA-312M	Grade TP316L	S31603	---	0.035	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASME SA-358/SA-358M*	Grade 316L	S31603	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASME SA-409/SA-409M	Grade TP316L	S31603	---	0.035	2.00	0.75	0.045	0.030	16.0-18.0	10.0-15.0	2.0-3.0	---
ASME SA-688/SA-688M	Grade TP 316L	S31603	---	0.035	2.00	0.75	0.040	0.030	16.00-18.00	10.00-15.00	2.00-3.00	---
ASTM A213/A213M-15a	Grade TP316L	S31603	---	0.035	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A249/A249M-14a	Grade TP316L	S31603	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A312/A312M-15	Grade TP316L	S31603	---	0.035	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A358/A358M-14a*	Grade 316L	S31603	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASTM A409/A409M-15	Grade TP316L	S31603	---	0.035	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A688/A688M-15	Grade TP316L	S31603	---	0.035	2.00	0.75	0.040	0.030	16.00-18.00	10.00-15.00	2.00-3.00	---
EN 10216-5:2013	X2CrNiMo17-12-2	---	1.4404	0.030	2.00	1.00	0.040	0.015	16.5-18.5	10.0-13.0	2.0-2.5	N 0.10
	X2CrNiMo18-14-3	---	1.4435	0.030	2.00	1.00	0.040	0.015	17.0-19.0	12.5-15.0	2.50-3.0	N 0.10
EN 10217-7:2014	X2CrNiMo17-12-2	---	1.4404	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-2.50	N 0.10
	X2CrNiMo17-12-3	---	1.4432	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.0	2.50-3.0	N 0.10
	X2CrNiMo18-14-3	---	1.4435	0.030	2.00	1.00	0.045	0.015	17.0-19.0	12.5-15.0	2.50-3.0	N 0.10
JIS G 3459:2012	Symbol SUS316LTP	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	12.00-16.00	2.00-3.00	---
JIS G 3463:2012	Symbol SUS316LTB	---	---	0.030	2.00	1.00	0.040	0.030	16.00-18.00	12.00-16.00	2.00-3.00	---
JIS G 3468:2011	Symbol SUS316LTPY	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
ASME SA-213/SA-213M	Grade TP316LN	S31653	---	0.035	2.00	1.00	0.045	0.030	16.0-18.0	10.0-13.0	2.00-3.00	N 0.10-0.16
ASME SA-249/SA-249M	Grade TP316LN	S31653	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-13.0	2.00-3.00	N 0.10-0.16
ASME SA-376/SA-376M	Grade TP316LN	S31653	---	0.035	2.00	0.75	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	N 0.10-0.16
ASME SA-688/SA-688M	Grade TP 316LN	S31653	---	0.035	2.00	0.75	0.040	0.030	16.00-18.00	10.00-15.00	2.00-3.00	N 0.10-0.16
ASTM A213/A213M-15a	Grade TP316LN	S31653	---	0.035	2.00	1.00	0.045	0.030	16.0-18.0	10.0-13.0	2.00-3.00	N 0.10-0.16
ASTM A249/A249M-14a	Grade TP316LN	S31653	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-13.0	2.00-3.00	N 0.10-0.16
ASTM A376/A376M-14	Grade TP316LN	S31653	---	0.035	2.00	0.75	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	N 0.10-0.16
ASTM A688/A688M-15	Grade TP316LN	S31653	---	0.035	2.00	0.75	0.040	0.030	16.00-18.00	10.00-15.00	2.00-3.00	N 0.10-0.16
EN 10216-5:2013	X2CrNiMoN17-13-3	---	1.4429	0.030	2.00	1.00	0.040	0.015	16.5-18.5	11.0-14.0	2.50-3.0	N 0.12-0.22
EN 10217-7:2014	X2CrNiMoN17-13-3	---	1.4429	0.030	2.00	1.00	0.045	0.015	16.5-18.5	11.0-14.0	2.50-3.0	N 0.12-0.22

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-213/SA-213M	Grade TP316H	S31609	---	0.04-0.10	2.00	1.00	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
ASME SA-249/SA-249M	Grade TP316H	S31609	---	0.04-0.10	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASME SA-312/SA-312M	Grade TP316H	S31609	---	0.04-0.10	2.00	1.00	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
ASME SA-358/SA-358M*	Grade 316H	S31609	---	0.04-0.10	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASME SA-376/SA-376M	Grade TP316H	S31609	---	0.04-0.10	2.00	0.75	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
ASTM A213/A213M-15a	Grade TP316H	S31609	---	0.04-0.10	2.00	1.00	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
ASTM A249/A249M-14a	Grade TP316H	S31609	---	0.04-0.10	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A312/A312M-15	Grade TP316H	S31609	---	0.04-0.10	2.00	1.00	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
ASTM A358/A358M-14a*	Grade 316H	S31609	---	0.04-0.10	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A376/A376M-14	Grade TP316H	S31609	---	0.04-0.10	2.00	0.75	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
EN 10216-5:2013	X6CrNiMo17-13-2	---	1.4918	0.04-0.08	2.00	0.75	0.035	0.015	16.0-18.0	12.0-14.0	2.00-2.50	---
JIS G 3459:2012	Symbol SUS316HTP	---	---	0.04-0.10	2.00	0.75	0.030	0.030	16.00-18.00	11.00-14.00	2.00-3.00	---
JIS G 3463:2012	Symbol SUS316HTB	---	---	0.04-0.10	2.00	0.75	0.030	0.030	16.00-18.00	11.00-14.00	2.00-3.00	---
JIS G 3467:2013	Symbol SUS316HTF	---	---	0.04-0.10	2.00	0.75	0.030	0.030	16.00-18.00	11.00-14.00	2.00-3.00	---
EN 10216-5:2013	X6CrNiMoTi17-12-2	---	1.4571	0.08	2.00	1.00	0.040	0.015	16.5-18.5	10.5-13.5	2.00-2.50	Ti 5xC to 0.70
EN 10217-7:2014	X6CrNiMoTi17-12-2	---	1.4571	0.08	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.5	2.00-2.50	Ti 5xC to 0.70
JIS G 3459:2012	Symbol SUS316TiTP	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti 5xC min
JIS G 3463:2012	Symbol SUS316TiTB	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti 5xC min
ASME SA-213/SA-213M	Grade TP317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASME SA-249/SA-249M	Grade TP317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASME SA-312/SA-312M	Grade TP317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-14.0	3.0-4.0	---
ASME SA-409/SA-409M	Grade TP317	S31700	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	11.0-14.0	3.0-4.0	---
ASTM A213/A213M-15a	Grade TP317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASTM A249/A249M-14a	Grade TP317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASTM A312/A312M-15	Grade TP317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASTM A409/A409M-15	Grade TP317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
JIS G 3459:2012	Symbol SUS317TP	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 3463:2012	Symbol SUS317TB	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 3468:2011	Symbol SUS317TPY	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-213/SA-213M	Grade TP317L	S31703	---	0.035	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASME SA-249/SA-249M	Grade TP317L	S31703	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASME SA-312/SA-312M	Grade TP317L	S31703	---	0.035	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASTM A213/A213M-15a	Grade TP317L	S31703	---	0.035	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASTM A249/A249M-14a	Grade TP317L	S31703	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASTM A312/A312M-15	Grade TP317L	S31703	---	0.035	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
EN 10217-7:2014	X2CrNiMo18-15-4	---	1.4438	0.030	2.00	1.00	0.045	0.015	17.5-19.5	13.0-16.0	3.0-4.0	N 0.10
JIS G 3459:2012	Symbol SUS317LTP	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 3463:2012	Symbol SUS317LTB	---	---	0.030	2.00	1.00	0.040	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 3468:2011	Symbol SUS317LTPY	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
ASME SA-213/SA-213M	Grade TP317LM	S31725	---	0.03	2.00	1.00	0.045	0.030	18.0-20.0	13.5-17.5	4.0-5.0	Cu 0.75; N 0.20
ASME SA-249/SA-249M	---	S31725	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	13.5-17.5	4.0-5.0	N 0.20
ASME SA-312/SA-312M	---	S31725	---	0.03	2.00	1.00	0.040	0.030	18.0-20.0	13.5-17.5	4.0-5.0	Cu 0.75; N 0.10
ASME SA-358/SA-358M*	---	S31725	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	13.5-17.5	4.0-5.0	N 0.20
ASME SA-376/SA-376M	---	S31725	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	13.5-17.5	4.0-5.0	Cu 0.75; N 0.20
ASME SA-409/SA-409M	---	S31725	---	0.03	2.00	0.75	0.045	0.030	18.0-20.0	13.5-17.5	4.0-5.0	Cu 0.75; N 0.10
ASTM A213/A213M-15a	Grade TP317LM	S31725	---	0.03	2.00	1.00	0.045	0.030	18.0-20.0	13.5-17.5	4.0-5.0	Cu 0.75; N 0.20
ASTM A249/A249M-14a	---	S31725	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	13.5-17.5	4.0-5.0	N 0.20
ASTM A312/A312M-15	---	S31725	---	0.03	2.00	1.00	0.040	0.030	18.0-20.0	13.5-17.5	4.0-5.0	Cu 0.75; N 0.10
ASTM A358/A358M-14a*	---	S31725	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	13.5-17.5	4.0-5.0	N 0.20
ASTM A376/A376M-14	---	S31725	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	13.5-17.5	4.0-5.0	Cu 0.75; N 0.20
ASTM A409/A409M-15	---	S31725	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	13.5-17.5	4.0-5.0	N 0.020
EN 10216-5:2013	X2CrNiMoN17-13-5	---	1.4439	0.030	2.00	1.00	0.040	0.015	16.5-18.5	12.5-14.5	4.0-5.0	N 0.12-0.22
EN 10217-7:2014	X2CrNiMoN17-13-5	---	1.4439	0.030	2.00	1.00	0.045	0.015	16.5-18.5	12.5-14.5	4.0-5.0	N 0.12-0.22

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-213/SA-213M	Grade TP321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5x(C+N) to 0.70
ASME SA-249/SA-249M	Grade TP321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	N 0.10; Ti 5x(C+N) to 0.70
ASME SA-312/SA-312M	Grade TP321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	N 0.10; Ti 5xC to 0.70
ASME SA-358/SA-358M*	Grade 321	S32100	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-12.0	---	N 0.10; Ti 5x(C+N) to 0.70
ASME SA-376/SA-376M	Grade TP321	S32100	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Ti 5xC to 0.70
ASME SA-409/SA-409M	Grade TP321	S32100	---	0.08	2.00	0.75	0.045	0.030	17.0-20.0	9.00-12.0	---	Ti 5xC to 0.70
ASTM A213/A213M-15a	Grade TP321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5x(C+N) to 0.70
ASTM A249/A249M-14a	Grade TP321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	N 0.10; Ti 5x(C+N) to 0.70
ASTM A312/A312M-15	Grade TP321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	N 0.10; Ti 5x(C+N) to 0.70
ASTM A358/A358M-14a*	Grade 321	S32100	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-12.0	---	N 0.10; Ti 5x(C+N) to 0.70
ASTM A376/A376M-14	Grade TP321	S32100	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Ti 5xC to 0.70
ASTM A409/A409M-15	Grade TP321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-20.0	9.00-12.0	---	Ti 5xC to 0.70
EN 10216-5:2013	X6CrNiTi18-10	---	1.4541	0.08	2.00	1.00	0.040	0.015	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70
EN 10217-7:2014	X6CrNiTi18-10	---	1.4541	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70
JIS G 3459:2012	Symbol SUS321TP	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5xC min
JIS G 3463:2012	Symbol SUS321TB	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Ti 5xC min
JIS G 3467:2013	Symbol SUS321TF	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Ti 5xC min
JIS G 3468:2011	Symbol SUS321TPY	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5xC min
ASME SA-213/SA-213M	Grade TP321H	S32109	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 4x(C+N) to 0.70
ASME SA-249/SA-249M	Grade TP321H	S32109	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	N 0.10; Ti 5x(C+N) to 0.70
ASME SA-312/SA-312M	Grade TP321H	S32109	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 4xC to 0.60
ASME SA-376/SA-376M	Grade TP321H	S32109	---	0.04-0.10	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Ti 4xC to 0.70
ASTM A213/A213M-15a	Grade TP321H	S32109	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.00-12.0	---	Ti 4x(C+N) to 0.70
ASTM A249/A249M-14a	Grade TP321H	S32109	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.00-12.0	---	N 0.10; Ti 5x(C+N) to 0.70
ASTM A312/A312M-15	Grade TP321H	S32109	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	N 0.10; Ti 4xC to 0.70
ASTM A376/A376M-14	Grade TP321H	S32109	---	0.04-0.10	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Ti 4xC to 0.70
EN 10216-5:2013	X7CrNiTi18-10	---	1.4940	0.04-0.08	2.00	1.00	0.040	0.015	17.0-19.0	9.0-13.0	---	N 0.10; Ti 5x(C+N) to 0.80
JIS G 3459:2012	Symbol SUS321HTP	---	---	0.04-0.10	2.00	0.75	0.030	0.030	17.00-20.00	9.00-13.00	---	Ti 4xC to 0.60
JIS G 3463:2012	Symbol SUS321HTB	---	---	0.04-0.10	2.00	0.75	0.030	0.030	17.00-20.00	9.00-13.00	---	Ti 4xC to 0.60
JIS G 3467:2013	Symbol SUS321HTF	---	---	0.04-0.10	2.00	0.75	0.030	0.030	17.00-20.00	9.00-13.00	---	Ti 4xC to 0.60

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-213/SA-213M	Grade TP347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Nb 10xC to 1.10
ASME SA-249/SA-249M	Grade TP347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 10xC to 1.10
ASME SA-312/SA-312M	Grade TP347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 10xC to 1.00
ASME SA-358/SA-358M*	Grade 347	S34700	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 10xC to 1.00
ASME SA-376/SA-376M	Grade TP347	S34700	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 10xC to 1.10
ASME SA-409/SA-409M	Grade TP347	S34700	---	0.08	2.00	0.75	0.045	0.030	17.0-20.0	9.00-13.0	---	(Cb+Ta) 10xC to 1.0
ASTM A213/A213M-15a	Grade TP347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Nb 10xC to 1.10
ASTM A249/A249M-14a	Grade TP347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 10xC to 1.10
ASTM A312/A312M-15	Grade TP347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 10xC to 1.00
ASTM A358/A358M-14a*	Grade 347	S34700	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 10xC to 1.00
ASTM A376/A376M-14	Grade TP347	S34700	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 10xC to 1.10
ASTM A409/A409M-15	Grade TP347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.00-12.0	---	(Cb+Ta) 10xC to 1.10
EN 10216-5:2013	X6CrNiNb18-10	---	1.4550	0.08	2.00	1.00	0.040	0.015	17.0-19.0	9.0-12.0	---	Nb 10xC to 1.00
EN 10217-7:2014	X6CrNiNb18-10	---	1.4550	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Nb 10xC to 1.00
JIS G 3459:2012	Symbol SUS347TP	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min
JIS G 3463:2012	Symbol SUS347TB	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min
JIS G 3467:2013	Symbol SUS347TF	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min
JIS G 3468:2011	Symbol SUS347TPY	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min
ASME SA-213/SA-213M	Grade TP347H	S34709	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-13.0	---	Nb 8xC to 1.10
	Grade TP347HFG	S34710	---	0.06-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-13.0	---	Nb 8xC to 1.10
ASME SA-249/SA-249M	Grade TP347H	S34709	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 8xC to 1.10
ASME SA-312/SA-312M	Grade TP347H	S34709	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 8xC to 1.0
ASME SA-376/SA-376M	Grade TP347H	S34709	---	0.04-0.10	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 8xC to 1.10
ASTM A213/A213M-15a	Grade TP347H	S34709	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-13.0	---	Nb 8xC to 1.10
	Grade TP347HFG	S34710	---	0.06-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-13.0	---	Nb 8xC to 1.10
ASTM A249/A249M-14a	Grade TP347H	S34709	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 8xC to 1.10
ASTM A312/A312M-15	Grade TP347H	S34709	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 8xC to 1.0
ASTM A376/A376M-14	Grade TP347H	S34709	---	0.04-0.10	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 8xC to 1.10
EN 10216-5:2013	X7CrNiNb18-10	---	1.4912	0.04-0.10	2.00	1.00	0.040	0.015	17.0-19.0	9.0-12.0	---	Nb 10xC to 1.20
GB 5310-1995	Grade 1Cr19Ni11Nb	---	---	0.04-0.10	2.00	1.00	0.03	0.03	17.00-20.00	9.00-13.00	---	(Nb+Ta) 0.80-1.00; Cu 0.20
JIS G 3459:2012	Symbol SUS347HTP	---	---	0.04-0.10	2.00	1.00	0.030	0.030	17.00-20.00	9.00-13.00	---	Nb 8xC to 1.00
JIS G 3463:2012	Symbol SUS347HTB	---	---	0.04-0.10	2.00	1.00	0.030	0.030	17.00-20.00	9.00-13.00	---	Nb 8xC to 1.00
JIS G 3467:2013	Symbol SUS347HTF	---	---	0.04-0.10	2.00	0.75	0.030	0.030	17.00-20.00	9.00-13.00	---	Nb 8xC to 1.00

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2A Chemical Composition of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A240/A240M-15a	Type 800	N08800	---	0.10	1.50	1.00	0.045	0.015	19.0-23.0	30.0-35.0	---	Cu 0.75; Ti 0.15-0.60 Al 0.15-0.60; Fe 39.5 min;
JIS G 3467:2013	Symbol NCF800TF	---	---	0.10	1.50	1.00	0.030	0.015	19.00-23.00	30.00-35.00	---	Cu 0.75; Al 0.15-0.60; Ti 0.15-0.60
ASTM A240/A240M-15a	Type 800H	N08810	---	0.05-0.10	1.50	1.00	0.045	0.015	19.0-23.0	30.0-35.0	---	Cu 0.75; Ti 0.15-0.60; Al 0.15-0.60; Fe 39.5 min
JIS G 3467:2013	Symbol NCF800HTF	---	---	0.05-0.10	1.50	1.00	0.030	0.015	19.00-23.00	30.00-35.00	---	Cu 0.75; Al 0.15-0.60; Ti 0.15-0.60
ASME SA-249/SA-249M	---	N08367	---	0.030	2.00	1.00	0.040	0.030	20.0-22.0	23.5-25.5	6.0-7.0	Cu 0.75; N 0.18-0.25
	---	N08926	---	0.020	2.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.0-7.0	Cu 0.50-1.50; N 0.15-0.25
ASME SA-312/SA-312M	---	N08926	---	0.020	2.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.0-7.0	Cu 0.50-1.50; N 0.15-0.25
ASME SA-688/SA-688M	---	N08367	---	0.030	2.00	1.00	0.040	0.030	20.00-22.00	23.50-25.50	6.00-7.00	Cu 0.75; N 0.18-0.25
	---	N08926	---	0.020	2.00	0.5	0.03	0.01	19.00-21.00	24.00-26.00	6.0-7.0	Cu 0.5-1.5; N 0.15-0.25
ASTM A249/A249M-14a	---	N08367	---	0.030	2.00	1.00	0.040	0.030	20.0-22.0	23.5-25.5	6.0-7.0	N 0.18-0.25; Cu 0.75
	---	N08926	---	0.020	2.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.0-7.0	N 0.15-0.25; Cu 0.50-1.50
ASTM A312/A312M-15	---	N08926	---	0.020	2.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.0-7.0	N 0.15-0.25; Cu 0.50-1.50
ASTM A688/A688M-15	---	N08367	---	0.030	2.00	1.00	0.040	0.030	20.00-22.00	23.50-25.50	6.00-7.00	N 0.18-0.25; Cu 0.75
	---	N08926	---	0.020	2.00	0.5	0.03	0.01	19.00-21.00	24.00-26.00	6.0-7.0	N 0.15-0.25; Cu 0.5-1.5
JIS G 3463:2012	Symbol SUS836LTB	---	---	0.030	2.00	1.00	0.040	0.030	19.00-24.00	24.00-26.00	5.00-7.00	N 0.25
ASME SA-249/SA-249M	---	N08904	---	0.020	2.00	1.00	0.040	0.030	19.0-23.0	23.0-28.0	4.0-5.0	N 0.10; Cu 1.00-2.00
ASME SA-358/SA-358M*	---	N08904	---	0.020	2.00	1.00	0.045	0.035	19.0-23.0	23.0-28.0	4.00-5.00	N 0.10; Cu 1.00-2.00
	---	N08926	---	0.020	2.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.00-7.00	N 0.15-0.25; Cu 0.50-1.50
ASTM A249/A249M-14a	---	N08904	---	0.020	2.00	1.00	0.040	0.030	19.0-23.0	23.0-28.0	4.0-5.0	N 0.10; Cu 1.00-2.00
ASTM A269/A269M-14e1	---	N08904	---	0.020	2.00	1.00	0.040	0.030	19.0-23.0	23.0-28.0	4.0-5.0	N 0.10; Cu 1.00-2.00
	---	N08925	---	0.020	1.00	0.50	0.045	0.030	19.0-21.0	24.0-26.0	6.0-7.0	N 0.10-0.20; Cu 0.80-1.50
ASTM A358/A358M-14a*	---	N08904	---	0.020	2.00	1.00	0.045	0.035	19.0-23.0	23.0-28.0	4.00-5.00	N 0.10; Cu 1.00-2.00
	---	N08926	---	0.020	2.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.00-7.00	N 0.15-0.25; Cu 0.50-1.50
EN 10216-5:2013	X1NiCrMoCu25-20-5	---	1.4539	0.020	2.00	0.70	0.030	0.010	19.0-21.0	24.0-26.0	4.0-5.0	N 0.15; Cu 1.20-2.00
	X1NiCrMoCuN25-20-7	---	1.4529	0.020	1.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.0-7.0	Cu 0.50-1.50; N 0.15-0.25
EN 10217-7:2014	X1NiCrMoCu25-20-5	---	1.4539	0.020	2.00	0.70	0.030	0.010	19.0-21.0	24.0-26.0	4.0-5.0	N 0.15; Cu 1.20-2.00
	X1NiCrMoCuN25-20-7	---	1.4529	0.020	1.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.0-7.0	Cu 0.50-1.50; N 0.15-0.25
JIS G 3459:2012	Symbol SUS890LTP	---	---	0.020	2.00	1.00	0.045	0.030	19.00-23.00	23.00-28.00	4.00-5.00	Cu 1.00-2.00
JIS G 3463:2012	Symbol SUS890LTB	---	---	0.020	2.00	1.00	0.040	0.030	19.00-23.00	23.00-28.00	4.00-5.00	Cu 1.00-2.00

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP304	S30400	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP304	S30400	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASME SA-312/SA-312M	Grade TP304	S30400	---	---	---	205	30	515	75	35 L, 25 T	A+Q or RC	---
ASME SA-358/SA-358M*	Grade 304	S30400	---	---	---	205	30	515	75	40	H or HT	201 max HBW; 92 max HRBW
ASME SA-376/SA-376M	Grade TP304	S30400	---	---	---	205	30	515 L	75 L	35 L, 25 T	HT+Q or RC	---
ASME SA-409/SA-409M	Grade TP304	S30400	---	---	---	205	30	515 T	75 T	---	HT+Q or RC	---
ASME SA-688/SA-688M	Grade TP 304	S30400	---	$t \geq 0.7$	$t \geq 0.028$	205	30	515	75	35	SA+RC	90 max HRB
ASTM A213/A213M-15a	Grade TP304	S30400	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	Grade TP304	S30400	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A270/A270M-15*	Grade TP 304	S30400	---	O.D. ≤ 300	O.D. ≤ 12	205	30	515	75	35	HT+Q or RC	90 max HRB
ASTM A312/A312M-15	Grade TP304	S30400	---	---	---	205	30	515	75	35 L; 25 T	A+Q or RC	---
ASTM A358/A358M-14a*	Grade 304	S30400	---	---	---	205	30	515	75	40	H, HT, HT-O or HT-SO	201 max HBW; 92 max HRBW
ASTM A376/A376M-14	Grade TP304	S30400	---	---	---	205	30	515	75	35 L; 25 T	see standard	---
ASTM A409/A409M-15	Grade TP304	S30400	---	---	---	205	30	515 T	75 T	---	H, HT, HT-O or HT-SO	---
ASTM A688/A688M-15	Grade TP304	S30400	---	$t \geq 0.7$	$t \geq 0.028$	205	30	515	75	35	SA+RC	90 max HRB
ASTM A908-03 (2013)	Type 304	S30400	---	$0.05 \leq t \leq 0.4$	$0.002 \leq t \leq 0.015$	---	---	1030-1370	150-200	---	---	---
EN 10216-5:2013	X5CrNi18-10	---	1.4301	$t \leq 60$	---	195	---	500-700	---	40 L, 35 T	SA	see standard for impact data
EN 10217-7:2014	X5CrNi18-10	---	1.4301	$t \leq 60$	---	195	---	500-700	---	40 L, 35 T	SA	see standard for impact data
JIS G 3459:2012	Symbol SUS304TP	---	---	$d \geq 40$	---	205	---	520	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS304TB	---	---	$d < 10$	---	205	---	520	---	27 L	ST	---
				$10 \leq d < 20$	---	205	---	520	---	30 L	ST	---
				$d \geq 20$	---	205	---	520	---	35 L	ST	---
JIS G 3467:2013	Symbol SUS304TF	---	---	---	---	205	---	520	---	35	ST	---
JIS G 3468:2011	Symbol SUS304TPY	---	---	---	---	205	---	520	---	35 L; 25 T	ST	---

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP304L	S30403	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	170	25	485	70	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP304L	S30403	---	$t \geq 0.4$	$t \geq 0.015$	170	25	485	70	35	ST+Q or RC	90 max HRB
	Grade TP304N	S30451	---	$t \geq 0.4$	$t \geq 0.015$	240	35	550	80	35	ST+Q or RC	90 max HRB
ASME SA-312/SA-312M	Grade TP304L	S30403	---	---	---	170	25	485	70	35 L, 25 T	A+Q or RC	---
ASME SA-358/SA-358M*	Grade 304L	S30403	---	---	---	170	25	485	70	40	H or HT	201 max HBW; 92 max HRBW
ASME SA-409/SA-409M	Grade TP304L	S30403	---	---	---	170	25	485 T	70 T	---	HT+Q or RC	---
ASME SA-688/SA-688M	Grade TP 304L	S30403	---	$t \geq 0.7$	$t \geq 0.028$	175	25	485	70	35	SA+RC	90 max HRB
ASTM A213/A213M-15a	Grade TP304L	S30403	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	170	25	485	70	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	Grade TP304L	S30403	---	$t \geq 0.4$	$t \geq 0.015$	170	25	485	70	35	ST+Q or RC	90 max HRB
	Grade TP304N	S30451	---	$t \geq 0.4$	$t \geq 0.015$	240	35	550	80	35	ST+Q or RC	90 max HRB
ASTM A312/A312M-15	Grade TP304L	S30403	---	---	---	170	25	485	70	35 L; 25 T	A+Q or RC	---
ASTM A358/A358M-14a*	Grade 304L	S30403	---	---	---	170	25	485	70	40	H, HT, HT-O or HT-SO	201 max HBW; 92 max HRBW
ASTM A409/A409M-15	Grade TP304L	S30403	---	---	---	170	25	485 T	70 T	---	H, HT, HT-O or HT-SO	---
ASTM A688/A688M-15	Grade TP 304L	S30403	---	$t \geq 0.7$	$t \geq 0.028$	175	25	485	70	35	SA+RC	90 max HRB
EN 10216-5:2013	X2CrNi18-9	---	1.4307	$t \leq 60$	---	180	---	460-680	---	40 L, 35 T	SA	see standard for impact data
	X2CrNi19-11	---	1.4306	$t \leq 60$	---	180	---	460-680	---	40 L, 35 T	SA	see standard for impact data
EN 10217-7:2014	X2CrNi18-9	---	1.4307	$t \leq 60$	---	180	---	470-670	---	40 L, 35 T	SA	see standard for impact data
	X2CrNi19-11	---	1.4306	$t \leq 60$	---	180	---	460-680	---	40 L, 35 T	SA	see standard for impact data
JIS G 3459:2012	Symbol SUS304LTP	---	---	$d \geq 40$	---	175	---	480	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS304LTB	---	---	$d < 10$	---	175	---	480	---	27 L	ST	---
				$10 \leq d < 20$	---	175	---	480	---	30 L	ST	---
				$d \geq 20$	---	175	---	480	---	35 L	ST	---
JIS G 3468:2011	Symbol SUS304LTPY	---	---	---	---	175	---	480	---	35 L; 25 T	ST	---

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP304LN	S30453	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP304LN	S30453	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASME SA-376/SA-376M	Grade TP304LN	S30453	---	---	---	205	30	515 L	75 L	35 L, 25 T	HT+Q or RC	---
ASME SA-688/SA-688M	Grade TP 304LN	S30453	---	$t \geq 0.7$	$t \geq 0.028$	205	30	515	75	35	SA+RC	90 max HRB
ASTM A213/A213M-15a	Grade TP304LN	S30453	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	Grade TP304LN	S30453	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A376/A376M-14	Grade TP304LN	S30453	---	---	---	205	30	515	75	35 L; 25 T	see standard	---
ASTM A688/A688M-15	Grade TP304LN	S30453	---	$t \geq 0.7$	$t \geq 0.028$	205	30	515	75	35	SA+RC	90 max HRB
EN 10216-5:2013	X2CrNiN18-10	---	1.4311	$t \leq 60$	---	270	---	550-760	---	35 L, 30 T	SA	see standard for impact data
EN 10217-7:2014	X2CrNiN18-10	---	1.4311	$t \leq 60$	---	270	---	550-760	---	35 L, 30 T	SA	see standard for impact data

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP304H	S30409	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP304H	S30409	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASME SA-312/SA-312M	Grade TP304H	S30409	---	---	---	205	30	515	75	35 L, 25 T	A+Q or RC	---
ASME SA-358/SA-358M*	Grade 304H	S30409	---	---	---	205	30	515	75	40	A+Q or ST	201 max HBW; 92 max HRBW
ASME SA-376/SA-376M	Grade TP304H	S30409	---	---	---	205	30	515	75	35 L, 25 T	SA+Q or SA+RC	---
ASTM A213/A213M-15a	Grade TP304H	S30409	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	Grade TP304H	S30409	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A312/A312M-15	Grade TP304H	S30409	---	---	---	205	30	515	75	35 L; 25 T	A+Q or RC	---
ASTM A358/A358M-14a*	Grade 304H	S30409	---	---	---	205	30	515	75	40	H, HT, HT-O or HT-SO	201 max HBW; 92 max HRBW
ASTM A376/A376M-14	Grade TP304H	S30409	---	---	---	205	30	515	75	35 L; 25 T	see standard	---
EN 10216-5:2013	X6CrNi18-10	---	1.4948	$t \leq 50$	---	185	---	500-700	---	40 L, 35 T	SA	see standard for impact data
GB 5310-1995	Grade 1Cr18Ni9	---	---	---	---	205	---	520 L	---	35 L	ST	---
JIS G 3459:2012	Symbol SUS304HTP	---	---	$d \geq 40$	---	205	---	520	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS304HTB	---	---	$d < 10$	---	205	---	520	---	27 L	ST	---
				$10 \leq d < 20$	---	205	---	520	---	30 L	ST	---
				$d \geq 20$	---	205	---	520	---	35 L	ST	---
JIS G 3467:2013	Symbol SUS304HTF	---	---	---	---	205	---	520	---	35	ST	---

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP309S	S30908	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP309S	S30908	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASME SA-312/SA-312M	Grade TP309S	S30908	---	---	---	205	30	515	75	35 L, 25 T	A+Q or RC	---
ASME SA-358/SA-358M*	Grade 309S	S30908	---	---	---	205	30	515	75	40	H or HT	217 max HBW; 95 max HRBW
ASTM A213/A213M-15a	Grade TP309S	S30908	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	Grade TP309S	S30908	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A312/A312M-15	Grade TP309S	S30908	---	---	---	205	30	515	75	35 L; 25 T	A+Q, RC	---
ASTM A358/A358M-14a*	Grade 309S	S30908	---	---	---	205	30	515	75	40	H, HT, HT-O or HT-SO	217 max HBW; 95 max HRBW
JIS G 3459:2012	Symbol SUS309STP	---	---	$d \geq 40$	---	205	---	520	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS309STB	---	---	$d < 10$	---	205	---	520	---	27 L	ST	---
				$10 \leq d < 20$	---	205	---	520	---	30 L	ST	---
				$d \geq 20$	---	205	---	520	---	35 L	ST	---
JIS G 3468:2011	Symbol SUS309STPY	---	---	---	---	205	---	520	---	35 L; 25 T	ST	---

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP309H	S30909	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP309H	S30909	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A213/A213M-15a	Grade TP309H	S30909	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	Grade TP309H	S30909	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
JIS G 3459:2012	Symbol SUS309TP	---	---	$d \geq 40$	---	205	---	520	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS309TB	---	---	$d < 10$	---	205	---	520	---	27 L	ST	---
				$10 \leq d < 20$	---	205	---	520	---	30 L	ST	---
				$d \geq 20$	---	205	---	520	---	35 L	ST	---
ASME SA-213/SA-213M	Grade TP310S	S31008	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP310S	S31008	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASME SA-312/SA-312M	Grade TP310S	S31008	---	---	---	205	30	515	75	35 L, 25 T	A+Q or RC	---
ASME SA-358/SA-358M*	Grade 310S	S31008	---	---	---	205	30	515	75	40	H or HT	217 max HBW; 95 max HRBW
ASTM A213/A213M-15a	Grade TP310S	S31008	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	Grade TP310S	S31008	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A312/A312M-15	Grade TP310S	S31008	---	---	---	205	30	515	75	35 L; 25 T	A+Q, RC	---
ASTM A358/A358M-14a*	Grade 310S	S31008	---	---	---	205	30	515	75	40	H, HT, HT-O or HT-SO	217 max HBW; 95 max HRBW
JIS G 3459:2012	Symbol SUS310STP	---	---	$d \geq 40$	---	205	---	520	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS310STB	---	---	$d < 10$	---	205	---	520	---	27 L	ST	---
				$10 \leq d < 20$	---	205	---	520	---	30 L	ST	---
				$d \geq 20$	---	205	---	520	---	35 L	ST	---
JIS G 3468:2011	Symbol SUS310STPY	---	---	---	---	205	---	520	---	35 L; 25 T	ST	---

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP310H	S31009	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A213/A213M-15a	Grade TP310H	S31009	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
JIS G 3463:2012	Symbol SUS310TB	---	---	$d < 10$	---	205	---	520	---	27 L	ST	---
				$10 \leq d < 20$	---	205	---	520	---	30 L	ST	---
				$d \geq 20$	---	205	---	520	---	35 L	ST	---
JIS G 3467:2013	Symbol SUS310TF	---	---	---	---	205	---	520	---	35	ST	---

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP316	S31600	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP316	S31600	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASME SA-312/SA-312M	Grade TP316	S31600	---	---	---	205	30	515	75	35 L, 25 T	A+Q or RC	---
ASME SA-358/SA-358M*	Grade 316	S31600	---	---	---	205	30	515	75	40	H or HT	217 max HBW; 95 max HRBW
ASME SA-376/SA-376M	Grade TP316	S31600	---	---	---	205	30	515	75	35 L, 25 T	HT+Q or RC	---
ASME SA-409/SA-409M	Grade TP316	S31600	---	---	---	205	30	515 T	75 T	---	HT+Q or RC	---
ASME SA-688/SA-688M	Grade TP 316	S31600	---	$t \geq 0.7$	$t \geq 0.028$	205	30	515	75	35	SA+RC	90 max HRB
ASTM A213/A213M-15a	Grade TP316	S31600	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	Grade TP316	S31600	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A312/A312M-15	Grade TP316	S31600	---	---	---	205	30	515	75	35 L; 25 L	A+Q or RC	---
ASTM A358/A358M-14a*	Grade 316	S31600	---	---	---	205	30	515	75	40	H, HT, HT-O or HT-SO	217 max HBW; 95 max HRBW
ASTM A376/A376M-14	Grade TP316	S31600	---	---	---	205	30	515	75	35 L; 25 L	see standard	---
ASTM A409/A409M-15	Grade TP316	S31600	---	---	---	205	30	515 T	75 T	---	H, HT, HT-O or HT-SO	---
ASTM A688/A688M-15	Grade TP316	S31600	---	$t \geq 0.7$	$t \geq 0.028$	205	30	515	75	35	SA+RC	90 max HRB
EN 10216-5:2013	X5CrNiMo17-12-2	---	1.4401	$t \leq 60$	---	205	---	510-710	---	40 L, 30 T	SA	see standard for impact data
	X3CrNiMo17-13-3	---	1.4436	$t \leq 60$	---	205	---	510-710	---	40 L, 30 T	SA	
EN 10217-7:2014	X5CrNiMo17-12-2	---	1.4401	$t \leq 60$	---	205	---	510-710	---	40 L, 30 T	SA	see standard for impact data
	X3CrNiMo17-13-3	---	1.4436	$t \leq 60$	---	205	---	510-710	---	40 L, 30 T	SA	
JIS G 3459:2012	Symbol SUS316TP	---	---	$d \geq 40$	---	205	---	520	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS316TB	---	---	$d < 10$	---	205	---	520	---	27 L	ST	---
				$10 \leq d < 20$	---	205	---	520	---	30 L	ST	---
				$d \geq 20$	---	205	---	520	---	35 L	ST	---
JIS G 3467:2013	Symbol SUS316TF	---	---	---	---	205	---	520	---	35	ST	---
JIS G 3468:2011	Symbol SUS316TPY	---	---	---	---	205	---	520	---	35 L; 25 T	ST	---

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP316L	S31603	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	170	25	485	70	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP316L	S31603	---	$t \geq 0.4$	$t \geq 0.015$	170	25	485	70	35	ST+Q or RC	90 max HRB
ASME SA-312/SA-312M	Grade TP316L	S31603	---	---	---	170	25	485	70	35 L, 25 T	A+Q or RC	---
ASME SA-358/SA-358M*	Grade 316L	S31603	---	---	---	170	25	485	70	40	H or HT	217 max HBW; 95 max HRBW
ASME SA-409/SA-409M	Grade TP316L	S31603	---	---	---	170	25	485 T	70 T	---	HT+Q or RC	---
ASME SA-688/SA-688M	Grade TP 316L	S31603	---	$t \geq 0.7$	$t \geq 0.028$	175	25	485	70	35	SA+RC	90 max HRB
ASTM A213/A213M-15a	Grade TP316L	S31603	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	170	25	485	70	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	Grade TP316L	S31603	---	$t \geq 0.4$	$t \geq 0.015$	170	25	485	70	35	ST+Q or RC	90 max HRB
ASTM A312/A312M-15	Grade TP316L	S31603	---	---	---	170	25	485	70	35 L; 25 T	A+Q or RC	---
ASTM A358/A358M-14a*	Grade 316L	S31603	---	---	---	170	25	485	70	40	H, HT, HT-O or HT-SO	217 max HBW; 95 max HRBW
ASTM A409/A409M-15	Grade TP316L	S31603	---	---	---	170	25	485	70	---	H, HT, HT-O or HT-SO	---
ASTM A688/A688M-15	Grade TP316L	S31603	---	$t \geq 0.7$	$t \geq 0.028$	175	25	485	70	35	SA+RC	90 max HRB

Note: This section continued on next page.

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10216-5:2013	X2CrNiMo17-12-2	---	1.4404	$t \leq 60$	---	190	---	490-690	---	40 L, 30 T	SA	see standard for impact data
	X2CrNiMo18-14-3	---	1.4435	$t \leq 60$	---	190	---	490-690	---	40 L, 30 T	SA	see standard for impact data
EN 10217-7:2014	X2CrNiMo17-12-2	---	1.4404	$t \leq 60$	---	190	---	490-690	---	40 L, 30 T	SA	see standard for impact data
	X2CrNiMo17-12-3	---	1.4432	$t \leq 60$	---	190	---	490-690	---	40 L, 30 T	SA	see standard for impact data
	X2CrNiMo18-14-3	---	1.4435	$t \leq 60$	---	190	---	490-690	---	40 L, 30 T	SA	see standard for impact data
JIS G 3459:2012	Symbol SUS316LTP	---	---	$d \geq 40$	---	175	---	480	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS316LTB	---	---	$d < 10$	---	175	---	480	---	27 L	ST	---
				$10 \leq d < 20$	---	175	---	480	---	30 L	ST	---
				$d \geq 20$	---	175	---	480	---	35 L	ST	---
JIS G 3468:2011	Symbol SUS316LTPY	---	---	---	---	175	---	480	---	35 L; 25 T	ST	---
ASME SA-213/SA-213M	Grade TP316LN	S31653	---	---	---	---	---	---	---	---	ST+Q or RC	---
ASME SA-249/SA-249M	Grade TP316LN	S31653	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASME SA-376/SA-376M	Grade TP316LN	S31653	---	---	---	205	30	515	75	35 L, 25 T	HT+Q or RC	---
ASME SA-688/SA-688M	Grade TP 316LN	S31653	---	$t \geq 0.7$	$t \geq 0.028$	205	30	515	75	35	SA+RC	90 max HRB
ASTM A213/A213M-15a	Grade TP316LN	S31653	---	---	---	---	---	---	---	---	ST+Q or RC	---
ASTM A249/A249M-14a	Grade TP316LN	S31653	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A376/A376M-14	Grade TP316LN	S31653	---	---	---	205	30	515	75	35 L; 25 T	see standard	---
ASTM A688/A688M-15	Grade TP316LN	S31653	---	$t \geq 0.7$	$t \geq 0.028$	205	30	515	75	35	SA+RC	90 max HRB
EN 10216-5:2013	X2CrNiMoN17-13-3	---	1.4429	$t \leq 60$	---	295	---	580-800	---	35 L, 30 T	SA	see standard for impact data
EN 10217-7:2014	X2CrNiMoN17-13-3	---	1.4429	$t \leq 60$	---	295	---	580-800	---	35 L, 30 T	SA	see standard for impact data

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP316H	S31609	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP316H	S31609	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASME SA-312/SA-312M	Grade TP316H	S31609	---	---	---	205	30	515	75	35 L, 25 T	A+Q or RC	---
ASME SA-358/SA-358M*	Grade 316H	S31609	---	---	---	205	30	515	75	40	H or HT	217 max HBW; 95 max HRBW
ASME SA-376/SA-376M	Grade TP316H	S31609	---	---	---	205	30	515	75	35 L, 25 T	SA+Q or SA+RC	---
ASTM A213/A213M-15a	Grade TP316H	S31609	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	Grade TP316H	S31609	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A312/A312M-15	Grade TP316H	S31609	---	---	---	205	30	515	75	35 L; 25 T	A+Q or RC	---
ASTM A358/A358M-14a*	Grade 316H	S31609	---	---	---	205	30	515	75	40	H, HT, HT-O or HT-SO	217 max HBW; 95 max HRBW
ASTM A376/A376M-14	Grade TP316H	S31609	---	---	---	205	30	515	75	35 L; 25 T	see standard	---
EN 10216-5:2013	X6CrNiMo17-13-2	---	1.4918	$t \leq 50$	---	205	---	490-690	---	35 L, 30 T	SA	see standard for impact data
JIS G 3459:2012	Symbol SUS316HTP	---	---	$d \geq 40$	---	205	---	520	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS316HTB	---	---	$d < 10$	---	205	---	520	---	27 L	ST	---
				$10 \leq d < 20$	---	205	---	520	---	30 L	ST	---
				$d \geq 20$	---	205	---	520	---	35 L	ST	---
JIS G 3467:2013	Symbol SUS316HTF	---	---	---	---	205	---	520	---	35	ST	---
EN 10216-5:2013	X6CrNiMoTi17-12-2	---	1.4571	$t \leq 60$	---	210	---	500-730	---	35 L, 30 T	SA+CF	see standard for impact data
				$t \leq 60$	---	190	---	490-690	---	35 L, 30 T	SA+HF	see standard for impact data
EN 10217-7:2014	X6CrNiMoTi17-12-2	---	1.4571	$t \leq 60$	---	210	---	500-730	---	35 L, 30 T	SA	see standard for impact data
JIS G 3459:2012	Symbol SUS316TiTP	---	---	$d \geq 40$	---	205	---	520	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS316TiTB	---	---	$d < 10$	---	205	---	520	---	27 L	ST	---
				$10 \leq d < 20$	---	205	---	520	---	30 L	ST	---
				$d \geq 20$	---	205	---	520	---	35 L	ST	---

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP317	S31700	---	$0.4 \leq t < 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	34	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP317	S31700	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASME SA-312/SA-312M	Grade TP317	S31700	---	---	---	205	30	515	75	35 L, 25 T	A+Q or RC	---
ASME SA-409/SA-409M	Grade TP317	S31700	---	---	---	205	30	515 T	75 T	---	HT+Q or RC	---
ASTM A213/A213M-15a	Grade TP317	S31700	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	34	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	Grade TP317	S31700	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A312/A312M-15	Grade TP317	S31700	---	---	---	205	30	515	75	35 L; 25 T	A+Q or RC	---
ASTM A409/A409M-15	Grade TP317	S31700	---	---	---	205	30	515	75	---	H, HT, HT-O or HT-SO	---
JIS G 3459:2012	Symbol SUS317TP	---	---	$d \geq 40$	---	205	---	520	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS317TB	---	---	$d < 10$	---	205	---	520	---	27 L	ST	---
				$10 \leq d < 20$	---	205	---	520	---	30 L	ST	---
				$d \geq 20$	---	205	---	520	---	35 L	ST	---
JIS G 3468:2011	Symbol SUS317TPY	---	---	---	---	205	---	520	---	35 L; 25 T	ST	---
ASME SA-213/SA-213M	Grade TP317L	S31703	---	$0.4 \leq t < 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP317L	S31703	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASME SA-312/SA-312M	Grade TP317L	S31703	---	---	---	205	30	515	75	35 L, 25 T	A+Q or RC	---
ASTM A213/A213M-15a	Grade TP317L	S31703	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	Grade TP317L	S31703	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A312/A312M-15	Grade TP317L	S31703	---	---	---	205	30	515	75	35 L; 25 T	A+Q or RC	---
EN 10217-7:2014	X2CrNiMo18-15-4	---	1.4438	$t \leq 60$	---	220	---	490-690	---	35 L, 30 T	SA	see standard for impact data
JIS G 3459:2012	Symbol SUS317LTP	---	---	$d \geq 40$	---	175	---	480	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS317LTB	---	---	$d < 10$	---	175	---	480	---	27 L	ST	---
				$10 \leq d < 20$	---	175	---	480	---	30 L	ST	---
				$d \geq 20$	---	175	---	480	---	35 L	ST	---
JIS G 3468:2011	Symbol SUS317LTPY	---	---	---	---	175	---	480	---	35 L; 25 T	ST	---

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP317LM	S31725	---	$0.4 \leq t < 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	---	S31725	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASME SA-312/SA-312M	---	S31725	---	---	---	205	30	515	75	35 L, 25 T	A+Q or RC	---
ASME SA-358/SA-358M*	---	S31725	---	---	---	205	30	515	75	40	H or HT	217 max HBW; 95 max HRBW
ASME SA-376/SA-376M	---	S31725	---	---	---	205	30	515	75	35 L, 25 T	HT+Q or RC	---
ASME SA-409/SA-409M	---	S31725	---	---	---	205	30	515 T	75 T	---	HT+Q or RC	---
ASTM A213/A213M-15a	Grade TP317LM	S31725	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	---	S31725	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A312/A312M-14	---	S31725	---	---	---	205	30	515	75	35 L; 25 T	A+Q or RC	---
ASTM A358/A358M-14a*	---	S31725	---	---	---	205	30	515	75	40	H, HT, HT-O or HT-SO	217 max HBW; 95 max HRBW
ASTM A376/A376M-14	---	S31725	---	---	---	205	30	515	75	35 L; 25 T	HT	---
ASTM A409/A409M-15	---	S31725	---	---	---	205	30	515	75	---	H, HT, HT-O or HT-SO	---
EN 10216-5:2013	X2CrNiMoN17-13-5	---	1.4439	$t \leq 60$	--	285	---	580-800	---	35 L, 30 T	SA	see standard for impact data
EN 10217-7:2014	X2CrNiMoN17-13-5	---	1.4439	$t \leq 60$	--	285	---	580-800	---	35 L, 30 T	SA	see standard for impact data

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP321	S32100	---	$0.4 \leq t < 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP321	S32100	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASME SA-312/SA-312M	Grade TP321	S32100	---	---	---	205	30	515	75	35 L, 25 T	A+Q or RC	---
				---	$t \leq 0.375$	205	30	515	75	35 L, 25 T	A+Q or RC	---
				---	$t > 0.375$	170	25	485	70	35 L, 25 T	A+Q or RC	---
ASME SA-358/SA-358M*	Grade 321	S32100	---	---	---	205	30	515	75	40	H or HT	217 max HBW; 95 max HRBW
ASME SA-376/SA-376M	Grade TP321	S32100	---	---	$t \leq 0.375$	205	30	515	75	35 L, 25 T	HT+Q or RC	---
				---	$t > 0.375$	170	25	480	70	35 L, 25 T	HT+Q or RC	---
ASME SA-409/SA-409M	Grade TP321	S32100	---	---	---	205	30	515 T	75 T	---	HT+Q or RC	---
ASTM A213/A213M-15a	Grade TP321	S32100	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	Grade TP321	S32100	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A312/A312M-15	Grade TP321	S32100	---	---	$t \leq 0.375$	205	30	515	75	35 L; 25 T	A+Q or RC	---
				---	$t > 0.375$	170	25	485	70	35 L; 25 T	A+Q or RC	---
ASTM A358/A358M-14a*	Grade 321	S32100	---	---	---	205	30	515	75	40	H, HT, HT-O or HT-SO	217 max HBW; 95 max HRBW
ASTM A376/A376M-14	Grade TP321	S32100	---	---	$t \leq 0.375$	205	30	515	75	35 L; 25 T	see standard	---
				---	$t > 0.375$	170	25	480	70	35 L; 25 T	see standard	---
ASTM A409/A409M-15	Grade TP321	S32100	---	---	---	205	30	515	75	---	H, HT, HT-O or HT-SO	---
EN 10216-5:2013	X6CrNiTi18-10	---	1.4541	$t \leq 60$	---	200	---	500-730	---	35 L, 30 T	SA+CF	see standard for impact data
				$t \leq 60$	---	180	---	460-680	---	35 L, 30 T	SA+HF	see standard for impact data
EN 10217-7:2014	X6CrNiTi18-10	---	1.4541	$t \leq 60$	---	200	---	500-730	---	35 L, 30 T	SA	see standard for impact data
JIS G 3459:2012	Symbol SUS321TP	---	---	$d \geq 40$	---	205	---	520	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS321TB	---	---	$d < 10$	---	205	---	520	---	27 L	ST	---
				$10 \leq d < 20$	---	205	---	520	---	30 L	ST	---
				$d \geq 20$	---	205	---	520	---	35 L	ST	---
JIS G 3467:2013	Symbol SUS321TF	---	---	---	---	205	---	520	---	35	ST	---
				---	---	180	---	460	---	35	ST	---
JIS G 3468:2011	Symbol SUS321TPY	---	---	---	---	205	---	520	---	35 L; 25 T	ST	---

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP321H	S32109	---	$0.4 \leq t < 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP321H	S32109	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASME SA-312/SA-312M	Grade TP321H	S32109	---	---	---	205	30	515	75	35 L, 25 T	A+Q or RC	---
				---	$t \leq 0.1875$	205	30	515	75	35 L, 25 T	A+Q or RC	---
				---	$t > 0.1875$	170	25	480	70	35 L, 25 T	A+Q or RC	---
ASME SA-376/SA-376M	Grade TP321H	S32109	---	$t \leq 9.5$	$t \leq 0.375$	205	30	515	75	35 L, 25 T	SA+Q or SA+RC	---
				$t > 9.5$	$t > 0.375$	170	25	480	70	35 L, 25 T	SA+Q or SA+RC	---
ASTM A213/A213M-15a	Grade TP321H	S32109	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	Grade TP321H	S32109	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A312/A312M-15	Grade TP321H	S32109	---	---	---	205	30	515	75	35 L; 25 T	A+Q or RC	---
				---	$t \leq 0.375$	205	30	515	75	35 L; 25 T	A+Q or RC	---
				---	$t > 0.375$	170	25	480	70	35 L; 25 T	A+Q or RC	---
ASTM A376/A376M-14	Grade TP321H	S32109	---	$t \leq 9.5$	$t \leq 0.375$	205	30	515	75	35 L; 25 T	see standard	---
				$t > 9.5$	$t > 0.375$	170	25	480	70	35 L; 25 T	see standard	---
EN 10216-5:2013	X7CrNiTi18-10	---	1.4940	$t \leq 50$	---	190	---	510-710	---	35 L, 30 T	SA	see standard for impact data
JIS G 3459:2012	Symbol SUS321HTP	---	---	$d \geq 40$	---	205	---	520	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS321HTB	---	---	$d < 10$	---	205	---	520	---	27 L	ST	---
				$10 \leq d < 20$	---	205	---	520	---	30 L	ST	---
				$d \geq 20$	---	205	---	520	---	35 L	ST	---
JIS G 3467:2013	Symbol SUS321HTF	---	---	---	---	205	---	520	---	35	ST	---
				---	---	180	---	460	---	35	ST	---

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP347	S34700	---	$0.4 \leq t < 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP347	S34700	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASME SA-312/SA-312M	Grade TP347	S34700	---	---	---	205	30	515	75	35 L, 25 T	A+Q or RC	---
ASME SA-358/SA-358M*	Grade 347	S34700	---	---	---	205	30	515	75	40	H or HT	201 max HBW; 92 max HRBW
ASME SA-376/SA-376M	Grade TP347	S34700	---	---	---	205	30	515	75	35 L, 25 T	HT+Q or RC	---
ASME SA-409/SA-409M	Grade TP347	S34700	---	---	---	205	30	515 T	75 T	---	HT+Q or RC	---
ASTM A213/A213M-15a	Grade TP347	S34700	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	Grade TP347	S34700	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A312/A312M-15	Grade TP347	S34700	---	---	---	205	30	515	75	35 L; 25 T	A+Q or RC	---
ASTM A358/A358M-14a*	Grade 347	S34700	---	---	---	205	30	515	75	40	H, HT, HT-O or HT-SO	201 max HBW; 92 max HRBW
ASTM A376/A376M-14	Grade TP347	S34700	---	---	---	205	30	515	75	35 L; 25 T	see standard	---
ASTM A409/A409M-15	Grade TP347	S34700	---	---	---	205	30	515	75	---	H, HT, HT-O or HT-SO	---
EN 10216-5:2013	X6CrNiNb18-10	---	1.4550	$t \leq 60$	---	205	---	510-740	---	35 L, 30 T	SA	see standard for impact data
EN 10217-7:2014	X6CrNiNb18-10	---	1.4550	$t \leq 60$	---	205	---	510-740	---	35 L, 30 T	SA	see standard for impact data
JIS G 3459:2012	Symbol SUS347TP	---	---	$d \geq 40$	---	205	---	520	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS347TB	---	---	$d < 10$	---	205	---	520	---	27 L	ST	---
				$10 \leq d < 20$	---	205	---	520	---	30 L	ST	---
				$d \geq 20$	---	205	---	520	---	35 L	ST	---
JIS G 3467:2013	Symbol SUS347TF	---	---	---	---	205	---	520	---	35	ST	---
JIS G 3468:2011	Symbol SUS347TPY	---	---	---	---	205	---	520	---	35 L; 25 T	ST	---

*: See "List of Standards" at the beginning of the chapter.

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-213/SA-213M	Grade TP347H	S34709	---	$0.4 \leq t < 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
	Grade TP347HFG	S34710	---	$0.4 \leq t < 12.7$	$0.015 \leq t \leq 0.500$	205	30	550	80	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASME SA-249/SA-249M	Grade TP347H	S34709	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASME SA-312/SA-312M	Grade TP347H	S34709	---	---	---	205	30	515	75	35 L, 25 T	A+Q or RC	---
ASME SA-376/SA-376M	Grade TP347H	S34709	---	---	---	205	30	515	75	35 L, 25 T	SA+Q or SA+RC	---
ASTM A213/A213M-15a	Grade TP347H	S34709	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	515	75	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
	Grade TP347HFG	S34710	---	$0.4 \leq t \leq 12.7$	$0.015 \leq t \leq 0.500$	205	30	550	80	35	ST+Q or RC	192 max HBW/ 200 max HV; 90 max HRB
ASTM A249/A249M-14a	Grade TP347H	S34709	---	$t \geq 0.4$	$t \geq 0.015$	205	30	515	75	35	ST+Q or RC	90 max HRB
ASTM A312/A312M-15	Grade TP347H	S34709	---	---	---	205	30	515	75	35 L; 25 T	A+Q or RC	---
ASTM A376/A376M-14	Grade TP347H	S34709	---	---	---	205	30	515	75	35 L; 25 T	see standard	---
EN 10216-5:2013	X7CrNiNb18-10	---	1.4912	$t \leq 50$	---	205	---	510-710	---	40 L, 30 T	SA	see standard for impact data
GB 5310-1995	Grade 1Cr19Ni11Nb	---	---	---	---	205	---	520 L	---	35 L	ST	---
JIS G 3459:2012	Symbol SUS347HTP	---	---	$d \geq 40$	---	205	---	520	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS347HTB	---	---	$d < 10$	---	205	---	520	---	27 L	ST	---
				$10 \leq d < 20$	---	205	---	520	---	30 L	ST	---
				$d \geq 20$	---	205	---	520	---	35 L	ST	---
JIS G 3467:2013	Symbol SUS347HTF	---	---	---	---	205	---	520	---	35	ST	---
ASTM A240/A240M-15a	Type 800	N08800	---	$t \geq 0.50$	$t \geq 0.020$	205	30	520	75	30	---	---
JIS G 3467:2013	Symbol NCF800TF	---	---	---	---	205	---	520	---	30	ST	---
				---	---	175	---	450	---	30	ST	---
ASTM A240/A240M-15a	Type 800H	N08810	---	$t \geq 0.50$	$t \geq 0.020$	170	25	450	65	30	---	---
JIS G 3467:2013	Symbol NCF800HTF	---	---	---	---	175	---	450	---	30	ST	---

5.9 Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

5.9.2B Mechanical Properties of Austenitic Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-249/SA-249M	---	N08367	---	---	$0.015 < t \leq 0.187$	310	45	690	100	30	ST+Q or RC	100 max HRB
				---	$t > 0.187$	310	45	655	95	30	ST+Q or RC	100 max HRB
		N08926	---	$t \geq 0.4$	$t \geq 0.015$	295	43	650	94	35	ST+Q or RC	100 max HRB
ASME SA-312/SA-312M	---	N08926	---	---	---	295	43	650	94	35 L, 25 T	A+Q or RC	---
ASME SA-688/SA-688M	---	N08367	---	---	$0.028 \leq t \leq 0.187$	310	45	690	100	30	SA+Q	90 max HRB
				---	$t > 0.187$	310	45	655	95	30	SA+Q	90 max HRB
		N08926	---	$t \geq 0.7$	$t \geq 0.028$	295	43	650	94	35	SA+Q or SA+RC	90 max HRB
ASTM A249/A249M-14a	---	N08367	---	---	$0.015 < t \leq 0.187$	310	45	690	100	30	ST+Q or RC	100 max HRB
				---	$t > 0.187$	310	45	655	95	30	ST+Q or RC	100 max HRB
		N08926	---	$t \geq 0.4$	$t \geq 0.015$	295	43	650	94	35	ST+Q or RC	100 max HRB
ASTM A312/A312M-15	---	N08926	---	---	---	295	43	650	94	35 L; 25 T	A+Q or RC	---
ASTM A688/A688M-15	---	N08367	---	---	$0.028 \leq t \leq 0.187$	310	45	655	95	30	SA+Q	100 max HRB
				---	$t > 0.187$	310	45	655	95	30	SA+Q	100 max HRB
		N08926	---	$t \geq 0.7$	$t \geq 0.028$	295	43	650	94	35	SA+Q or SA+RC	90 max HRB
JIS G 3463:2012	Symbol SUS836LTB	---	---	$d < 10$	---	205	---	520	---	27 L	ST	---
				$10 \leq d < 20$	---	205	---	520	---	30 L	ST	---
				$d \geq 20$	---	205	---	520	---	35 L	ST	---
ASME SA-249/SA-249M	---	N08904	---	$t \geq 0.4$	$t \geq 0.015$	215	31	490	71	35	ST+Q or RC	90 max HRB
ASME SA-358/SA-358M*	---	N08904	---	---	---	220	31	490	71	35	H or HT	90 max HRBW
		N08926	---	---	---	295	43	650	94	35	H or HT	---
ASTM A249/A249M-14a	---	N08904	---	$t \geq 0.4$	$t \geq 0.015$	215	31	490	71	35	ST+Q or RC	90 max HRB
ASTM A269/A269M-14e1	---	N08904	---	$t \geq 0.38$	$t \geq 0.015$	---	---	---	---	---	HT	192 max HBW/ 200 max HV; 90 max HRB
		N08925	---	$t \geq 0.38$	$t \geq 0.015$	---	---	---	---	---	HT	217 max HBW; 95 max HRB
ASTM A358/A358M-14a*	---	N08904	---	---	---	220	31	490	71	35	H, HT, HT-O or HT-SO	90 max HRBW
		N08926	---	---	---	295	43	650	94	35	H, HT, HT-O or HT-SO	---
EN 10216-5:2013	X1NiCrMoCu25-20-5	---	1.4539	$t \leq 60$	---	230	---	520-720	---	35 L, 30 T	SA	see standard for impact data
	X1NiCrMoCuN25-20-7	---	1.4529	$t \leq 60$	---	270	---	600-800	---	35 L, 30 T	SA	
EN 10217-7:2014	X1NiCrMoCu25-20-5	---	1.4539	$t \leq 60$	---	220	---	520-720	---	35 L, 30 T	SA	see standard for impact data
	X1NiCrMoCuN25-20-7	---	1.4529	$t \leq 60$	---	300	---	600-800	---	40 L, 40 T	SA	
JIS G 3459:2012	Symbol SUS890LTP	---	---	$d \geq 40$	---	215	---	490	---	35 L; 25 T	ST	---
JIS G 3463:2012	Symbol SUS890LTB	---	---	$d < 10$	---	215	---	490	---	27 L	ST	---
				$10 \leq d < 20$	---	215	---	490	---	30 L	ST	---
				$d \geq 20$	---	215	---	490	---	35 L	ST	---

*: See "List of Standards" at the beginning of the chapter.

5.10 Line Pipe Steels

5.10.1A Mechanical Properties of Line Pipe Steels Without Notch Toughness Requirements

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
API 5L - 2012	L175 or A25	---	1.8700	$t \leq 25.0$	$t \leq 0.984$	175	25.4	310	45	see standard	see standard	---
	L175P or A25P	---	1.8707	$t \leq 25.0$	$t \leq 0.984$	175	25.4	310	45	see standard	see standard	---
EN ISO 3183:2012	L175 or A25	---	1.8700	$t \leq 25.0$	$t \leq 0.984$	175	25.4	310	45	see standard	see standard	---
	L175P or A25P	---	1.8707	$t \leq 25.0$	$t \leq 0.984$	175	25.4	310	45	see standard	see standard	---
API 5L - 2012	L210 or A	---	1.8713	$t \leq 25.0$	$t \leq 0.984$	210	30.5	335	48.6	see standard	see standard	---
EN ISO 3183:2012	L210 or A	---	1.8713	$t \leq 25.0$	$t \leq 0.984$	210	30.5	335	48.6	see standard	see standard	---
GB/T 14164-2005	Grade S210 - PSL1	---	---	---	---	210	---	335 T	---	25 T	HR or CtR	---
API 5L - 2012	L245 or B	---	1.8723	$t \leq 25.0$	$t \leq 0.984$	245	35.5	415	60.2	see standard	see standard	---
CSA Z245.1-14	241 - Category 1	---	---	---	---	241-495	---	414-760	---	see standard	see standard	---
EN ISO 3183:2012	L245 or B	---	1.8723	$t \leq 25.0$	$t \leq 0.984$	245	35.5	415	60.2	see standard	see standard	---
GB/T 14164-2005	Grade S245 - PSL1	---	---	---	---	245	---	415 T	---	21 T	HR or CtR	---
	Grade S290 - PSL1	---	---	---	---	290	---	415 T	---	21 T	HR or CtR	---
API 5L - 2012	L290 or X42	---	1.8728	$t \leq 25.0$	$t \leq 0.984$	290	42.1	415	60.2	see standard	see standard	---
CSA Z245.1-14	290 - Category 1	---	---	---	---	290-495	---	414-760	---	see standard	see standard	---
EN ISO 3183:2012	L290 or X42	---	1.8728	$t \leq 25.0$	$t \leq 0.984$	290	42.1	415	60.2	see standard	see standard	---
API 5L - 2012	L320 or X46	---	1.8729	$t \leq 25.0$	$t \leq 0.984$	320	46.4	435	63.1	see standard	see standard	---
EN ISO 3183:2012	L320 or X46	---	1.8729	$t \leq 25.0$	$t \leq 0.984$	320	46.4	435	63.1	see standard	see standard	---
GB/T 14164-2005	Grade S320 - PSL1	---	---	---	---	320	---	435 T	---	20 T	HR or CtR	---
API 5L - 2012	L360 or X52	---	1.8730	$t \leq 25.0$	$t \leq 0.984$	360	52.2	460	66.7	see standard	see standard	---
CSA Z245.1-14	359 - Category 1	---	---	---	---	359-530	---	455-760	---	see standard	see standard	---
EN ISO 3183:2012	L360 or X52	---	1.8730	$t \leq 25.0$	$t \leq 0.984$	360	52.2	460	66.7	see standard	see standard	---
GB/T 14164-2005	Grade S360 - PSL1	---	---	---	---	360	---	460 T	---	19 T	HR or CtR	---

5.10 Line Pipe Steels

5.10.1A Mechanical Properties of Line Pipe Steels Without Notch Toughness Requirements (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
API 5L - 2012	L390 or X56	---	1.8724	$t \leq 25.0$	$t \leq 0.984$	390	56.6	490	71.1	see standard	see standard	---
CSA Z245.1-14	386 - Category 1	---	---	---	---	386-540	---	490-760	---	see standard	see standard	---
EN ISO 3183:2012	L390 or X56	---	1.8724	$t \leq 25.0$	$t \leq 0.984$	390	56.6	490	71.1	see standard	see standard	---
GB/T 14164-2005	Grade S390 - PSL1	---	---	---	---	390	---	490 T	---	18 T	HR or CtR	---
API 5L - 2012	L415 or X60	---	1.8725	$t \leq 25.0$	$t \leq 0.984$	415	60.2	520	75.4	see standard	see standard	---
CSA Z245.1-14	414 - Category 1	---	---	---	---	414-565	---	517-760	---	see standard	see standard	---
EN ISO 3183:2012	L415 or X60	---	1.8725	$t \leq 25.0$	$t \leq 0.984$	415	60.2	520	75.4	see standard	see standard	---
GB/T 14164-2005	Grade S415 - PSL1	---	---	---	---	415	---	520 T	---	17 T	HR or CtR	---
API 5L - 2012	L450 or X65	---	1.8726	$t \leq 25.0$	$t \leq 0.984$	450	65.3	535	77.6	see standard	see standard	---
CSA Z245.1-14	448 - Category 1	---	---	---	---	448-600	---	531-760	---	see standard	see standard	---
EN ISO 3183:2012	L450 or X65	---	1.8726	$t \leq 25.0$	$t \leq 0.984$	450	65.3	535	77.6	see standard	see standard	---
GB/T 14164-2005	Grade S450 - PSL1	---	---	---	---	450	---	535 T	---	17 T	HR or CtR	---
API 5L - 2012	L485 or X70	---	1.8727	$t \leq 25.0$	$t \leq 0.984$	485	70.3	570	82.7	see standard	see standard	---
CSA Z245.1-14	483 - Category 1	---	---	---	---	483-620	---	565-760	---	see standard	see standard	---
EN ISO 3183:2012	L485 or X70	---	1.8727	$t \leq 25.0$	$t \leq 0.984$	485	70.3	570	82.7	see standard	see standard	---
GB/T 14164-2005	Grade S485 - PSL1	---	---	---	---	485	---	570 T	---	16 T	HR or CtR	---

5.10 Line Pipe Steels

5.10.1B Chemical Composition of Line Pipe Steels Without Notch Toughness Requirements

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
API 5L - 2012	L175 or A25 Seamless	---	1.8700	0.21	0.60	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
	L175P or A25P Seamless	---	1.8707	0.21	0.60	---	0.045-0.080	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
	L175 or A25 Welded	---	1.8700	0.21	0.60	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
	L175P or A25P Welded	---	1.8707	0.21	0.60	---	0.045-0.080	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
EN ISO 3183:2012	L175 or A25 Seamless	---	1.8700	0.21	0.60	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
	L175P or A25P Seamless	---	1.8707	0.21	0.60	---	0.045-0.080	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
	L175 or A25 Welded	---	1.8700	0.21	0.60	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
	L175P or A25P Welded	---	1.8707	0.21	0.60	---	0.045-0.080	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
API 5L - 2012	L210 or A Seamless	---	1.8713	0.22	0.90	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
	L210 or A Welded	---	1.8713	0.22	0.90	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
EN ISO 3183:2012	L210 or A Seamless	---	1.8713	0.22	0.90	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
	L210 or A Welded	---	1.8713	0.22	0.90	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
GB/T 14164-2005	Grade S210 - PSL1	---	---	0.22	0.90	0.35	0.03	0.03	---	---	---	---
API 5L - 2012	L245 or B Seamless	---	1.8723	0.28	1.20	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V) 0.06; (Nb+V+Ti) 0.15
	L245 or B Welded	---	1.8723	0.26	1.20	---	0.30	0.30	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V) 0.06; (Nb+V+Ti) 0.15
CSA Z245.1-14	241 - Category 1	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN ISO 3183:2012	L245 or B Seamless	---	1.8723	0.28	1.20	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V) 0.06; (Nb+V+Ti) 0.15
	L245 or B Welded	---	1.8723	0.26	1.20	---	0.30	0.30	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V) 0.06; (Nb+V+Ti) 0.15
GB/T 14164-2005	Grade S245 - PSL1	---	---	0.26	1.20	0.35	0.03	0.03	---	---	---	---
	Grade S290 - PSL1	---	---	0.26	1.30	0.35	0.03	0.03	---	---	---	---
API 5L - 2012	L290 or X42 Seamless	---	1.8728	0.28	1.30	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L290 or X42 Welded	---	1.8728	0.26	1.30	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
CSA Z245.1-14	290 - Category 1	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN ISO 3183:2012	L290 or X42 Seamless	---	1.8728	0.28	1.30	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L290 or X42 Welded	---	1.8728	0.26	1.30	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15

5.10 Line Pipe Steels

5.10.1B Chemical Composition of Line Pipe Steels Without Notch Toughness Requirements (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
API 5L - 2012	L320 or X46 Seamless	---	1.8729	0.28	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L320 or X46 Welded	---	1.8729	0.26	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
EN ISO 3183:2012	L320 or X46 Seamless	---	1.8729	0.28	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L320 or X46 Welded	---	1.8729	0.26	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
GB/T 14164-2005	Grade S320 - PSL1	---	---	0.26	1.40	0.35	0.03	0.03	---	---	---	---
API 5L - 2012	L360 or X52 Seamless	---	1.8730	0.28	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L360 or X52 Welded	---	1.8730	0.26	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
CSA Z245.1-14	359 - Category 1	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN ISO 3183:2012	L360 or X52 Seamless	---	1.8730	0.28	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L360 or X52 Welded	---	1.8730	0.26	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
GB/T 14164-2005	Grade S360 - PSL1	---	---	0.26	1.40	0.35	0.03	0.03	---	---	---	---
API 5L - 2012	L390 or X56 Seamless	---	1.8724	0.28	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L390 or X56 Welded	---	1.8724	0.26	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
CSA Z245.1-14	386 - Category 1	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN ISO 3183:2012	L390 or X56 Seamless	---	1.8724	0.28	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L390 or X56 Welded	---	1.8724	0.26	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
GB/T 14164-2005	Grade S390 - PSL1	---	---	0.26	1.40	0.40	0.03	0.03	---	---	---	---
API 5L - 2012	L415 or X60 Seamless	---	1.8725	0.28	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L415 or X60 Welded	---	1.8725	0.26	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
CSA Z245.1-14	414 - Category 1	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN ISO 3183:2012	L415 or X60 Seamless	---	1.8725	0.28	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L415 or X60 Welded	---	1.8725	0.26	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
GB/T 14164-2005	Grade S415 - PSL1	---	---	0.26	1.40	0.40	0.03	0.03	---	---	---	---

5.10 Line Pipe Steels

5.10.1B Chemical Composition of Line Pipe Steels Without Notch Toughness Requirements (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
API 5L - 2012	L450 or X65 Seamless	---	1.8726	0.28	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L450 or X65 Welded	---	1.8726	0.26	1.45	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
CSA Z245.1-14	448 - Category 1	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN ISO 3183:2012	L450 or X65 Seamless	---	1.8726	0.28	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L450 or X65 Welded	---	1.8726	0.26	1.45	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
GB/T 14164-2005	Grade S450 - PSL1	---	---	0.26	1.45	0.40	0.03	0.03	---	---	---	---
API 5L - 2012	L485 or X70 Seamless	---	1.8727	0.28	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L485 or X70 Welded	---	1.8727	0.26	1.65	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
CSA Z245.1-14	483 - Category 1	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN ISO 3183:2012	L485 or X70 Seamless	---	1.8727	0.28	1.40	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L485 or X70 Welded	---	1.8727	0.26	1.65	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
GB/T 14164-2005	Grade S485 - PSL1	---	---	0.26	1.65	0.40	0.03	0.03	---	---	---	---

5.10 Line Pipe Steels

5.10.2A Mechanical Properties of Line Pipe Steels With Notch Toughness Requirements

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
API 5L - 2012	L175 or A25	---	1.8700	$t \leq 25.0$	$t \leq 0.984$	175	25.4	310	45	see standard	see standard	---
	L175P or A25P	---	1.8707	$t \leq 25.0$	$t \leq 0.984$	175	25.4	310	45	see standard	see standard	---
EN ISO 3183:2012	L175 or A25	---	1.8700	$t \leq 25.0$	$t \leq 0.984$	175	25.4	310	45	see standard	see standard	---
	L175P or A25P	---	1.8707	$t \leq 25.0$	$t \leq 0.984$	175	25.4	310	45	see standard	see standard	---
GB/T 14164-2005	Grade S175 I - PSL1	---	---	---	---	175	---	315 T	---	27 T	HR or CTR	---
	Grade S175 II - PSL1	---	---	---	---	175	---	315 T	---	27 T	HR or CTR	---
API 5L - 2012	L245R or BR	---	1.8788	$t \leq 25.0$	$t \leq 0.984$	245-450	35.5-65.3	415-655	60.2-95	see standard	see standard	see standard
	L245N or BN	---	1.8790	$t \leq 25.0$	$t \leq 0.984$	245-450	35.5-65.3	415-655	60.2-95	see standard	see standard	see standard
	L245Q or BQ	---	1.8737	$t \leq 25.0$	$t \leq 0.984$	245-450	35.5-65.3	415-655	60.2-95	see standard	see standard	see standard
	L245M or BM	---	1.8746	$t \leq 25.0$	$t \leq 0.984$	245-450	35.5-65.3	415-655	60.2-95	see standard	see standard	see standard
CSA Z245.1-14	Grade 241 - Category 2	---	---	---	---	241-495	---	414-760	---	see standard	see standard	see standard
	Grade 241 - Category 3	---	---	---	---	241-495	---	414-760	---	see standard	see standard	see standard
EN ISO 3183:2012	L245R or BR	---	1.8788	$t \leq 25.0$	$t \leq 0.984$	245-450	35.5-65.3	415-655	60.2-95	see standard	see standard	see standard
	L245N or BN	---	1.8790	$t \leq 25.0$	$t \leq 0.984$	245-450	35.5-65.3	415-655	60.2-95	see standard	see standard	see standard
	L245Q or BQ	---	1.8737	$t \leq 25.0$	$t \leq 0.984$	245-450	35.5-65.3	415-655	60.2-95	see standard	see standard	see standard
	L245M or BM	---	1.8746	$t \leq 25.0$	$t \leq 0.984$	245-450	35.5-65.3	415-655	60.2-95	see standard	see standard	see standard
GB/T 14164-2005	Grade S245 - PSL2	---	---	---	---	245-445	---	415-755 T	---	21 T	HR or CTR	T: 40 J @ 0°C
API 5L - 2012	L290R or X42R	---	1.8789	$t \leq 25.0$	$t \leq 0.984$	290-495	42.1-71.8	415-655	60.2-95	see standard	see standard	see standard
	L290N or X42N	---	1.8791	$t \leq 25.0$	$t \leq 0.984$	290-495	42.1-71.8	415-655	60.2-95	see standard	see standard	see standard
	L290Q or X42Q	---	1.8738	$t \leq 25.0$	$t \leq 0.984$	290-495	42.1-71.8	415-655	60.2-95	see standard	see standard	see standard
	L290M or X42M	---	1.8747	$t \leq 25.0$	$t \leq 0.984$	290-495	42.1-71.8	415-655	60.2-95	see standard	see standard	see standard
CSA Z245.1-14	Grade 290 - Category 2	---	---	---	---	290-495	---	414-760	---	see standard	see standard	see standard
	Grade 290 - Category 3	---	---	---	---	290-495	---	414-760	---	see standard	see standard	see standard
EN ISO 3183:2012	L290R or X42R	---	1.8789	$t \leq 25.0$	$t \leq 0.984$	290-495	42.1-71.8	415-655	60.2-95	see standard	see standard	see standard
	L290N or X42N	---	1.8791	$t \leq 25.0$	$t \leq 0.984$	290-495	42.1-71.8	415-655	60.2-95	see standard	see standard	see standard
	L290Q or X42Q	---	1.8738	$t \leq 25.0$	$t \leq 0.984$	290-495	42.1-71.8	415-655	60.2-95	see standard	see standard	see standard
	L290M or X42M	---	1.8747	$t \leq 25.0$	$t \leq 0.984$	290-495	42.1-71.8	415-655	60.2-95	see standard	see standard	see standard
GB/T 14164-2005	Grade S290 - PSL2	---	---	---	---	290-495	---	415-755 T	---	21 T	HR or CTR	T: 42 J @ 0°C

5.10 Line Pipe Steels

5.10.2A Mechanical Properties of Line Pipe Steels With Notch Toughness Requirements (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
API 5L - 2012	L320N or X46N	---	1.8792	$t \leq 25.0$	$t \leq 0.984$	320-525	46.4-76.1	435-655	63.1-95	see standard	see standard	see standard
	L320Q or X46Q	---	1.8739	$t \leq 25.0$	$t \leq 0.984$	320-525	46.4-76.1	435-655	63.1-95	see standard	see standard	see standard
	L320M or X46M	---	1.8748	$t \leq 25.0$	$t \leq 0.984$	320-525	46.4-76.1	435-655	63.1-95	see standard	see standard	see standard
EN ISO 3183:2012	L320N or X46N	---	1.8792	$t \leq 25.0$	$t \leq 0.984$	320-525	46.4-76.1	435-655	63.1-95	see standard	see standard	see standard
	L320Q or X46Q	---	1.8739	$t \leq 25.0$	$t \leq 0.984$	320-525	46.4-76.1	435-655	63.1-95	see standard	see standard	see standard
	L320M or X46M	---	1.8748	$t \leq 25.0$	$t \leq 0.984$	320-525	46.4-76.1	435-655	63.1-95	see standard	see standard	see standard
GB/T 14164-2005	Grade S320 - PSL2	---	---	---	---	320-525	---	435-755 T	---	20 T	HR or CtR	T: 42 J @ 0°C
API 5L - 2012	L360N or X52N	---	1.8793	$t \leq 25.0$	$t \leq 0.984$	360-530	52.2-76.9	460-760	66.7-110.2	see standard	see standard	see standard
	L360Q or X52Q	---	1.8741	$t \leq 25.0$	$t \leq 0.984$	360-530	52.2-76.9	460-760	66.7-110.2	see standard	see standard	see standard
	L360M or X52M	---	1.8749	$t \leq 25.0$	$t \leq 0.984$	360-530	52.2-76.9	460-760	66.7-110.2	see standard	see standard	see standard
CSA Z245.1-14	Grade 359 - Category 2	---	---	---	---	359-530	---	455-760	---	see standard	see standard	see standard
	Grade 359 - Category 3	---	---	---	---	359-530	---	455-760	---	see standard	see standard	see standard
EN ISO 3183:2012	L360N or X52N	---	1.8793	$t \leq 25.0$	$t \leq 0.984$	360-530	52.2-76.9	460-760	66.7-110.2	see standard	see standard	see standard
	L360Q or X52Q	---	1.8741	$t \leq 25.0$	$t \leq 0.984$	360-530	52.2-76.9	460-760	66.7-110.2	see standard	see standard	see standard
	L360M or X52M	---	1.8749	$t \leq 25.0$	$t \leq 0.984$	360-530	52.2-76.9	460-760	66.7-110.2	see standard	see standard	see standard
GB/T 14164-2005	Grade S360 - PSL2	---	---	---	---	360-530	---	460-755 T	---	19 T	HR or CtR	T: 42 J @ 0°C
API 5L - 2012	L390N or X56N	---	1.8970	$t \leq 25.0$	$t \leq 0.984$	390-545	56.6-79	490-760	71.1-110.2	see standard	see standard	see standard
	L390Q or X56Q	---	1.8740	$t \leq 25.0$	$t \leq 0.984$	390-545	56.6-79	490-760	71.1-110.2	see standard	see standard	see standard
	L390M or X56M	---	1.8971	$t \leq 25.0$	$t \leq 0.984$	390-545	56.6-79	490-760	71.1-110.2	see standard	see standard	see standard
CSA Z245.1-14	Grade 386 - Category 2	---	---	---	---	386-540	---	490-760	---	see standard	see standard	see standard
	Grade 386 - Category 3	---	---	---	---	386-540	---	490-760	---	see standard	see standard	see standard
EN ISO 3183:2012	L390N or X56N	---	1.8970	$t \leq 25.0$	$t \leq 0.984$	390-545	56.6-79	490-760	71.1-110.2	see standard	see standard	see standard
	L390Q or X56Q	---	1.8740	$t \leq 25.0$	$t \leq 0.984$	390-545	56.6-79	490-760	71.1-110.2	see standard	see standard	see standard
	L390M or X56M	---	1.8971	$t \leq 25.0$	$t \leq 0.984$	390-545	56.6-79	490-760	71.1-110.2	see standard	see standard	see standard
GB/T 14164-2005	Grade S390 - PSL2	---	---	---	---	390-545	---	490-755 T	---	18 T	HR or CtR	T: 42 J @ 0°C

5.10 Line Pipe Steels

5.10.2A Mechanical Properties of Line Pipe Steels With Notch Toughness Requirements (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength		Tensile Strength		Elongation %, min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
API 5L - 2012	L415N or X60N	---	1.8736	$t \leq 25.0$	$t \leq 0.984$	415-565	60.2-81.9	520-760	75.4-110.2	see standard	see standard	see standard
	L415Q or X60Q	---	1.8742	$t \leq 25.0$	$t \leq 0.984$	415-565	60.2-81.9	520-760	75.4-110.2	see standard	see standard	see standard
	L415M or X60M	---	1.8752	$t \leq 25.0$	$t \leq 0.984$	415-565	60.2-81.9	520-760	75.4-110.2	see standard	see standard	see standard
CSA Z245.1-14	Grade 414 - Category 2	---	---	---	---	414-565	---	517-760	---	see standard	see standard	see standard
	Grade 414 - Category 3	---	---	---	---	414-565	---	517-760	---	see standard	see standard	see standard
EN ISO 3183:2012	L415N or X60N	---	1.8736	$t \leq 25.0$	$t \leq 0.984$	415-565	60.2-81.9	520-760	75.4-110.2	see standard	see standard	see standard
	L415Q or X60Q	---	1.8742	$t \leq 25.0$	$t \leq 0.984$	415-565	60.2-81.9	520-760	75.4-110.2	see standard	see standard	see standard
	L415M or X60M	---	1.8752	$t \leq 25.0$	$t \leq 0.984$	415-565	60.2-81.9	520-760	75.4-110.2	see standard	see standard	see standard
GB/T 14164-2005	Grade S415 - PSL2	---	---	---	---	415-565	---	520-755 T	---	17 T	HR or Ctr	T: 42 J @ 0°C
API 5L - 2012	L450Q or X65Q	---	1.8743	$t \leq 25.0$	$t \leq 0.984$	450-600	65.3-87	535-760	77.6-110.2	see standard	see standard	see standard
	L450M or X65M	---	1.8754	$t \leq 25.0$	$t \leq 0.984$	450-600	65.3-87	535-760	77.6-110.2	see standard	see standard	see standard
CSA Z245.1-14	Grade 448 - Category 2	---	---	---	---	448-600	---	531-760	---	see standard	see standard	see standard
	Grade 448 - Category 3	---	---	---	---	448-600	---	531-760	---	see standard	see standard	see standard
EN ISO 3183:2012	L450Q or X65Q	---	1.8743	$t \leq 25.0$	$t \leq 0.984$	450-600	65.3-87	535-760	77.6-110.2	see standard	see standard	see standard
	L450M or X65M	---	1.8754	$t \leq 25.0$	$t \leq 0.984$	450-600	65.3-87	535-760	77.6-110.2	see standard	see standard	see standard
GB/T 14164-2005	Grade S450 - PSL2	---	---	---	---	450-600	---	535-755 T	---	17 T	HR or Ctr	T: 47 J @ 0°C
API 5L - 2012	L485Q or X70Q	---	1.8744	$t \leq 25.0$	$t \leq 0.984$	485-635	70.3-92.1	570-760	82.7-110.2	see standard	see standard	see standard
	L485M or X70M	---	1.8756	$t \leq 25.0$	$t \leq 0.984$	485-635	70.3-92.1	570-760	82.7-110.2	see standard	see standard	see standard
CSA Z245.1-14	Grade 483 - Category 2	---	---	---	---	483-620	---	565-760	---	see standard	see standard	see standard
	Grade 483 - Category 3	---	---	---	---	483-620	---	565-760	---	see standard	see standard	see standard
EN ISO 3183:2012	L485Q or X70Q	---	1.8744	$t \leq 25.0$	$t \leq 0.984$	485-635	70.3-92.1	570-760	82.7-110.2	see standard	see standard	see standard
	L485M or X70M	---	1.8756	$t \leq 25.0$	$t \leq 0.984$	485-635	70.3-92.1	570-760	82.7-110.2	see standard	see standard	see standard
GB/T 14164-2005	Grade S485 - PSL2	---	---	---	---	485-620	---	570-755 T	---	16 T	HR or Ctr	T: 63 J @ 0°C
API 5L - 2012	L555Q or X80Q	---	1.8745	$t \leq 25.0$	$t \leq 0.984$	555-705	80.5-102.3	625-825	90.6-119.7	see standard	see standard	see standard
	L555M or X80M	---	1.8758	$t \leq 25.0$	$t \leq 0.984$	555-705	80.5-102.3	625-825	90.6-119.7	see standard	see standard	see standard
CSA Z245.1-14	Grade 550 - Category 2	---	---	---	---	550-690	---	620-830	---	see standard	see standard	see standard
	Grade 550 - Category 3	---	---	---	---	550-690	---	620-830	---	see standard	see standard	see standard
EN ISO 3183:2012	L555Q or X80Q	---	1.8745	$t \leq 25.0$	$t \leq 0.984$	555-705	80.5-102.3	625-825	90.6-119.7	see standard	see standard	see standard
	L555M or X80M	---	1.8758	$t \leq 25.0$	$t \leq 0.984$	555-705	80.5-102.3	625-825	90.6-119.7	see standard	see standard	see standard
GB/T 14164-2005	Grade S555 - PSL2	---	---	---	---	555-690	---	625-825 T	---	15 T	HR or Ctr	T: 96 J @ 0°C

5.10 Line Pipe Steels

5.10.2B Chemical Composition of Line Pipe Steels With Notch Toughness Requirements

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
API 5L - 2012	L175 or A25 Seamless	---	1.8700	0.21	0.60		0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
	L175P or A25P Seamless	---	1.8707	0.21	0.60	---	0.045-0.080	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
	L175 or A25 Welded	---	1.8700	0.21	0.60	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
	L175P or A25P Welded	---	1.8707	0.21	0.60	---	0.045-0.080	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
EN ISO 3183:2012	L175 or A25 Seamless	---	1.8700	0.21	0.60		0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
	L175P or A25P Seamless	---	1.8707	0.21	0.60	---	0.045-0.080	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
	L175 or A25 Welded	---	1.8700	0.21	0.60	---	0.030	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
	L175P or A25P Welded	---	1.8707	0.21	0.60	---	0.045-0.080	0.030	0.50	0.50	0.15	Cu 0.50; B 0.001
GB/T 14164-2005	Grade S175 I - PSL1	---	---	0.21	0.60	0.35	0.03	0.03	---	---	---	---
	Grade S175 II - PSL1	---	---	0.21	0.60	0.35	0.045-0.080	0.03	---	---	---	---
API 5L - 2012	L245R or BR	---	1.8788	0.24	1.20	0.40	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04 (Nb+V) 0.06
	L245N or BN	---	1.8790	0.24	1.20	0.40	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04 (Nb+V) 0.06
	L245Q or BQ	---	1.8737	0.18	1.40	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05
	L245M or BM	---	1.8746	0.22	1.20	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05
CSA Z245.1-14	Grade 241 - Category 2	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
	Grade 241 - Category 3	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN ISO 3183:2012	L245R or BR	---	1.8788	0.24	1.20	0.40	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04 (Nb+V) 0.06
	L245N or BN	---	1.8790	0.24	1.20	0.40	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04 (Nb+V) 0.06
	L245Q or BQ	---	1.8737	0.18	1.40	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05
	L245M or BM	---	1.8746	0.22	1.20	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05
GB/T 14164-2005	Grade S245 - PSL2	---	---	0.22	1.20	0.35	0.025	0.015	---	---	---	---

5.10 Line Pipe Steels

5.10.2B Chemical Composition of Line Pipe Steels With Notch Toughness Requirements (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
API 5L - 2012	L290R or X42R	---	1.8789	0.24	1.20	0.40	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.06
	L290N or X42N	---	1.8791	0.24	1.20	0.40	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.06
	L290Q or X42Q	---	1.8738	0.18	1.40	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05
	L290M or X42M	---	1.8747	0.22	1.30	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05
CSA Z245.1-14	Grade 290 - Category 2	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
	Grade 290 - Category 3	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN ISO 3183:2012	L290R or X42R	---	1.8789	0.24	1.20	0.40	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.06
	L290N or X42N	---	1.8791	0.24	1.20	0.40	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.06
	L290Q or X42Q	---	1.8738	0.18	1.40	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05
	L290M or X42M	---	1.8747	0.22	1.30	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05
GB/T 14164-2005	Grade S290 - PSL2	---	---	0.20	1.30	0.35	0.025	0.015	---	---	---	---
API 5L - 2012	L320N or X46N	---	1.8792	0.24	1.40	0.40	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.07; (Nb+V+Ti) 0.15
	L320Q or X46Q	---	1.8739	0.18	1.40	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05
	L320M or X46M	---	1.8748	0.22	1.30	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05
EN ISO 3183:2012	L320N or X46N	---	1.8792	0.24	1.40	0.40	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.07; (Nb+V+Ti) 0.15
	L320Q or X46Q	---	1.8739	0.18	1.40	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05
	L320M or X46M	---	1.8748	0.22	1.30	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05
GB/T 14164-2005	Grade S320 - PSL2	---	---	0.20	1.40	0.35	0.025	0.015	---	---	---	---

5.10 Line Pipe Steels

5.10.2B Chemical Composition of Line Pipe Steels With Notch Toughness Requirements (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
API 5L - 2012	L360N or X52N	---	1.8793	0.24	1.40	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.10; (Nb+V+Ti) 0.15
	L360Q or X52Q	---	1.8741	0.18	1.50	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05
	L360M or X52M	---	1.8749	0.22	1.40	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
CSA Z245.1-14	Grade 359 - Category 2	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
	Grade 359 - Category 3	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN ISO 3183:2012	L360N or X52N	---	1.8793	0.24	1.40	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.10; (Nb+V+Ti) 0.15
	L360Q or X52Q	---	1.8741	0.18	1.50	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.05
	L360M or X52M	---	1.8749	0.22	1.40	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
GB/T 14164-2005	Grade S360 - PSL2	---	---	0.20	1.40	0.35	0.025	0.015	---	---	---	---
API 5L - 2012	L390N or X56N	---	1.8970	0.24	1.40	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.10; (Nb+V+Ti) 0.15
	L390Q or X56Q	---	1.8740	0.18	1.50	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.07; (Nb+V+Ti) 0.15
	L390M or X56M	---	1.8971	0.22	1.40	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
CSA Z245.1-14	Grade 386 - Category 2	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
	Grade 386 - Category 3	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN ISO 3183:2012	L390N or X56N	---	1.8970	0.24	1.40	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.10; (Nb+V+Ti) 0.15
	L390Q or X56Q	---	1.8740	0.18	1.50	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.07; (Nb+V+Ti) 0.15
	L390M or X56M	---	1.8971	0.22	1.40	0.45	0.025	0.015	0.30	0.30	0.15	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
GB/T 14164-2005	Grade S390 - PSL2	---	---	0.20	1.40	0.40	0.025	0.015	---	---	---	---

5.10 Line Pipe Steels

5.10.2B Chemical Composition of Line Pipe Steels With Notch Toughness Requirements (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, % max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
API 5L - 2012	L415N or X60N	---	1.8736	0.24	1.40	0.45	0.025	0.015	0.50	0.50	0.50	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.10; (Nb+V+Ti) 0.15
	L415Q or X60Q	---	1.8742	0.18	1.70	0.45	0.025	0.025	0.50	0.50	0.50	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L415M or X60M	---	1.8752	0.12	1.60	0.45	0.025	0.015	0.50	0.50	0.50	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
CSA Z245.1-14	Grade 414 - Category 2	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
	Grade 414 - Category 3	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN ISO 3183:2012	L415N or X60N	---	1.8736	0.24	1.40	0.45	0.025	0.015	0.50	0.50	0.50	Cu 0.50; B 0.001; Ti 0.04; Nb 0.05; V 0.10; (Nb+V+Ti) 0.15
	L415Q or X60Q	---	1.8742	0.18	1.70	0.45	0.025	0.025	0.50	0.50	0.50	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L415M or X60M	---	1.8752	0.12	1.60	0.45	0.025	0.015	0.50	0.50	0.50	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
GB/T 14164-2005	Grade S415 - PSL2	---	---	0.20	1.40	0.40	0.025	0.015	---	---	---	---
API 5L - 2012	L450Q or X65Q	---	1.8743	0.18	1.70	0.45	0.025	0.015	0.50	0.50	0.50	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L450M or X65M	---	1.8754	0.12	1.60	0.45	0.025	0.015	0.50	0.50	0.50	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
CSA Z245.1-14	Grade 448 - Category 2	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
	Grade 448 - Category 3	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN ISO 3183:2012	L450Q or X65Q	---	1.8743	0.18	1.70	0.45	0.025	0.015	0.50	0.50	0.50	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L450M or X65M	---	1.8754	0.12	1.60	0.45	0.025	0.015	0.50	0.50	0.50	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
GB/T 14164-2005	Grade S450 - PSL2	---	---	0.20	1.45	0.40	0.025	0.015	---	---	---	---
API 5L - 2012	L485Q or X70Q	---	1.8744	0.18	1.80	0.45	0.025	0.015	0.50	0.50	0.50	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L485M or X70M	---	1.8756	0.12	1.70	0.45	0.025	0.015	0.50	0.50	0.50	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
CSA Z245.1-14	Grade 483 - Category 2	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
	Grade 483 - Category 3	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN ISO 3183:2012	L485Q or X70Q	---	1.8744	0.18	1.80	0.45	0.025	0.015	0.50	0.50	0.50	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
	L485M or X70M	---	1.8756	0.12	1.70	0.45	0.025	0.015	0.50	0.50	0.50	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
GB/T 14164-2005	Grade S485 - PSL2	---	---	0.20	1.65	0.40	0.025	0.015	---	---	---	---
API 5L - 2012	L555Q or X80Q	---	1.8745	0.18	1.90	0.45	0.025	0.015	0.50	1.00	0.50	Cu 0.50; B 0.004; (Nb+V+Ti) 0.15
	L555M or X80M	---	1.8758	0.12	1.85	0.45	0.025	0.015	0.50	1.00	0.50	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
CSA Z245.1-14	Grade 550 - Category 2	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
	Grade 550 - Category 3	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN ISO 3183:2012	L555Q or X80Q	---	1.8745	0.18	1.90	0.45	0.025	0.015	0.50	1.00	0.50	Cu 0.50; B 0.004; (Nb+V+Ti) 0.15
	L555M or X80M	---	1.8758	0.12	1.85	0.45	0.025	0.015	0.50	1.00	0.50	Cu 0.50; B 0.001; (Nb+V+Ti) 0.15
GB/T 14164-2005	Grade S555 - PSL2	---	---	0.20	1.85	0.40	0.025	0.015	---	---	---	---

Chapter

6

STEEL FORGINGS

ASME Standards

ASME SA-105/SA-105M	Carbon Steel Forgings, for Piping Applications
ASME SA-181/SA-181M	Carbon Steel Forgings, for General-Purpose Piping
ASME SA-182/SA-182M	Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASME SA-266/SA-266M	Carbon Steel Forgings for Pressure Vessel Components
ASME SA-336/SA-336M	Alloy Steel Forgings for Pressure and High-Temperature Parts
ASME SA-350/SA-350M	Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components
ASME SA-403/SA-403M	Wrought Austenitic Stainless Steel Piping Fittings
ASME SA-508/SA-508M	Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels
ASME SA-541/SA-541M	Quenched and Tempered Carbon and Alloy Steel Forgings for Pressure Vessel Components
ASME SA-705/SA-705M	Age-Hardening Stainless Steel Forgings
ASME SA-815/SA-815M	Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings

ASTM Standards

ASTM A105/A105M-14	Carbon Steel Forgings for Piping Applications
ASTM A181/A181M-14	Carbon Steel Forgings, for General-Purpose Piping
ASTM A182/A182M-15	Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A266/A266M-13	Carbon Steel Forgings for Pressure Vessel Components
ASTM A336/A336M-10a	Alloy Steel Forgings for Pressure and High-Temperature Parts
ASTM A350/A350M-15	Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components
ASTM A403/A403M-15	Wrought Austenitic Stainless Steel Piping Fittings
ASTM A473-15	Stainless Steel Forgings
ASTM A508/A508M-14	Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels
ASTM A541/A541M-05 (2015)	Quenched and Tempered Carbon and Alloy Steel Forgings for Pressure Vessel Components
ASTM A668/A668M-15	Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A705/A705M-13	Age-Hardening Stainless Steel Forgings
ASTM A774/A774M-14	As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures
ASTM A815/A815M-14	Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings
ASTM A965/A965M-14	Steel Forgings, Austenitic, for Pressure and High Temperature Parts
ASTM A1021-05 (2015)	Martensitic Stainless Steel Forgings and Forging Stock for High-Temperature Service

EN Standards

EN 10222-2:1999	Steel forgings for pressure purposes - Part 2: Ferritic and martensitic steels with specified elevated temperature properties
EN 10222-3:1998	Steel forgings for pressure purposes - Part 3: Nickel steels with specified low-temperature properties
EN 10222-4:1998 A1:2001	Steel forgings for pressure purposes - Part 4: Weldable fine-grain steels with high proof strength
EN 10222-5:1999	Steel forgings for pressure purposes - Part 5: Martensitic, austenitic and austenitic-ferritic stainless steels
EN 10250-2:1999 C1:2000	Open die steel forgings for general engineering purposes - Part 2: Non-alloy quality and special steels
EN 10250-3:1999	Open die steel forgings for general engineering purposes - Part 3: Alloy special steels
EN 10250-4:1999	Open die steel forgings for general engineering purposes - Part 4: Stainless steels

GB Standards

GB/T 15712-1995	Ferritic Pearlitic Engineering Steels for Precipitation Hardening from Hot-Working Temperature
GB/T 17107-1997	Structural Steel Grades and Mechanical Property for Forgings

ISO Standards

ISO 9327-2:1999	Steel Forgings and Rolled or Forged Bars for Pressure Purposes. Technical Delivery Conditions. Part 2: Non-Alloy and Alloy (Mo, Cr and CrMo) Steels with Specified Elevated Temperature Properties
ISO 9327-3:1999	Steel Forgings and Rolled or Forged Bars for Pressure Purposes. Technical Delivery Conditions. Part 3: Nickel Steels with Specified Low Temperature Properties
ISO 9327-4:1999	Steel Forgings and Rolled or Forged Bars for Pressure Purposes. Technical Delivery Conditions. Part 4: Weldable Fine Grain Steels with High Proof Strength
ISO 9327-5:1999	Steel Forgings and Rolled or Forged Bars for Pressure Purposes. Technical Delivery Conditions. Part 5: Stainless Steels

JIS Standards

JIS G 3201:1988 A1:2008	Carbon steel forgings for general use
JIS G 3202:1988 A1:2008	Carbon steel forgings for pressure vessels
JIS G 3203:1988 A1:2008	Alloy steel forgings for pressure vessels for high-temperature service
JIS G 3204:1988 A1:2008	Quenched and tempered alloy steel forgings for pressure vessels
JIS G 3205:1988 A1:2008	Carbon and alloy steel forgings for pressure vessels for low-temperature service
JIS G 3206:1993 A1:2008	High strength chromium-molybdenum alloy steel forgings for pressure vessels under high-temperature service
JIS G 3214:1991 A1:2009	Stainless steel forgings for pressure vessels
JIS G 3221:1988 A1:2008	Chromium molybdenum steel forgings for general use

Heat Treatment Terms Applicable to this Chapter

Standard	Heat Treatment Terms
ASME SA-105/SA-105M	A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
ASME SA-181/SA-181M	AM: as manufactured; A: annealed; N: normalized; N+T: normalized and tempered
ASME SA-182/SA-182M	A: annealed; N+T: normalized and tempered; Q+T: quenched and tempered; ST+Q: solution treated and quenched; N: normalized; T: tempered
ASME SA-266/SA-266M	A: annealed; N: normalized; N+T: normalized and tempered; BA: liquid quenched if agreed upon at the time of enquiry and order
ASME SA-336/SA-336M	A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
ASME SA-350/SA-350M	N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
ASME SA-403/SA-403M	SA: solution annealed
ASME SA-508/SA-508M	Q: quenched
ASME SA-541/SA-541M	Q+T: quenched and tempered
ASME SA-705/SA-705M	ST: solution treated; AH: age hardened
ASME SA-815/SA-815M	HT+Q: heat treated then quenched; RC: rapidly cooled
ASTM A105/A105M-14	A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
ASTM A181/A181M-14	AM: as manufactured; A: annealed; N: normalized; N+T: normalized and tempered
ASTM A182/A182M-15	A: annealed; N+T: normalized and tempered; Q+T: quenched and tempered; ST+Q: solution treated and quenched; N: normalized; T: tempered
ASTM A266/A266M-13	A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
ASTM A336/A336M-10a	A: annealed; N+T: normalized and tempered; Q+T: liquid quenched and tempered
ASTM A350/A350M-15	N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
ASTM A403/A403M-15	SA+Q: solution annealed then quenched; RC: rapidly cooled
ASTM A473-15	N+T: normalized and tempered; A: annealed; SHT: solution heat treated; A+Q: annealed and water quenched; RC: rapidly cooled
ASTM A508/A508M-14	Q+T: quenched and tempered
ASTM A541/A541M-05 (2015)	Q+T: quenched and tempered
ASTM A668/A668M-15	A: annealed; N: normalized; N+T: normalized and tempered; NN+T: double-normalized and tempered; Q+T: quenched and tempered; N+Q+T: normalized, quenched and tempered
ASTM A705/A705M-13	ST: solution treated; AH: age hardened
ASTM A774/A774M-14	---: heat treatment is not required
ASTM A815/A815M-14	HT+Q: heat treated then quenched; RC: rapidly cooled
ASTM A965/A965M-14	SA+Q: solution annealed and quenched
ASTM A1021-05 (2015)	HT+Q+T: heat treated and quenched, then tempered
EN 10222-2:1999	A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
EN 10222-3:1998	N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered; NN+T: double normalized and tempered
EN 10222-4:1998 A1:2001	Q+T: quenched and tempered; N: normalized
EN 10222-5:1999	Q+T: quenched and tempered; QT+T: quenched and double tempered; ST: solution treated
EN 10250-2:1999 C1:2000	N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered; A: annealed
EN 10250-3:1999	Q+T: quenched and tempered
EN 10250-4:1999	A: annealed; Q+T: quenched and tempered; SA: solution annealed; PH: precipitation hardened
GB/T 15712-1995	HR: hot-rolled
GB/T 17107-1997	N+T: normalized and tempered; N: normalized; H+T: hardened and tempered
ISO 9327-2:1999	A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
ISO 9327-3:1999	N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
ISO 9327-4:1999	N: normalized; Q+T: quenched and tempered
ISO 9327-5:1999	Q+T: quenched and tempered
JIS G 3201:1988 A1:2008	A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
JIS G 3202:1988 A1:2008	A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
JIS G 3203:1988 A1:2008	A: annealed; N+T: normalized and tempered
JIS G 3204:1988 A1:2008	Q+T: quenched and tempered
JIS G 3205:1988 A1:2008	A: annealed; N+T: normalized and tempered; Q+T: quenched and tempered
JIS G 3206:1993 A1:2008	N+T: normalized and tempered; Q+T: quenched and tempered
JIS G 3214:1991 A1:2009	Q+T: quenched and tempered; ST: solution treated; HT: heat treated
JIS G 3221:1988 A1:2008	H+T: hardening and tempering

Impact Testing Notes Applicable to this Chapter

see standard for impact data: impact testing requirements are listed in the standard for multiple test temperatures.

6.1 Carbon Steel Forgings

6.1.1A Mechanical Properties of Carbon Steel Forgings for General Use

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
GB/T 17107-1997	Grade 15	---	---	$t \leq 100$	---	195	---	320 L	---	27 L	N+T	97-143 HB; L: 47 J @ RT
				$100 < t \leq 300$	---	165	---	310 L	---	25 L	N+T	97-143 HB; L: 47 J @ RT
				$300 < t \leq 500$	---	145	---	300 L	---	24 L	N+T	97-143 HB; L: 43 J @ RT
ASTM A668/A668M-15	Class A (AH)	---	---	$d \leq 500$	$d \leq 20$	---	---	325	47	---	---	183 max HBW
GB/T 17107-1997	Grade Q235	---	---	$t \leq 100$	---	210	---	330 L	---	23 L	---	---
				$100 < t \leq 300$	---	195	---	320 L	---	22 L	---	---
				$300 < t \leq 500$	---	185	---	310 L	---	21 L	---	---
				$500 < t \leq 700$	---	175	---	300 L	---	20 L	---	---
EN 10250-2:1999 C1:2000	S235JRG2	---	1.0038	$t \leq 100$	---	215	---	340	---	24 L	N or N+T	L: 35 J @ RT
				$100 < t \leq 250$	---	175	---	340	---	23 L, 17 T	N or N+T	see standard for impact data
				$250 < t \leq 500$	---	165	---	340	---	23 L, 17 T	N or N+T	
	S235J2G3	---	1.0116	$t \leq 100$	---	215	---	340	---	24 L	N or N+T	L: 35 J @ -20°C
				$100 < t \leq 250$	---	175	---	340	---	23 L, 17 T	N or N+T	see standard for impact data
GB/T 17107-1997	Grade 20	---	---	$t \leq 100$	---	215	---	340 L	---	24 L	N or N+T	103-156 HB; L: 43 J @ RT
				$100 < t \leq 250$	---	195	---	330 L	---	23 L	N or N+T	103-156 HB; L: 39 J @ RT
				$250 < t \leq 500$	---	185	---	320 L	---	22 L	N or N+T	103-156 HB; L: 39 J @ RT
				$500 < t \leq 1000$	---	175	---	300 L	---	20 L	N or N+T	103-156 HB; L: 35 J @ RT
JIS G 3201:1988 A1:2008	Symbol SF 340 A	---	---	---	---	175	---	340-440	---	27 L, 23 T	A, N or N+T	90 min. HB
	Symbol SF 390 A	---	---	---	---	195	---	390-490	---	25 L, 21 T	A, N or N+T	105 min. HB

6.1 Carbon Steel Forgings

6.1.1A Mechanical Properties of Carbon Steel Forgings for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
EN 10250-2:1999 C1:2000	C22	---	1.0402	$t \leq 100$	---	210	---	410	---	25 L	N or N+T	---
ISO 9327-2:1999	Type PH 26	---	---	$t \leq 16$	---	265	---	410-530	---	26 L, 24 T	N or Q+T	see standard for impact data
				$16 < t \leq 40$	---	255	---	410-530	---	26 L, 24 T	N or Q+T	
				$40 < t \leq 60$	---	245	---	410-530	---	25 L, 23 T	N or Q+T	
				$60 < t \leq 100$	---	215	---	410-530	---	24 L, 22 T	N or Q+T	
				$100 < t \leq 150$	---	200	---	390-520	---	24 L, 22 T	N or Q+T	
				$150 < t \leq 250$	---	200	---	390-520	---	23 L, 21 T	N or Q+T	
ASTM A668/A668M-15	Class B (BH)	---	---	$d \leq 500$	$d \leq 20$	205	30	415	60	24	A, N or N+T	120-174 HBW
GB/T 17107-1997	Grade 25	---	---	$t \leq 100$	---	235	---	420 L	---	22 L	N or N+T	112-170 HB; L: 39 J @ RT
				$100 < t \leq 250$	---	215	---	390 L	---	20 L	N or N+T	112-170 HB; L: 31 J @ RT
				$250 < t \leq 500$	---	205	---	380 L	---	18 L	N or N+T	112-170 HB; L: 31 J @ RT
JIS G 3201:1988 A1:2008	Symbol SF 440 A	---	---	---	---	225	---	440-540	---	24 L, 19 T	A, N or N+T	121 min. HB
EN 10250-2:1999 C1:2000	C25	---	1.0406	$t \leq 100$	---	230	---	440	---	23 L	N or N+T	L: 35 J @ RT
				$100 < t \leq 250$	---	210	---	420	---	23 L, 17 T	N or N+T	see standard for impact data
				$250 < t \leq 500$	---	190	---	400	---	23 L, 17 T	N or N+T	
				$500 < t \leq 1000$	---	180	---	390	---	22 L, 16 T	N or N+T	
	C25E	---	1.1158	$t \leq 70$	---	270	---	450	---	25 L	Q+T	L: 45 J @ RT
				$t \leq 100$	---	230	---	440	---	23 L	N or N+T	L: 35 J @ RT
				$70 < t \leq 160$	---	220	---	410	---	25 L, 18 T	Q+T	see standard for impact data
				$100 < t \leq 250$	---	210	---	420	---	23 L, 17 T	N or N+T	
				$160 < t \leq 330$	---	210	---	390	---	24 L, 16 T	Q+T	
				$250 < t \leq 500$	---	190	---	400	---	23 L, 17 T	N or N+T	
				$500 < t \leq 1000$	---	180	---	390	---	22 L, 16 T	N or N+T	

6.1 Carbon Steel Forgings

6.1.1A Mechanical Properties of Carbon Steel Forgings for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASTM A668/A668M-15	Class C (CH)	---	---	d ≤ 300	d ≤ 12	230	33	455	66	23	A, N or N+T	137-183 HBW
				300 < d ≤ 500	12 < d ≤ 20	230	33	455	66	22	A, N or N+T	137-183 HBW
ISO 9327-2:1999	Type PH 29	---	---	t ≤ 16	---	290	---	460-580	---	24 L, 22 T	N or Q+T	see standard for impact data
				16 < t ≤ 40	---	285	---	460-580	---	24 L, 22 T	N or Q+T	
				40 < t ≤ 60	---	280	---	460-580	---	24 L, 22 T	N or Q+T	
				60 < t ≤ 100	---	255	---	460-580	---	23 L, 21 T	N or Q+T	
				100 < t ≤ 150	---	230	---	440-570	---	23 L, 21 T	N or Q+T	
				150 < t ≤ 250	---	220	---	440-570	---	22 L, 20 T	N or Q+T	
GB/T 17107-1997	Grade 30	---	---	t ≤ 100	---	245	---	470 L	---	19 L	N or N+T	126-179 HB; L: 31 J @ RT
				100 < t ≤ 300	---	235	---	460 L	---	19 L	N or N+T	126-179 HB; L: 27 J @ RT
				300 < t ≤ 500	---	225	---	450 L	---	18 L	N or N+T	126-179 HB; L: 27 J @ RT
				500 < t ≤ 800	---	215	---	440 L	---	17 L	N or N+T	126-179 HB; L: 28 J @ RT
EN 10250-2:1999 C1:2000	C30	---	1.0528	t ≤ 100	---	250	---	480	---	21 L	N or N+T	---
				100 < t ≤ 250	---	230	---	460	---	21 L	N or N+T	---
JIS G 3201:1988 A1:2008	Symbol SF 490 A	---	---	---	---	245	---	490-590	---	22 L, 17 T	A, N or N+T	134 min. HB
ISO 9327-2:1999	Type PH 31	---	---	t ≤ 16	---	315	---	490-610	---	23 L, 21 T	N or Q+T	see standard for impact data
				16 < t ≤ 40	---	310	---	490-610	---	23 L, 21 T	N or Q+T	
				40 < t ≤ 60	---	305	---	490-610	---	23 L, 21 T	N or Q+T	
				60 < t ≤ 100	---	280	---	490-610	---	22 L, 20 T	N or Q+T	
				100 < t ≤ 150	---	255	---	470-600	---	22 L, 20 T	N or Q+T	
				150 < t ≤ 250	---	245	---	460-590	---	21 L, 19 T	N or Q+T	
GB/T 17107-1997	Grade 35	---	---	t ≤ 100	---	265	---	510 L	---	18 L	N or N+T	149-187 HB; L: 28 J @ RT
				t ≤ 100	---	295	---	550 L	---	19 L	H+T	156-207 HB; L: 47 J @ RT
				100 < t ≤ 300	---	255	---	490 L	---	18 L	N or N+T	149-187 HB; L: 24 J @ RT
				100 < t ≤ 300	---	275	---	530 L	---	18 L	H+T	156-207 HB; L: 39 J @ RT
				100 < t ≤ 300	---	245	---	470 TN	---	13 TN	N+T	TN: 20 J @ RT
				300 < t ≤ 500	---	235	---	470 L	---	17 L	N or N+T	143-187 HB; L: 24 J @ RT
				300 < t ≤ 500	---	225	---	450 TN	---	12 TN	N+T	TN: 20 J @ RT
				500 < t ≤ 750	---	225	---	450 L	---	16 L	N or N+T	137-187 HB; L: 20 J @ RT
				500 < t ≤ 750	---	215	---	430 TN	---	11 TN	N+T	TN: 16 J @ RT
				750 < t ≤ 1000	---	215	---	430 L	---	15 L	N or N+T	137-187 HB; L: 20 J @ RT
ASTM A668/A668M-15	Class D (DH)	---	---	750 < t ≤ 1000	---	205	---	410 TN	---	10 TN	N+T	TN: 16 J @ RT
				d ≤ 200	d ≤ 8	260	37.5	515	75	24	A, N or N+T	149-207 HBW
				200 < d ≤ 300	8 < d ≤ 12	260	37.5	515	75	22	A, N or N+T	149-207 HBW
				300 < d ≤ 500	12 < d ≤ 20	260	37.5	515	75	20	A, N or N+T	149-207 HBW
				d > 500	d > 20	260	37.5	515	75	19	A, N or N+T	149-207 HBW

Note: This section continued on next page.

6.1 Carbon Steel Forgings

6.1.1A Mechanical Properties of Carbon Steel Forgings for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
EN 10250-2:1999 C1:2000	C35	---	1.0501	t ≤ 100	---	270	---	520	---	19 L	N or N+T	L: 30 J @ RT
				100 < t ≤ 250	---	245	---	500	---	19 L, 15 T	N or N+T	see standard for impact data
				250 < t ≤ 500	---	220	---	480	---	19 L, 15 T	N or N+T	
				500 < t ≤ 1000	---	210	---	470	---	18 L, 14 T	N or N+T	
JIS G 3201:1988 A1:2008	Symbol SF 540 B	---	---	t < 100	---	335	---	540-690	---	21 L, 17 T	Q+T	see standard for impact data; 152 min. HB
				100 ≤ t < 250	---	315	---	540-690	---	21 L, 17 T	Q+T	see standard for impact data; 152 min. HB
				250 ≤ t < 400	---	295	---	540-690	---	20 L, 16 T	Q+T	see standard for impact data; 152 min. HB
	Symbol SF 540 A	---	---	---	---	275	---	540-640	---	20 L, 16 T	A, N or N+T	152 min. HB
GB/T 17107-1997	Grade 40	---	---	t ≤ 100	---	275	---	550 L	---	17 L	N+T	143-207 HB; L: 24 J @ RT
				t ≤ 100	---	340	---	615 L	---	18 L	H+T	196-241 HB; L: 39 J @ RT
				100 < t ≤ 250	---	265	---	530 L	---	17 L	N+T	143-207 HB; L: 24 J @ RT
				100 < t ≤ 250	---	295	---	590 L	---	17 L	H+T	189-229 HB; L: 31 J @ RT
				250 < t ≤ 500	---	255	---	510 L	---	16 L	N+T	143-207 HB; L: 20 J @ RT
				250 < t ≤ 500	---	275	---	560 L	---	17 L	H+T	163-219 HB
				500 < t ≤ 1000	---	245	---	490 L	---	15 L	N+T	143-207 HB; L: 20 J @ RT
EN 10250-2:1999 C1:2000	C40	---	1.0511	t ≤ 100	---	290	---	550	---	17 L	N or N+T	---
				100 < t ≤ 250	---	260	---	530	---	17 L	N or N+T	---
	C35E	---	1.1181	t ≤ 70	---	320	---	550	---	20 L	Q+T	L: 35 J @ RT
				t ≤ 100	---	270	---	520	---	19 L	N or N+T	L: 30 J @ RT
				70 < t ≤ 160	---	290	---	490	---	22 L, 15 T	Q+T	see standard for impact data
				100 < t ≤ 250	---	245	---	500	---	19 L, 15 T	N or N+T	
				160 < t ≤ 330	---	270	---	470	---	21 L, 14 T	Q+T	
				250 < t ≤ 500	---	220	---	480	---	19 L, 15 T	N or N+T	
				500 < t ≤ 1000	---	210	---	470	---	18 L, 14 T	N or N+T	

6.1 Carbon Steel Forgings

6.1.1A Mechanical Properties of Carbon Steel Forgings for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
EN 10250-2:1999 C1:2000	C45	---	1.0503	---	---	---	---	---	---	---	A	207 max HB
				$t \leq 100$	---	305	---	580	---	16L	N or N+T	---
				$100 < t \leq 250$	---	275	---	560	---	16 L, 12 T	N or N+T	see standard for impact data
				$250 < t \leq 500$	---	240	---	540	---	16 L, 12 T	N or N+T	
				$500 < t \leq 1000$	---	230	---	530	---	15 L, 11 T	N or N+T	
ASTM A668/A668M-15	Class E (EH)	---	---	$d \leq 200$	$d \leq 8$	305	44	585	85	25	N+T or NN+T	174-217 HBW
				$200 < d \leq 300$	$8 < d \leq 12$	295	43	570	83	23	N+T or NN+T	174-217 HBW
				$300 < d \leq 500$	$12 < d \leq 20$	295	43	570	83	22	N+T or NN+T	174-217 HBW
GB/T 17107-1997	Grade 45	---	---	$t \leq 100$	---	295	---	590 L	---	15 L	N or N+T	170-217 HB; L: 23 J @ RT
				$t \leq 100$	---	370	---	630 L	---	17 L	H+T	207-302 HB; L: 31 J @ RT
				$100 < t \leq 250$	---	345	---	590 L	---	18 L	H+T	197-286 HB; L: 31 J @ RT
				$100 < t \leq 300$	---	285	---	570 L	---	15 L	N or N+T	163-217 HB; L: 19 J @ RT
				$100 < t \leq 300$	---	275	---	540 TN	---	10 TN	N+T	TN: 16 J @ RT
				$300 < t \leq 500$	---	275	---	550 L	---	14 L	N or N+T	163-217 HB; L: 19 J @ RT
				$250 < t \leq 500$	---	345	---	590 L	---	17 L	H+T	187-255 HB
				$300 < t \leq 500$	---	265	---	520 TN	---	10 TN	N+T	TN: 16 J @ RT
				$500 < t \leq 750$	---	255	---	500 TN	---	9 TN	N+T	TN: 12 J @ RT
				$500 < t \leq 1000$	---	265	---	530 L	---	13 L	N or N+T	156-217 HB; L: 15 J @ RT
				$750 < t \leq 1000$	---	245	---	480 TN	---	8 TN	N+T	TN: 12 J @ RT
JIS G 3201:1988 A1:2008	Symbol SF 590 B	---	---	$t < 100$	---	360	---	590-740	---	19 L, 15 T	Q+T	see standard for impact data; 167 min. HB
				$100 \leq t < 250$	---	335	---	590-740	---	19 L, 14 T	Q+T	see standard for impact data; 167 min. HB
				$250 \leq t \leq 400$	---	325	---	590-740	---	18 L, 14 T	Q+T	see standard for impact data; 167 min. HB
	Symbol SF 590 A	---	---	---	---	295	---	590-690	---	18 L, 14 T	A, N or N+T	167 min. HB
GB/T 15712-1995	Grade YF35V	---	---	$t \leq 40$	---	390	---	590	---	18	HR	229 max HB; 47 J @ RT

6.1 Carbon Steel Forgings

6.1.1A Mechanical Properties of Carbon Steel Forgings for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
EN 10250-2:1999 C1:2000	C50	---	1.0540	t ≤ 100	---	320	---	610	---	14 L	N or N+T	---
				100 < t ≤ 250	---	290	---	590	---	14 L	N or N+T	---
ASTM A668/A668M-15	Class F (FH)	---	---	d ≤ 100	d ≤ 4	380	55	620	90	20	Q+T or N+Q+T	187-235 HBW
				100 < d ≤ 175	4 < d ≤ 7	345	50	585	85	20	Q+T or N+Q+T	174-217 HBW
				175 < d ≤ 254	7 < d ≤ 10	345	50	585	85	19	Q+T or N+Q+T	174-217 HBW
				254 < d ≤ 500	10 < d ≤ 20	330	48	565	82	19	Q+T or N+Q+T	174-217 HBW
EN 10250-2:1999 C1:2000	C45E	---	1.1191	t ≤ 70	---	370	---	630	---	17 L	Q+T	L: 25 J @ RT
				t ≤ 100	---	305	---	580	---	16 L	N or N+T	---
				70 < t ≤ 160	---	340	---	590	---	18 L, 12 T	Q+T	see standard for impact data
				100 < t ≤ 250	---	275	---	560	---	16 L, 12 T	N or N+T	
				160 < t ≤ 330	---	320	---	540	---	17 L, 11 T	Q+T	
				250 < t ≤ 500	---	240	---	540	---	16 L, 12 T	N or N+T	
	C55	---	1.0535	500 < t ≤ 1000	---	230	---	530	---	15 L, 11 T	N or N+T	229 max HB
				---	---	---	---	---	---	---	A	
				t ≤ 100	---	330	---	640	---	12 L	N or N+T	
				100 < t ≤ 250	---	300	---	620	---	12 L, 9 T	N or N+T	
				250 < t ≤ 500	---	260	---	600	---	12 L, 9 T	N or N+T	
JIS G 3201:1988 A1:2008	Symbol SF 640 B	---	---	500 < t ≤ 1000	---	250	---	590	---	11 L, 8 T	N or N+T	---
				t < 100	---	390	---	640-780	---	16 L, 11 T	Q+T	see standard for impact data; 183 min. HB
				100 ≤ t < 250	---	360	---	640-780	---	16 L, 11 T	Q+T	see standard for impact data; 183 min. HB
				250 ≤ t ≤ 400	---	345	---	640-780	---	15 L, 10 T	Q+T	see standard for impact data; 183 min. HB
GB/T 15712-1995	Grade YF40V	---	---	t ≤ 40	---	420	---	640	---	16	HR	255 max HB; 37 J @ RT
GB/T 17107-1997	Grade 55	---	---	t ≤ 100	---	320	---	645 L	---	12 L	N+T	187-229 HB; L: 23 J @ RT
				100 < t ≤ 300	---	310	---	625 L	---	11 L	N+T	187-229 HB; L: 19 J @ RT
				300 < t ≤ 500	---	305	---	610 L	---	10 L	N+T	187-229 HB; L: 19 J @ RT
	Grade 50	---	---	t ≤ 16	---	500	---	700 L	---	14 L	H+T	L: 31 J @ RT
				16 < t ≤ 40	---	430	---	650 L	---	16 L	H+T	L: 31 J @ RT
				t ≤ 100	---	310	---	610 L	---	13 L	N+T	L: 23 J @ RT
				40 < t ≤ 100	---	370	---	630 L	---	17 L	H+T	L: 31 J @ RT
				100 < t ≤ 250	---	345	---	590 L	---	17 L	H+T	L: 31 J @ RT
				100 < t ≤ 300	---	295	---	590 L	---	12 L	N+T	L: 19 J @ RT
				300 < t ≤ 500	---	285	---	570 L	---	12 L	N+T	L: 19 J @ RT
				250 < t ≤ 500	---	345	---	590 L	---	17 L	H+T	---
				500 < t ≤ 750	---	265	---	550 L	---	12 L	N+T	L: 15 J @ RT

6.1 Carbon Steel Forgings

6.1.1B Chemical Composition of Carbon Steel Forgings for General Use

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB/T 17107-1997	Grade 15	---	---	0.12-0.19	0.35-0.65	0.17-0.37	0.035	0.035	0.25	0.25	---	Cu 0.25
ASTM A668/A668M-15	Class A (AH)	---	---	---	1.35	---	0.050	0.025	---	---	---	---
GB/T 17107-1997	Grade Q235	---	---	0.14-0.22	0.30-0.65	0.30	0.045	0.050	0.30	0.30	---	Cu 0.30
EN 10250-2:1999 C1:2000	S235JRG2	---	1.0038	0.20	1.40	0.55	0.045	0.045	0.30	0.30	0.08	Al 0.020 min.; (Cr+Mo+Ni) 0.48
	S235J2G3	---	1.0116	0.17	1.40	0.55	0.035	0.035	0.30	0.30	0.08	Al 0.020 min.; (Cr+Mo+Ni) 0.48
GB/T 17107-1997	Grade 20	---	---	0.17-0.24	0.35-0.65	0.17-0.37	0.035	0.035	0.25	0.25	---	Cu 0.25
JIS G 3201:1988 A1:2008	Symbol SF 340 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
	Symbol SF 390 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
EN 10250-2:1999 C1:2000	C22	---	1.0402	0.17-0.24	0.40-0.70	0.40	0.045	0.045	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
ISO 9327-2:1999	Type PH 26	---	---	0.20	0.50-1.40	0.35	0.035	0.030	0.30	0.30	0.08	Al 0.02 min.; Cu 0.30; (Cr+Cu+Mo+Ni) 0.70
ASTM A668/A668M-15	Class B (BH)	---	---	---	1.35	---	0.050	0.025	---	---	---	---
GB/T 17107-1997	Grade 25	---	---	0.22-0.30	0.50-0.80	0.17-0.37	0.035	0.035	0.25	0.25	---	Cu 0.25
JIS G 3201:1988 A1:2008	Symbol SF 440 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
EN 10250-2:1999 C1:2000	C25	---	1.0406	0.22-0.29	0.40-0.70	0.40	0.045	0.045	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
	C25E	---	1.1158	0.22-0.29	0.40-0.70	0.40	0.035	0.035	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
ASTM A668/A668M-15	Class C (CH)	---	---	---	1.35	---	0.050	0.025	---	---	---	---
ISO 9327-2:1999	Type PH 29	---	---	0.20	0.90-1.50	0.40	0.035	0.030	0.30	0.30	0.08	Al 0.02 min.; Cu 0.30; (Cr+Cu+Mo+Ni) 0.70
GB/T 17107-1997	Grade 30	---	---	0.27-0.35	0.50-0.80	0.17-0.37	0.035	0.035	0.25	0.25	---	Cu 0.25
EN 10250-2:1999 C1:2000	C30	---	1.0528	0.27-0.34	0.50-0.80	0.40	0.045	0.045	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
JIS G 3201:1988 A1:2008	Symbol SF 490 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
ISO 9327-2:1999	Type PH 31	---	---	0.20	0.90-1.60	0.10-0.50	0.035	0.030	0.30	0.30	0.08	Al 0.02 min.; Cu 0.30; (Cr+Cu+Mo+Ni) 0.70
GB/T 17107-1997	Grade 35	---	---	0.32-0.40	0.50-0.80	0.17-0.37	0.035	0.035	0.25	0.25	---	Cu 0.25
ASTM A668/A668M-15	Class D (DH)	---	---	---	1.35	---	0.050	0.025	---	---	---	---
EN 10250-2:1999 C1:2000	C35	---	1.0501	0.32-0.39	0.50-0.80	0.40	0.045	0.045	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
JIS G 3201:1988 A1:2008	Symbol SF 540 B	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
	Symbol SF 540 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
GB/T 17107-1997	Grade 40	---	---	0.37-0.45	0.50-0.80	0.17-0.37	0.035	0.035	0.25	0.25	---	Cu 0.25
EN 10250-2:1999 C1:2000	C40	---	1.0511	0.37-0.44	0.50-0.80	0.40	0.045	0.045	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
	C35E	---	1.1181	0.32-0.39	0.50-0.80	0.40	0.035	0.035	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
EN 10250-2:1999 C1:2000	C45	---	1.0503	0.42-0.50	0.50-0.80	0.40	0.045	0.045	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
ASTM A668/A668M-15	Class E (EH)	---	---	---	1.35	---	0.050	0.025	---	---	---	---
GB/T 17107-1997	Grade 45	---	---	0.42-0.50	0.50-0.80	0.17-0.37	0.035	0.035	0.25	0.25	---	Cu 0.25
JIS G 3201:1988 A1:2008	Symbol SF 590 B	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
	Symbol SF 590 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
GB/T 15712-1995	Grade YF35V	---	---	0.32-0.39	0.60-1.00	0.20-0.40	0.035	0.035-0.075	0.30	0.30	---	V 0.06-0.13; Cu 0.30

6.1 Carbon Steel Forgings

6.1.1B Chemical Composition of Carbon Steel Forgings for General Use (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A668/A668M-15	Class F (FH)	---	---	---	1.35	---	0.050	0.025	---	---	---	---
EN 10250-2:1999 C1:2000	C45E	---	1.1191	0.42-0.50	0.50-0.80	0.40	0.035	0.035	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
	C50	---	1.0540	0.47-0.55	0.60-0.90	0.40	0.045	0.045	0.40	0.40	0.10	(Cr+Mo+Ni) 0.63
	C55	---	1.0535	0.52-0.60	0.60-0.90	0.40	0.045	0.045	0.40	0.40	0.10	---
JIS G 3201:1988 A1:2008	Symbol SF 640 B	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
GB/T 15712-1995	Grade YF40V	---	---	0.37-0.44	0.60-1.00	0.20-0.40	0.035	0.035-0.075	0.30	0.30	---	V 0.06-0.13; Cu 0.30
GB/T 17107-1997	Grade 55	---	---	0.52-0.60	0.50-0.80	0.17-0.37	0.035	0.035	0.25	0.25	---	Cu 0.25
	Grade 50	---	---	0.47-0.55	0.50-0.80	0.17-0.37	0.035	0.035	0.25	0.25	---	Cu 0.25

6.1 Carbon Steel Forgings

6.1.2A Mechanical Properties of Carbon Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
EN 10222-4:1998 A1:2001	P285QH	---	1.0478	$t \leq 16$	---	275	---	370-510	---	22 L, 21 T	Q+T	see standard for impact data
				$16 < t \leq 35$	---	275	---	370-510	---	22 L, 21 T	Q+T	
				$35 < t \leq 70$	---	255	---	370-510	---	22 L, 21 T	Q+T	
				$70 < t \leq 100$	---	235	---	370-510	---	22 L, 21 T	Q+T	
				$100 < t \leq 250$	---	215	---	370-510	---	22 L, 21 T	Q+T	
				$250 < t \leq 400$	---	195	---	370-510	---	22 L, 21 T	Q+T	
	P285NH	---	1.0477	$t \leq 16$	---	275	---	390-510	---	24 L, 23 T	N	see standard for impact data
				$16 < t \leq 35$	---	275	---	390-510	---	24 L, 23 T	N	
				$35 < t \leq 70$	---	255	---	390-510	---	24 L, 23 T	N	
				$70 < t \leq 100$	---	235	---	390-510	---	24 L, 23 T	N	
				$100 < t \leq 250$	---	215	---	390-510	---	24 L, 23 T	N	
				$250 < t \leq 400$	---	195	---	390-510	---	24 L, 23 T	N	
ISO 9327-4:1999	Type P 28	---	---	$t \leq 16$	---	285	---	390-510	---	26 L, 24 T	N or Q+T	see standard for impact data
				$16 < t \leq 35$	---	285	---	390-510	---	26 L, 24 T	N or Q+T	
				$35 < t \leq 50$	---	275	---	390-510	---	26 L, 24 T	N or Q+T	
				$50 < t \leq 70$	---	265	---	390-510	---	26 L, 24 T	N or Q+T	
				$70 < t \leq 100$	---	245	---	370-510	---	25 L, 23 T	N or Q+T	
				$100 < t \leq 250$	---	225	---	370-510	---	24 L, 22 T	N or Q+T	
	Type PH 28	---	---	$t \leq 16$	---	285	---	390-510	---	26 L, 24 T	N or Q+T	see standard for impact data
				$16 < t \leq 35$	---	285	---	390-510	---	26 L, 24 T	N or Q+T	
				$35 < t \leq 50$	---	275	---	390-510	---	26 L, 24 T	N or Q+T	
				$50 < t \leq 70$	---	265	---	390-510	---	26 L, 24 T	N or Q+T	
				$70 < t \leq 100$	---	245	---	370-510	---	25 L, 23 T	N or Q+T	
				$100 < t \leq 250$	---	225	---	370-510	---	24 L, 22 T	N or Q+T	
	Type PL 28	---	---	$t \leq 16$	---	285	---	390-510	---	26 L, 24 T	N or Q+T	see standard for impact data
				$16 < t \leq 35$	---	285	---	390-510	---	26 L, 24 T	N or Q+T	
				$35 < t \leq 50$	---	275	---	390-510	---	26 L, 24 T	N or Q+T	
				$50 < t \leq 70$	---	265	---	390-510	---	26 L, 24 T	N or Q+T	
				$70 < t \leq 100$	---	245	---	370-510	---	25 L, 23 T	N or Q+T	
				$100 < t \leq 250$	---	225	---	370-510	---	24 L, 22 T	N or Q+T	

6.1 Carbon Steel Forgings

6.1.2A Mechanical Properties of Carbon Steel Forgings for Piping, Pressure Vessel and Components (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
EN 10222-2:1999	P245GH	---	1.0352	$t \leq 35$	---	235	---	410-530	---	25 L, 23 T	A, N, N+T or Q+T	see standard for impact data
				$35 < t \leq 160$	---	210	---	410-530	---	25 L, 23 T	A, N, N+T or Q+T	
JIS G 3202:1988 A1:2008	Symbol SFVC 1	---	---	---	---	205	---	410-560	---	21 L	A, N, N+T or Q+T	---
ASME SA-181/SA-181M	Class 60	---	---	---	---	205	30	415	60	22	AM, A, N or N+T	---
ASME SA-266/SA-266M	Grade 1	---	---	---	---	205	30	415-585	60-85	23 L	A, N, N+T or BA	---
ASME SA-350/SA-350M	Grade LF1, Class 1	K03009	---	---	---	205	30	415-585	60-85	25	N, N+T, or Q+T	see standard for impact data 197 max HB
ASTM A181/A181M-14	Class 60	---	---	---	---	205	30	415	60	22	AM, A, N or N+T	---
ASTM A266/A266M-13	Grade 1	---	---	---	---	205	30	415-585	60-85	23 L	A, N, N+T or Q+T	---
ASTM A350/A350M-15	Grade LF1, Class 1	K03009	---	---	---	205	30	415-585	60-85	25	N, N+T or Q+T	see standard for impact data 197 max HBW
JIS G 3205:1988 A1:2008	Symbol SFL 1	---	---	---	---	225	---	440-590	---	22 L	A, N+T or Q+T	21 J @ -30°C
EN 10222-2:1999	P280GH	---	1.0426	$t \leq 35$	---	270	---	460-580	---	23 L, 21 T	N, N+T or Q+T	see standard for impact data
				$35 < t \leq 160$	---	245	---	460-580	---	23 L, 21 T	N, N+T or Q+T	
EN 10222-4:1998 A1:2001	P355QH	---	1.0571	$t \leq 16$	---	345	---	470-630	---	21 L, 19 T	Q+T	see standard for impact data
				$16 < t \leq 35$	---	345	---	470-630	---	21 L, 19 T	Q+T	
				$35 < t \leq 70$	---	325	---	470-630	---	21 L, 19 T	Q+T	
				$70 < t \leq 100$	---	305	---	470-630	---	21 L, 19 T	Q+T	
				$100 < t \leq 250$	---	285	---	470-630	---	21 L, 19 T	Q+T	
				$250 < t \leq 400$	---	265	---	470-630	---	21 L, 19 T	Q+T	
ASME SA-541/SA-541M	Grade 1	K03506	---	---	---	250	36	485-655	70-95	20	Q+T	see standard for impact data
	Grade 1A	K03020	---	---	---	250	36	485-655	70-95	20	Q+T	see standard for impact data
ASTM A541/A541M-05 (2015)	Grade 1	K03506	---	---	---	250	36	485-655	70-95	20	Q+T	see standard for impact data
	Grade 1A	K03020	---	---	---	250	36	485-655	70-95	20	Q+T	see standard for impact data
ASME SA-105/SA-105M	---	K03504	---	---	---	250	36	485	70	30	A, N, N+T or Q+T	187 max HB
ASME SA-181/SA-181M	Class 70	---	---	---	---	250	36	485	70	18	AM, A, N or N+T	---
ASME SA-266/SA-266M	Grade 2	---	---	---	---	250	36	485-655	70-95	20 L	A, N, N+T or BA	---
	Grade 4	K03017	---	---	---	250	36	485-655	70-95	20 L	A, N, N+T or BA	---
ASME SA-350/SA-350M	Grade LF2, Class 1	K03011	---	---	---	250	36	485-655	70-95	22	N, N+T or Q+T	see standard for impact data 197 max HB
	Grade LF2, Class 2	K03011	---	---	---	250	36	485-655	70-95	22	N, N+T or Q+T	see standard for impact data 197 max HB
ASME SA-508/SA-508M	Grade 1	K13502	---	---	---	250	36	485-655	70-95	20	Q	20 J @ 4.4°C
	Grade 1A	K13502	---	---	---	250	36	485-655	70-95	20	Q	20 J @ 4.4°C
ASTM A105/A105M-14	---	K03504	---	---	---	250	36	485	70	30	A, N, N+T or Q+T	187 max HBW
ASTM A181/A181M-14	Class 70	---	---	---	---	250	36	485	70	18	AM, A, N or N+T	---
ASTM A266/A266M-13	Grade 2	---	---	---	---	250	36	485-655	70-95	20 L	A, N, N+T or Q+T	---
	Grade 4	K03017	---	---	---	250	36	485-655	70-95	20 L	A, N, N+T or Q+T	---

Note: This section continued on next page

6.1 Carbon Steel Forgings

6.1.2A Mechanical Properties of Carbon Steel Forgings for Piping, Pressure Vessel and Components (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A350/A350M-15	Grade LF2, Class 1	K03011	---	---	---	250	36	485-655	70-95	22	N, N+T or Q+T	see standard for impact data 197 max HBW
	Grade LF2, Class 2	K03011	---	---	---	250	36	485-655	70-95	22	N, N+T or Q+T	see standard for impact data 197 max HBW
ASTM A508/A508M-14	Grade 1	K13502	---	---	---	250	36	485-655	70-95	20	Q+T	20 J @ 4.4°C
	Grade 1A	K13502	---	---	---	250	36	485-655	70-95	20	Q+T	20 J @ 4.4°C
JIS G 3202:1988 A1:2008	Symbol SFVC 2 A	---	---	---	---	245	---	490-640	---	18 L	A, N, N+T or Q+T	---
	Symbol SFVC 2 B	---	---	---	---	245	---	490-640	---	18 L	A, N, N+T or Q+T	27 J @ 0°C
JIS G 3205:1988 A1:2008	Symbol SFL 2	---	---	---	---	245	---	490-640	---	19 L	A, N+T or Q+T	27 J @ -45°C
EN 10222-2:1999	P305GH	---	1.0436	t ≤ 35	---	295	---	490-610	---	22 L, 20 T	N or N+T	see standard for impact data
				t ≤ 70	---	275	---	510-630	---	22 L, 20 T	Q+T	
				35 < t ≤ 160	---	270	---	490-610	---	22 L, 20 T	N or N+T	
EN 10222-4:1998 A1:2001	P355NH	---	1.0565	t ≤ 16	---	345	---	490-630	---	23 L, 21 T	N	see standard for impact data
				16 < t ≤ 35	---	345	---	490-630	---	23 L, 21 T	N	
				35 < t ≤ 70	---	325	---	490-630	---	23 L, 21 T	N	
				70 < t ≤ 100	---	305	---	490-630	---	23 L, 21 T	N	
				100 < t ≤ 250	---	285	---	490-630	---	23 L, 21 T	N	
				250 < t ≤ 400	---	265	---	490-630	---	23 L, 21 T	N	
ISO 9327-4:1999	Type P 35	---	---	t ≤ 16	---	355	---	490-610	---	24 L, 22 T	N or Q+T	see standard for impact data
				16 < t ≤ 35	---	355	---	490-610	---	24 L, 22 T	N or Q+T	
				35 < t ≤ 50	---	345	---	490-610	---	24 L, 22 T	N or Q+T	
				50 < t ≤ 70	---	325	---	490-610	---	24 L, 22 T	N or Q+T	
				70 < t ≤ 100	---	315	---	470-610	---	23 L, 21 T	N or Q+T	
				100 < t ≤ 250	---	295	---	470-610	---	22 L, 20 T	N or Q+T	
	Type PH 35	---	---	t ≤ 16	---	355	---	490-610	---	24 L, 22 T	N or Q+T	see standard for impact data
				16 < t ≤ 35	---	355	---	490-610	---	24 L, 22 T	N or Q+T	
				35 < t ≤ 50	---	345	---	490-610	---	24 L, 22 T	N or Q+T	
				50 < t ≤ 70	---	325	---	490-610	---	24 L, 22 T	N or Q+T	
				70 < t ≤ 100	---	315	---	470-610	---	23 L, 21 T	N or Q+T	
				100 < t ≤ 250	---	295	---	470-610	---	22 L, 20 T	N or Q+T	
	Type PL 35	---	---	t ≤ 16	---	355	---	490-610	---	24 L, 22 T	N or Q+T	see standard for impact data
				16 < t ≤ 35	---	355	---	490-610	---	24 L, 22 T	N or Q+T	
				35 < t ≤ 50	---	345	---	490-610	---	24 L, 22 T	N or Q+T	
				50 < t ≤ 70	---	325	---	490-610	---	24 L, 22 T	N or Q+T	
				70 < t ≤ 100	---	315	---	470-610	---	23 L, 21 T	N or Q+T	
				100 < t ≤ 250	---	295	---	470-610	---	22 L, 20 T	N or Q+T	

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6.1 Carbon Steel Forgings

6.1.2A Mechanical Properties of Carbon Steel Forgings for Piping, Pressure Vessel and Components (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ISO 9327-4:1999	Type PLH 35	---	---	$t \leq 16$	---	355	---	490-610	---	24 L, 22 T	N or Q+T	see standard for impact data
				$16 < t \leq 35$	---	355	---	490-610	---	24 L, 22 T	N or Q+T	
				$35 < t \leq 50$	---	345	---	490-610	---	24 L, 22 T	N or Q+T	
				$50 < t \leq 70$	---	325	---	490-610	---	24 L, 22 T	N or Q+T	
				$70 < t \leq 100$	---	315	---	470-610	---	23 L, 21 T	N or Q+T	
				$100 < t \leq 250$	---	295	---	470-610	---	22 L, 20 T	N or Q+T	

6.1.2B Chemical Composition of Carbon Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
EN 10222-4:1998 A1:2001	P285QH	---	1.0478	0.18	0.60-1.40	0.40	0.025	0.015	0.30	0.30	0.08	V 0.05; Al 0.020-0.060; Cu 0.20; Nb 0.03; N 0.020; (Nb+V) 0.05
	P285NH	---	1.0477	0.18	0.60-1.40	0.40	0.025	0.015	0.30	0.30	0.08	V 0.05; Al 0.020-0.060; Cu 0.20; Nb 0.03; N 0.020; (Nb+V) 0.05
ISO 9327-4:1999	Type P 28	---	---	0.18	0.50-1.40	0.10-0.40	0.035	0.030	0.30	0.30	0.08	V 0.05; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.020; (Cr+Cu+Mo) 0.45; (Nb+Ti+V) 0.05
	Type PH 28	---	---	0.18	0.50-1.40	0.10-0.40	0.035	0.030	0.30	0.30	0.08	V 0.05; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.020; (Cr+Cu+Mo) 0.45; (Nb+Ti+V) 0.05
	Type PL 28	---	---	0.16	0.50-1.40	0.10-0.40	0.025	0.020	0.30	0.30	0.08	V 0.05; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.020; (Cr+Cu+Mo) 0.45; (Nb+Ti+V) 0.05

6.1 Carbon Steel Forgings

6.1.2B Chemical Properties of Carbon Steel Forgings for Piping, Pressure Vessel and Components (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10222-2:1999	P245GH	---	1.0352	0.08-0.20	0.50-1.30	0.40	0.025	0.015	0.30	0.30	0.08	V 0.02; Cu 0.30; Nb 0.01; (Cr+Cu+Mo) 0.50
JIS G 3202:1988 A1:2008	Symbol SFVC 1	---	---	0.30	0.40-1.35	0.35	0.030	0.030	---	---	---	---
ASME SA-181/SA-181M	Class 60	---	---	0.35	1.10	0.10-0.35	0.05	0.05	---	---	---	---
ASME SA-266/SA-266M	Grade 1	---	---	0.30	0.40-1.05	0.15-0.35	0.025	0.025	---	---	---	---
ASME SA-350/SA-350M	Grade LF1, Class 1	K03009	---	0.30	0.60-1.35	0.15-0.30	0.035	0.040	0.30	0.40	0.12	V 0.08; Cu 0.40; Cb 0.02; (Cu+Ni+Cr+V+Mo) 1.00; (Cr+Mo) 0.32
ASTM A181/A181M-14	Class 60	---	---	0.35	1.10	0.10-0.35	0.05	0.05	---	---	---	---
ASTM A266/A266M-13	Grade 1	---	---	0.30	0.40-1.05	0.15-0.35	0.025	0.025	---	---	---	---
ASTM A350/A350M-15	Grade LF1, Class 1	K03009	---	0.30	0.60-1.35	0.15-0.30	0.035	0.040	0.30	0.40	0.12	V 0.08; Cu 0.40; Cb 0.02; (Cu+Ni+Cr+V+Mo) 1.00; (Cr+Mo) 0.32
JIS G 3205:1988 A1:2008	Symbol SFL 1	---	---	0.30	1.35	0.35	0.030	0.030	---	---	---	---
EN 10222-2:1999	P280GH	---	1.0426	0.08-0.20	0.90-1.50	0.40	0.025	0.015	0.30	0.30	0.08	V 0.02; Cu 0.30; Nb 0.01; (Cr+Cu+Mo) 0.50
EN 10222-4:1998 A1:2001	P355QH	---	1.0571	0.20	0.90-1.65	0.10-0.50	0.025	0.015	0.30	0.30	0.08	V 0.10; Al 0.020-0.060; Cu 0.20; Nb 0.05; N 0.020; (Nb+V) 0.12
ASME SA-541/SA-541M	Grade 1	K03506	---	0.35	0.40-0.90	0.35	0.025	0.025	0.25	0.40	0.10	V 0.05
	Grade 1A	K03020	---	0.30	0.70-1.35	0.40	0.025	0.025	0.25	0.40	0.10	V 0.05
ASTM A541/A541M-05 (2015)	Grade 1	K03506	---	0.35	0.40-0.90	0.35	0.025	0.025	0.25	0.40	0.10	V 0.05
	Grade 1A	K03020	---	0.30	0.70-1.35	0.40	0.025	0.025	0.25	0.40	0.10	V 0.05
ASME SA-105/SA-105M	---	K03504	---	0.35	0.60-1.05	0.10-0.35	0.035	0.040	0.30	0.40	0.12	V 0.08; Cu 0.40; (Cr+Mo) 0.32; (Cu+Ni+Cr+Mo+V) 1.00
ASME SA-181/SA-181M	Class 70	---	---	0.35	1.10	0.10-0.35	0.05	0.05	---	---	---	---
ASME SA-266/SA-266M	Grade 2	---	---	0.30	0.40-1.05	0.15-0.35	0.025	0.025	---	---	---	---
	Grade 4	K03017	---	0.30	0.80-1.35	0.15-0.35	0.025	0.025	---	---	---	---
ASME SA-350/SA-350M	Grade LF2, Class 1	K03011	---	0.30	0.60-1.35	0.15-0.30	0.035	0.040	0.30	0.40	0.12	V 0.08; Cu 0.40; Cb 0.02; (Cu+Ni+Cr+V+Mo) 1.00; (Cr+Mo) 0.32
	Grade LF2, Class 2	K03011	---	0.30	0.60-1.35	0.15-0.30	0.035	0.040	0.30	0.40	0.12	V 0.08; Cu 0.40; Cb 0.02; (Cu+Ni+Cr+V+Mo) 1.00; (Cr+Mo) 0.32
ASME SA-508/SA-508M	Grade 1	K13502	---	0.35	0.40-1.05	0.40	0.025	0.025	0.25	0.40	0.10	V 0.05; B 0.003; Cu 0.20; Cb 0.01; Ca 0.015; Ti 0.015; Al 0.025
	Grade 1A	K13502	---	0.30	0.70-1.35	0.40	0.025	0.025	0.25	0.40	0.10	V 0.05; B 0.003; Cu 0.20; Cb 0.01; Ca 0.015; Ti 0.015; Al 0.025

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6.1 Carbon Steel Forgings

6.1.2B Chemical Properties of Carbon Steel Forgings for Piping, Pressure Vessel and Components (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A105/A105M-14	---	K03504	---	0.35	0.60-1.05	0.10-0.35	0.035	0.040	0.30	0.40	0.12	V 0.08; Cu 0.40; (Cr+Mo) 0.32; (Cu+Ni+Cr+Mo+V) 1.00
ASTM A181/A181M-14	Class 70	---	---	0.35	1.10	0.10-0.35	0.05	0.05	---	---	---	---
ASTM A266/A266M-13	Grade 2	---	---	0.30	0.40-1.05	0.15-0.35	0.025	0.025	---	---	---	---
	Grade 4	K03017	---	0.30	0.80-1.35	0.15-0.35	0.025	0.025	---	---	---	---
ASTM A350/A350M-15	Grade LF2, Class 1	K03011	---	0.30	0.60-1.35	0.15-0.30	0.035	0.040	0.30	0.40	0.12	V 0.08; Cu 0.40; Cb 0.02; (Cu+Ni+Cr+V+Mo) 1.00; (Cr+Mo) 0.32
	Grade LF2, Class 2	K03011	---	0.30	0.60-1.35	0.15-0.30	0.035	0.040	0.30	0.40	0.12	V 0.08; Cu 0.40; Cb 0.02; (Cu+Ni+Cr+V+Mo) 1.00; (Cr+Mo) 0.32
ASTM A508/A508M-14	Grade 1	K13502	---	0.35	0.40-1.05	0.40	0.025	0.025	0.25	0.40	0.10	V 0.05; Cu 0.20; B 0.003; Cb 0.01; Ca 0.015; Ti 0.015; Al 0.025
	Grade 1A	K13502	---	0.30	0.70-1.35	0.40	0.025	0.025	0.25	0.40	0.10	V 0.05; Cu 0.20; B 0.003; Cb 0.01; Ca 0.015; Ti 0.015; Al 0.025
JIS G 3202:1988 A1:2008	Symbol SFVC 2 A	---	---	0.35	0.40-1.10	0.35	0.030	0.030	---	---	---	---
	Symbol SFVC 2 B	---	---	0.30	0.70-1.35	0.35	0.030	0.030	---	---	---	---
JIS G 3205:1988 A1:2008	Symbol SFL 2	---	---	0.30	1.35	0.35	0.030	0.030	---	---	---	---
EN 10222-2:1999	P305GH	---	1.0436	0.15-0.20	0.90-1.60	0.40	0.025	0.015	0.30	0.30	0.08	V 0.02; Cu 0.30; Nb 0.01; (Cr+Cu+Mo) 0.50
EN 10222-4:1998 A1:2001	P355NH	---	1.0565	0.20	0.90-1.65	0.10-0.50	0.025	0.015	0.30	0.30	0.08	V 0.10; Al 0.020-0.060; Cu 0.20; Nb 0.05; N 0.020; (Nb+V) 0.12
ISO 9327-4:1999	Type P 35	---	---	0.20	0.90-1.70	0.10-0.50	0.035	0.030	0.30	0.30	0.08	V 0.10; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.020; (Cr+Cu+Mo) 0.45; (Nb+Ti+V) 0.12
	Type PH 35	---	---	0.20	0.90-1.70	0.10-0.50	0.035	0.030	0.30	0.30	0.08	V 0.10; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.020; (Cr+Cu+Mo) 0.45; (Nb+Ti+V) 0.12
	Type PL 35	---	---	0.18	0.90-1.70	0.10-0.50	0.025	0.020	0.30	0.30	0.08	V 0.10; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.020; (Cr+Cu+Mo) 0.45; (Nb+Ti+V) 0.12
	Type PLH 35	---	---	0.18	0.90-1.70	0.10-0.50	0.025	0.020	0.30	0.30	0.08	V 0.10; Al 0.020 min.; Cu 0.30; Ti 0.03; Nb 0.05; N 0.020; (Cr+Cu+Mo) 0.45; (Nb+Ti+V) 0.12

6.2 Alloy Steel Forgings

6.2.1A Chemical Composition of 1¼Cr–¼Mo Alloy Steel Forgings for General Use

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10250-3:1999	25CrMo4	---	1.7218	0.22-0.29	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
JIS G 3221:1988 A1:2008	Symbol SFCM 690 S	---	---	0.48	0.30-0.85	0.15-0.35	0.030	0.030	0.90-1.50	---	0.15-0.30	Cu 0.30
EN 10250-3:1999	42CrMo4	---	1.7225	0.38-0.45	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
JIS G 3221:1988 A1:2008	Symbol SFCM 740 S	---	---	0.48	0.30-0.85	0.15-0.35	0.030	0.030	0.90-1.50	---	0.15-0.30	Cu 0.30
EN 10250-3:1999	34CrMo4	---	1.7220	0.30-0.37	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
	50CrMo4	---	1.7228	0.46-0.54	0.50-0.80	0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
JIS G 3221:1988 A1:2008	Symbol SFCM 780 S	---	---	0.48	0.30-0.85	0.15-0.35	0.030	0.030	0.90-1.50	---	0.15-0.30	Cu 0.30

6.2.1B Mechanical Properties of 1¼Cr–¼Mo Alloy Steel Forgings for General Use

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
EN 10250-3:1999	25CrMo4	---	1.7218	t ≤ 70	---	450	---	700	---	15 L	Q+T	L: 50 J @ RT
				70 < t ≤ 160	---	400	---	650	---	17 L, 13 T	Q+T	see standard for impact data
				160 < t ≤ 330	---	380	---	600	---	18 L, 14 T	Q+T	
JIS G 3221:1988 A1:2008	Symbol SFCM 690 S	---	---	t < 200	---	460	---	690-830	---	17 L	H+T	see standard for impact data; 201 min. HB
				200 ≤ t < 400	---	450	---	690-830	---	16 L, 12 T	H+T	see standard for impact data; 201 min. HB
				400 ≤ t < 700	---	450	---	690-830	---	15 L, 11 T	H+T	see standard for impact data; 201 min. HB
EN 10250-3:1999	42CrMo4	---	1.7225	t ≤ 160	---	500	---	750	---	14 L, 10 T	Q+T	see standard for impact data
				160 < t ≤ 330	---	460	---	700	---	15 L, 11 T	Q+T	
				330 < t ≤ 500	---	390	---	600	---	16 L, 12 T	Q+T	
JIS G 3221:1988 A1:2008	Symbol SFCM 740 S	---	---	t < 200	---	510	---	740-880	---	16 L	H+T	see standard for impact data; 217 min. HB
				200 ≤ t < 400	---	500	---	740-880	---	15 L, 11 T	H+T	see standard for impact data; 217 min. HB
				400 ≤ t < 700	---	490	---	740-880	---	14 L, 10 T	H+T	see standard for impact data; 217 min. HB
EN 10250-3:1999	34CrMo4	---	1.7220	t ≤ 70	---	550	---	800	---	14 L	Q+T	L: 45 J @ RT
				70 < t ≤ 160	---	450	---	700	---	15 L, 10 T	Q+T	see standard for impact data
				160 < t ≤ 330	---	410	---	650	---	16 L, 12 T	Q+T	
	50CrMo4	---	1.7228	t ≤ 160	---	550	---	800	---	13 L, 9 T	Q+T	see standard for impact data
				160 < t ≤ 330	---	540	---	750	---	14 L, 10 T	Q+T	
				330 < t ≤ 500	---	490	---	700	---	15 L, 11 T	Q+T	
JIS G 3221:1988 A1:2008	Symbol SFCM 780 S	---	---	t < 200	---	560	---	780-930	---	15 L	H+T	see standard for impact data; 229 min. HB
				200 ≤ t < 400	---	550	---	780-930	---	14 L, 10 T	H+T	see standard for impact data; 229 min. HB
				400 ≤ t < 700	---	540	---	780-930	---	13 L, 9 T	H+T	see standard for impact data; 229 min. HB

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.1A Chemical Composition of Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10222-2:1999	16Mo3	---	1.5415	0.12-0.20	0.40-0.90	0.35	0.025	0.015	0.30	0.30	0.25-0.35	V 0.02; Cu 0.30; Nb 0.01; (Cr+Cu) 0.50
ISO 9327-2:1999	Type 16Mo3	---	---	0.12-0.20	0.40-0.90	0.35	0.035	0.030	0.30	---	0.25-0.35	Cu 0.30
ASME SA-182/SA-182M	Grade F 1	K12822	---	0.28	0.60-0.90	0.15-0.35	0.045	0.045	---	---	0.44-0.65	---
ASME SA-336/SA-336M	Grade F1	K12520	---	0.20-0.30	0.60-0.80	0.20-0.35	0.025	0.025	---	---	0.40-0.60	---
ASTM A182/A182M-15	Grade F 1	K12822	---	0.28	0.60-0.90	0.15-0.35	0.045	0.045	---	---	0.44-0.65	---
ASTM A336/A336M-10a	Grade F1	K12520	---	0.20-0.30	0.60-0.80	0.20-0.35	0.025	0.025	---	---	0.40-0.60	---
JIS G 3203:1988 A1:2008	Grade SFVA F 1	---	---	0.30	0.60-0.90	0.35	0.030	0.030	---	---	0.45-0.65	---

6.2.2.1B Mechanical Properties of Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
EN 10222-2:1999	16Mo3	---	1.5415	t ≤ 35	---	285	---	440-570	---	23 L, 21 T	N or Q+T	see standard for impact data
				35 < t ≤ 70	---	275	---	440-570	---	23 L, 21 T	N or Q+T	
				70 < t ≤ 100	---	265	---	440-570	---	23 L, 21 T	N or Q+T	
				t ≤ 250	---	255	---	440-570	---	23 L, 21 T	Q+T	
				250 < t ≤ 500	---	240	---	420-550	---	23 L, 21 T	Q+T	
ISO 9327-2:1999	Type 16Mo3	---	---	t ≤ 40	---	270	---	450-600	---	26 L, 24 T	N, N+T or Q+T	see standard for impact data
				40 < t ≤ 60	---	260	---	450-600	---	25 L, 23 T	N, N+T or Q+T	
				60 < t ≤ 100	---	240	---	430-580	---	24 L, 22 T	N, N+T or Q+T	
				100 < t ≤ 250	---	220	---	420-570	---	21 L, 19 T	N, N+T or Q+T	
ASME SA-182/SA-182M	Grade F 1	K12822	---	---	---	275	40	485	70	20	A, N+T	143-192 HBW
ASME SA-336/SA-336M	Grade F1	K12520	---	---	---	275	40	485-660 L	70-95 L	20 L	A, N, N+T or Q+T	---
ASTM A182/A182M-15	Grade F 1	K12822	---	---	---	275	40	485	70	20	A, N+T	143-192 HBW
ASTM A336/A336M-10a	Grade F1	K12520	---	---	---	275	40	485-660 L	70-95 L	20 L	A, N+T or Q+T	---
JIS G 3203:1988 A1:2008	Grade SFVA F 1	---	---	---	---	275	---	480-660	---	18 L	A or N+T	---

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.2A Chemical Composition of ½Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-182/SA-182M	Grade F 2	K12122	---	0.05-0.21	0.30-0.80	0.10-0.60	0.040	0.040	0.50-0.81	---	0.44-0.65	---
ASTM A182/A182M-15	Grade F 2	K12122	---	0.05-0.21	0.30-0.80	0.10-0.60	0.040	0.040	0.50-0.81	---	0.44-0.65	---
JIS G 3203:1988 A1:2008	Grade SFVA F 2	---	---	0.20	0.30-0.80	0.60	0.030	0.030	0.50-0.80	---	0.45-0.65	---

6.2.2.2B Mechanical Properties of ½Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-182/SA-182M	Grade F 2	K12122	---	---	---	275	40	485	70	20	A, N+T	143-192 HBW
ASTM A182/A182M-15	Grade F 2	K12122	---	---	---	275	40	485	70	20	A, N+T	143-192 HBW
JIS G 3203:1988 A1:2008	Grade SFVA F 2	---	---	---	---	275	---	480-660	---	18 L	A or N+T	---

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.3A Chemical Composition of 1Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-182/SA-182M	Grade F 12, Class 2	K11564	---	0.10-0.20	0.30-0.80	0.10-0.60	0.040	0.040	0.80-1.25	---	0.44-0.65	---
ASME SA-336/SA-336M	Grade F12	K11564	---	0.10-0.20	0.30-0.80	0.10-0.60	0.025	0.025	0.80-1.10	---	0.45-0.65	---
ASTM A182/A182M-15	Grade F 12, Class 2	K11564	---	0.10-0.20	0.30-0.80	0.10-0.60	0.040	0.040	0.80-1.25	---	0.44-0.65	---
ASTM A336/A336M-10a	Grade F12	K11564	---	0.10-0.20	0.30-0.80	0.10-0.60	0.025	0.025	0.80-1.10	---	0.45-0.65	---
EN 10222-2:1999	13CrMo4-5	---	1.7335	0.08-0.18	0.40-1.00	0.35	0.025	0.015	0.70-1.15	0.30	0.40-0.60	V 0.02; Cu 0.30; Nb 0.01
ISO 9327-2:1999	Type 14CrMo4-5	---	---	0.08-0.18	0.40-1.00	0.35	0.035	0.030	0.70-1.15	---	0.40-0.60	Cu 0.30
JIS G 3203:1988 A1:2008	Grade SFVA F 12	---	---	0.20	0.30-0.80	0.60	0.030	0.030	0.80-1.25	---	0.45-0.65	---

6.2.2.3B Mechanical Properties of 1Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-182/SA-182M	Grade F 12, Class 2	K11564	---	---	---	275	40	485	70	20	A, N+T	143-207 HBW
ASME SA-336/SA-336M	Grade F12	K11564	---	---	---	275	40	485-660 L	70-95 L	20 L	A, N, N+T or Q+T	---
ASTM A182/A182M-15	Grade F 12, Class 2	K11564	---	---	---	275	40	485	70	20	A, N+T	143-207 HBW
ASTM A336/A336M-10a	Grade F12	K11564	---	---	---	275	40	485-660 L	70-95 L	20 L	A, N+T or Q+T	---
EN 10222-2:1999	13CrMo4-5	---	1.7335	t ≤ 35	---	285	---	440-590	---	20 L, 18 T	N+T	see standard for impact data
				35 < t ≤ 70	---	275	---	440-590	---	20 L, 18 T	N+T	
				70 < t ≤ 100	---	265	---	440-590	---	20 L, 18 T	N+T or Q+T	
				100 < t ≤ 250	---	255	---	440-590	---	20 L, 18 T	N+T or Q+T	
				250 < t ≤ 500	---	230	---	420-570	---	20 L, 18 T	N+T or Q+T	
ISO 9327-2:1999	Type 14CrMo4-5	---	---	t ≤ 40	---	300	---	450-600	---	22 L, 20 T	N+T or Q+T	see standard for impact data
				40 < t ≤ 60	---	300	---	450-600	---	21 L, 19 T	N+T or Q+T	
				60 < t ≤ 100	---	275	---	440-590	---	20 L, 18 T	N+T or Q+T	
				100 < t ≤ 250	---	255	---	430-580	---	20 L, 18 T	N+T or Q+T	
JIS G 3203:1988 A1:2008	Grade SFVA F 12	---	---	---	---	275	---	480-660	---	18 L	A or N+T	---

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.4A Chemical Composition of 1¼Cr–½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-182/SA-182M	Grade F 11, Class 2	K11572	---	0.10-0.20	0.30-0.80	0.50-1.00	0.040	0.040	1.00-1.50	---	0.44-0.65	---
	Grade F 11, Class 3	K11572	---	0.10-0.20	0.30-0.80	0.50-1.00	0.040	0.040	1.00-1.50	---	0.44-0.65	---
ASME SA-336/SA-336M	Grade F11, Class 2	K11572	---	0.10-0.20	0.30-0.80	0.50-1.00	0.025	0.025	1.00-1.50	---	0.45-0.65	---
	Grade F11, Class 3	K11572	---	0.10-0.20	0.30-0.80	0.50-1.00	0.025	0.025	1.00-1.50	---	0.45-0.65	---
ASTM A182/A182M-15	Grade F 11, Class 2	K11572	---	0.10-0.20	0.30-0.80	0.50-1.00	0.040	0.040	1.00-1.50	---	0.44-0.65	---
	Grade F 11, Class 3	K11572	---	0.10-0.20	0.30-0.80	0.50-1.00	0.040	0.040	1.00-1.50	---	0.44-0.65	---
ASTM A336/A336M-10a	Grade F11, Class 2	K11572	---	0.10-0.20	0.30-0.80	0.50-1.00	0.025	0.025	1.00-1.50	---	0.45-0.65	---
	Grade F11, Class 3	K11572	---	0.10-0.20	0.30-0.80	0.50-1.00	0.025	0.025	1.00-1.50	---	0.45-0.65	---
JIS G 3203:1988 A1:2008	Grade SFVA F 11 A	---	---	0.20	0.30-0.80	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	---
	Grade SFVA F 11 B	---	---	0.20	0.30-0.80	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	---

6.2.2.4B Mechanical Properties of 1¼Cr–½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-182/SA-182M	Grade F 11, Class 2	K11572	---	---	---	275	40	485	70	20	A, N+T	143-207 HBW
	Grade F 11, Class 3	K11572	---	---	---	310	45	515	75	20	A, N+T	156-207 HBW
ASME SA-336/SA-336M	Grade F11, Class 2	K11572	---	---	---	275	40	485-660 L	70-95 L	20 L	A, N, N+T or Q+T	---
	Grade F11, Class 3	K11572	---	---	---	310	45	515-690 L	75-100 L	18 L	A, N, N+T or Q+T	---
ASTM A182/A182M-15	Grade F 11, Class 2	K11572	---	---	---	275	40	485	70	20	A, N+T	143-207 HBW
	Grade F 11, Class 3	K11572	---	---	---	310	45	515	75	20	A, N+T	156-207 HBW
ASTM A336/A336M-10a	Grade F11, Class 2	K11572	---	---	---	275	40	485-660 L	70-95 L	20 L	A, N+T or Q+T	---
	Grade F11, Class 3	K11572	---	---	---	310	45	515-690 L	75-100 L	18 L	A, N+T or Q+T	---
JIS G 3203:1988 A1:2008	Grade SFVA F 11 A	---	---	---	---	275	---	480-660	---	18 L	A or N+T	---
	Grade SFVA F 11 B	---	---	---	---	315	---	520-690	---	18 L	A or N+T	---

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.5A Chemical Composition of 2¼Cr–1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-182/SA-182M	Grade F 22, Class 1	K21590	---	0.05-0.15	0.30-0.60	0.50	0.040	0.040	2.00-2.50	---	0.87-1.13	---
	Grade F 22, Class 3	K21590	---	0.05-0.15	0.30-0.60	0.50	0.040	0.040	2.00-2.50	---	0.87-1.13	---
ASME SA-336/SA-336M	Grade F22, Class 1	K21590	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.00-2.50	---	0.90-1.10	---
	Grade F22, Class 3	K21590	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.00-2.50	---	0.90-1.10	---
ASTM A182/A182M-15	Grade F 22, Class 1	K21590	---	0.05-0.15	0.30-0.60	0.50	0.040	0.040	2.00-2.50	---	0.87-1.13	---
	Grade F 22, Class 3	K21590	---	0.05-0.15	0.30-0.60	0.50	0.040	0.040	2.00-2.50	---	0.87-1.13	---
ASTM A336/A336M-10a	Grade F22, Class 1	K21590	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.00-2.50	---	0.90-1.10	---
	Grade F22, Class 3	K21590	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.00-2.50	---	0.90-1.10	---
EN 10222-2:1999	11CrMo9-10	---	1.7383	0.08-0.15	0.40-0.80	0.50	0.025	0.015	2.00-2.50	0.30	0.90-1.10	V 0.02; Cu 0.30; Nb 0.01
ISO 9327-2:1999	Type 13CrMo9-10	---	---	0.08-0.15	0.40-0.70	0.50	0.035	0.030	2.00-2.50	---	0.90-1.10	Cu 0.30
JIS G 3203:1988 A1:2008	Grade SFVA F 22 A	---	---	0.15	0.30-0.60	0.50	0.030	0.030	2.00-2.50	---	0.90-1.10	---
	Grade SFVA F 22 B	---	---	0.15	0.30-0.60	0.50	0.030	0.030	2.00-2.50	---	0.90-1.10	---
ASME SA-508/SA-508M	Grade 22, Class 3	K21590	---	0.11-0.15	0.30-0.60	0.35	0.015	0.015	2.00-2.50	0.25	0.90-1.10	V 0.02; Al 0.025; Cu 0.25; Cb 0.01; Ca 0.015; Ti 0.015; B 0.003
ASME SA-541/SA-541M	Grade 22, Class 3	---	---	0.11-0.15	0.30-0.60	0.50	0.015	0.015	2.00-2.50	0.25	0.90-1.10	V 0.02
ASTM A508/A508M-14	Grade 22, Class 3	K21590	---	0.11-0.15	0.30-0.60	0.35	0.015	0.015	2.00-2.50	0.25	0.90-1.10	V 0.02; Al 0.025; Cu 0.25; Cb 0.01; Ca 0.015; Ti 0.015; B 0.003
ASTM A541/A541M-05 (2015)	Grade 22, Class 3	---	---	0.11-0.15	0.30-0.60	0.50	0.015	0.015	2.00-2.50	0.25	0.90-1.10	V 0.02
JIS G 3206:1993 A1:2008	Symbol SFVCM F22B	---	---	0.17	0.30-0.60	0.50	0.015	0.015	2.00-2.50	---	0.90-1.10	V 0.03
ASME SA-182/SA-182M	Grade F 22V	K31835	---	0.11-0.15	0.30-0.60	0.10	0.015	0.010	2.00-2.50	0.25	0.90-1.10	V 0.25-0.35; Cu 0.20; Ti 0.030; Cb 0.07; B 0.002; Ca 0.015
ASME SA-336/SA-336M	Grade F22V	K31835	---	0.11-0.15	0.30-0.60	0.10	0.015	0.010	2.00-2.50	0.25	0.90-1.10	V 0.25-0.35; Cu 0.20; Ti 0.030; Cb 0.07; B 0.0020; Ca 0.015
ASME SA-541/SA-541M	Grade 22V	K31835	---	0.11-0.15	0.30-0.60	0.10	0.015	0.010	2.00-2.50	0.25	0.90-1.10	V 0.25-0.35; Cu 0.20; Ti 0.030; Cb 0.07; B 0.0020; Ca 0.015
ASTM A182/A182M-15	Grade F 22V	K31835	---	0.11-0.15	0.30-0.60	0.10	0.015	0.010	2.00-2.50	0.25	0.90-1.10	V 0.25-0.35; Cu 0.20; Ti 0.030; Cb 0.07; B 0.002; Ca 0.015
ASTM A336/A336M-10a	Grade F22V	K31835	---	0.11-0.15	0.30-0.60	0.10	0.015	0.010	2.00-2.50	0.25	0.90-1.10	V 0.25-0.35; Cu 0.20; Ti 0.030; Cb 0.07; B 0.0020; Ca 0.015
ASTM A541/A541M-05 (2015)	Grade 22V	K31835	---	0.11-0.15	0.30-0.60	0.10	0.015	0.010	2.00-2.50	0.25	0.90-1.10	V 0.25-0.35; Cu 0.20; Ti 0.030; Cb 0.07; B 0.0020; Ca 0.015
JIS G 3206:1993 A1:2008	Symbol SFVCM F22V	---	---	0.17	0.30-0.60	0.10	0.015	0.010	2.00-2.50	---	0.90-1.10	V 0.25-0.35

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.5B Mechanical Properties of 2¼Cr–1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-182/SA-182M	Grade F 22, Class 1	K21590	---	---	---	205	30	415	60	20	A, N+T	170 max HBW
	Grade F 22, Class 3	K21590	---	---	---	310	45	515	75	20	A, N+T	156-207 HBW
ASME SA-336/SA-336M	Grade F22, Class 1	K21590	---	---	---	205	30	415-585 L	60-85 L	20 L	A, N, N+T or Q+T	---
	Grade F22, Class 3	K21590	---	---	---	310	45	515-690 L	75-100 L	19 L	A, N, N+T or Q+T	---
ASTM A182/A182M-15	Grade F 22, Class 1	K21590	---	---	---	205	30	415	60	20	A, N+T	170 max HBW
	Grade F 22, Class 3	K21590	---	---	---	310	45	515	75	20	A, N+T	156-207 HBW
ASTM A336/A336M-10a	Grade F22, Class 1	K21590	---	---	---	205	30	415-585 L	60-85 L	20 L	A, N+T or Q+T	---
	Grade F22, Class 3	K21590	---	---	---	310	45	515-690 L	75-100 L	19 L	A, N+T or Q+T	---
EN 10222-2:1999	11CrMo9-10	---	1.7383	t ≤ 200	---	300	---	520-670	---	20 L, 20 T	N+T	see standard for impact data
				200 < t ≤ 500	---	255	---	450-600	---	23 L, 21 T	N+T or Q+T	
ISO 9327-2:1999	Type 13CrMo9-10	---	---	t ≤ 60	---	265	---	480-620	---	20 L, 18 T	N+T or Q+T	see standard for impact data
				60 < t ≤ 100	---	260	---	470-620	---	20 L, 18 T	N+T or Q+T	
				100 < t ≤ 150	---	250	---	460-610	---	20 L, 18 T	N+T or Q+T	
				150 < t ≤ 300	---	240	---	450-600	---	20 L, 18 T	N+T or Q+T	
JIS G 3203:1988 A1:2008	Grade SFVA F 22 A	---	---	---	---	205	---	410-590	---	18 L	A or N+T	---
	Grade SFVA F 22 B	---	---	---	---	315	---	520-690	---	18 L	A or N+T	---
ASME SA-508/SA-508M	Grade 22, Class 3	K21590	---	---	---	380	55	585-760	85-110	18	Q	54 J @ -18°C
ASME SA-541/SA-541M	Grade 22, Class 3	---	---	---	---	380	55	585-760	85-110	18	Q+T	54 J @ -18°C
ASTM A508/A508M-14	Grade 22, Class 3	K21590	---	---	---	380	55	585-760	85-110	18	Q+T	54 J @ -18°C
ASTM A541/A541M-05 (2015)	Grade 22, Class 3	---	---	---	---	380	55	585-760	85-110	18	Q+T	54 J @ -18°C
JIS G 3206:1993 A1:2008	Symbol SFVCM F22B	---	---	---	---	380	---	580-760	---	16 L	N+T or Q+T	54 J @ -18°C
ASME SA-182/SA-182M	Grade F 22V	K31835	---	---	---	415	60	585-780	85-110	18	N+T or Q+T	174-237 HBW; L: 54 J @ -18°C
ASME SA-336/SA-336M	Grade F22V	K31835	---	---	---	415	60	585-760 L	85-110 L	18 L	A, N, N+T or Q+T	L: 54 J @ -18°C
ASME SA-541/SA-541M	Grade 22V	K31835	---	---	---	415	60	585-760	85-110	18	Q+T	54 J @ -18°C
ASTM A182/A182M-15	Grade F 22V	K31835	---	---	---	415	60	585-780	85-110	18	N+T or Q+T	174-237 HBW; L: 54 J @ -18°C
ASTM A336/A336M-10a	Grade F22V	K31835	---	---	---	415	60	585-760 L	85-110 L	18 L	N+T or Q+T	L: 54 J @ -18°C
ASTM A541/A541M-05 (2015)	Grade 22V	K31835	---	---	---	415	60	585-760	85-110	18	Q+T	54 J @ -18°C
JIS G 3206:1993 A1:2008	Symbol SFVCM F22V	---	---	---	---	415	---	580-760	---	16 L	N+T or Q+T	54 J @ -18°C

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.6A Chemical Composition of 3Cr–1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-336/SA-336M	Grade F21, Class 1	K31545	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.7-3.3	---	0.80-1.06	---
ASTM A336/A336M-10a	Grade F21, Class 1	K31545	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.7-3.3	---	0.80-1.06	---
JIS G 3203:1988 A1:2008	Grade SFVA F 21 A	---	---	0.15	0.30-0.60	0.50	0.030	0.030	2.65-3.35	---	0.80-1.00	---
ASME SA-182/SA-182M	Grade F 21	K31545	---	0.05-0.15	0.30-0.60	0.50	0.040	0.040	2.7-3.3	---	0.80-1.06	---
ASME SA-336/SA-336M	Grade F21, Class 3	K31545	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.7-3.3	---	0.80-1.06	---
ASTM A182/A182M-15	Grade F 21	K31545	---	0.05-0.15	0.30-0.60	0.50	0.040	0.040	2.7-3.3	---	0.80-1.06	---
ASTM A336/A336M-10a	Grade F21, Class 3	K31545	---	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.7-3.3	---	0.80-1.06	---
JIS G 3203:1988 A1:2008	Grade SFVA F 21 B	---	---	0.15	0.30-0.60	0.50	0.030	0.030	2.65-3.35	---	0.80-1.00	---
ASME SA-182/SA-182M	Grade F 3V	K31830	---	0.05-0.18	0.30-0.60	0.10	0.020	0.020	2.8-3.2	---	0.90-1.10	V 0.20-0.30; Ti 0.015-0.035; B 0.001-0.003
ASME SA-336/SA-336M	Grade F3V	K31830	---	0.10-0.15	0.30-0.60	0.10	0.020	0.020	2.7-3.3	---	0.90-1.10	V 0.20-0.30; Ti 0.015-0.035; B 0.001-0.003
ASME SA-508/SA-508M	Grade 3V	K31830	---	0.10-0.15	0.30-0.60	0.10	0.020	0.020	2.8-3.3	---	0.90-1.10	V 0.20-0.30; Cu 0.25; Cb 0.01; Ti 0.015-0.035; B 0.001-0.003; Ca 0.015; Al 0.015
ASME SA-541/SA-541M	Grade 3V	K31830	---	0.10-0.15	0.30-0.60	0.10	0.020	0.020	2.8-3.3	---	0.90-1.10	V 0.20-0.30; Ti 0.015-0.035; B 0.001-0.003
ASTM A182/A182M-15	Grade F 3V	K31830	---	0.05-0.18	0.30-0.60	0.10	0.020	0.020	2.8-3.2	---	0.90-1.10	V 0.20-0.30; Ti 0.015-0.035; B 0.001-0.003
ASTM A336/A336M-10a	Grade F3V	K31830	---	0.10-0.15	0.30-0.60	0.10	0.020	0.020	2.7-3.3	---	0.90-1.10	V 0.20-0.30; Ti 0.015-0.035; B 0.001-0.003
ASTM A508/A508M-14	Grade 3V	K31830	---	0.10-0.15	0.30-0.60	0.10	0.020	0.020	2.8-3.3	---	0.90-1.10	V 0.20-0.30; Cu 0.25; Cb 0.01; Ti 0.015-0.035; B 0.001-0.003; Ca 0.015; Al 0.015
ASTM A541/A541M-05 (2015)	Grade 3V	K31830	---	0.10-0.15	0.30-0.60	0.10	0.020	0.020	2.8-3.3	---	0.90-1.10	V 0.20-0.30; Ti 0.015-0.035; B 0.001-0.003
JIS G 3206:1993 A1:2008	Symbol SFVCM F3V	---	---	0.17	0.30-0.60	0.10	0.015	0.010	2.75-3.25	---	0.90-1.10	V 0.20-0.30

6.2.2.6B Mechanical Properties of 3Cr-1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-336/SA-336M	Grade F21, Class 1	K31545	---	---	---	205	30	415-585 L	60-85 L	20 L	A, N, N+T or Q+T	---
ASTM A336/A336M-10a	Grade F21, Class 1	K31545	---	---	---	205	30	415-585 L	60-85 L	20 L	A, N+T or Q+T	---
JIS G 3203:1988 A1:2008	Grade SFVA F 21 A	---	---	---	---	205	---	410-590	---	18 L	A or N+T	---
ASME SA-182/SA-182M	Grade F 21	K31545	---	---	---	310	45	515	75	20	A, N+T	156-207 HBW
ASME SA-336/SA-336M	Grade F21, Class 3	K31545	---	---	---	310	45	515-690 L	75-100 L	19 L	A, N, N+T or Q+T	---
ASTM A182/A182M-15	Grade F 21	K31545	---	---	---	310	45	515	75	20	A, N+T	156-207 HBW
ASTM A336/A336M-10a	Grade F21, Class 3	K31545	---	---	---	310	45	515-690 L	75-100 L	19 L	A, N+T or Q+T	---
JIS G 3203:1988 A1:2008	Grade SFVA F 21 B	---	---	---	---	315	---	520-690	---	18 L	A or N+T	---

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.6B Mechanical Properties of 3Cr-1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-182/SA-182M	Grade F 3V	K31830	---	---	---	415	60	585-760	85-110	18	A, N+T	174-237 HBW; L: 54 J @ -18°C
ASME SA-336/SA-336M	Grade F3V	K31830	---	---	---	415	60	585-760 L	85-110 L	18 L	A, N, N+T or Q+T	L: 54 J @ -18°C
ASME SA-508/SA-508M	Grade 3V	K31830	---	---	---	415	60	585-760	85-110	18	Q	54 J @ -18°C
ASME SA-541/SA-541M	Grade 3V	K31830	---	---	---	415	60	585-760	85-110	18	Q+T	54 J @ -18°C
ASTM A182/A182M-15	Grade F 3V	K31830	---	---	---	415	60	585-760	85-110	18	A, N+T	174-237 HBW; L: 54 J @ -18°C
ASTM A336/A336M-10a	Grade F3V	K31830	---	---	---	415	60	585-760 L	85-110 L	18 L	A, N+T or Q+T	L: 54 J @ -18°C
ASTM A508/A508M-14	Grade 3V	K31830	---	---	---	415	60	585-760	85-110	18	Q+T	54 J @ -18°C
ASTM A541/A541M-05 (2015)	Grade 3V	K31830	---	---	---	415	60	585-760	85-110	18	Q+T	54 J @ -18°C
JIS G 3206:1993 A1:2008	Symbol SFVCM F3V	---	---	---	---	415	---	580-760	---	16 L	N+T or Q+T	54 J @ -18°C

6.2.2.7A Chemical Composition of 5Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
ASME SA-336/SA-336M	Grade F5	K41545	---	0.15	0.30-0.60	0.50	0.025	0.025	4.0-6.0	0.50	0.45-0.65	---
ASTM A336/A336M-10a	Grade F5	K41545	---	0.15	0.30-0.60	0.50	0.025	0.025	4.0-6.0	0.50	0.45-0.65	---
ISO 9327-2:1999	Type X12CrMo5-1	---	---	0.08-0.15	0.30-0.60	0.50	0.035	0.030	4.00-6.00	---	0.45-0.65	---
JIS G 3203:1988 A1:2008	Grade SFVA F 5 A	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
ASME SA-182/SA-182M	Grade F 5	K41545	---	0.15	0.30-0.60	0.50	0.030	0.030	4.0-6.0	0.50	0.44-0.65	---
ASTM A182/A182M-15	Grade F 5	K41545	---	0.15	0.30-0.60	0.50	0.030	0.030	4.0-6.0	0.50	0.44-0.65	---
JIS G 3203:1988 A1:2008	Grade SFVA F 5 B	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
ASME SA-336/SA-336M	Grade F5A	K42544	---	0.25	0.60	0.50	0.025	0.025	4.0-6.0	0.50	0.45-0.65	---
ASTM A336/A336M-10a	Grade F5A	K42544	---	0.25	0.60	0.50	0.025	0.025	4.0-6.0	0.50	0.45-0.65	---
JIS G 3203:1988 A1:2008	Grade SFVA F 5 C	---	---	0.25	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
ASME SA-182/SA-182M	Grade F 5a	K42544	---	0.25	0.60	0.50	0.040	0.030	4.0-6.0	0.50	0.44-0.65	---
ASTM A182/A182M-15	Grade F 5a	K42544	---	0.25	0.60	0.50	0.040	0.030	4.0-6.0	0.50	0.44-0.65	---
EN 10222-2:1999	X16CrMo5-1	---	1.7366	0.18	0.30-0.80	0.40	0.025	0.015	4.00-6.00	0.30	0.45-0.65	V 0.02; Cu 0.30; Nb 0.01
JIS G 3203:1988 A1:2008	Grade SFVA F 5 D	---	---	0.25	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.7B Mechanical Properties of 5Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-336/SA-336M	Grade F5	K41545	---	---	---	250	36	415-585 L	60-85 L	20 L	A, N, N+T or Q+T	---
ASTM A336/A336M-10a	Grade F5	K41545	---	---	---	250	36	415-585 L	60-85 L	20 L	A, N+T or Q+T	---
ISO 9327-2:1999	Type X12CrMo5-1	---	---	t ≤ 150	---	175	---	430-580	---	20 L, 18 T	A	---
JIS G 3203:1988 A1:2008	Grade SFVA F 5 A	---	---	---	---	245	---	410-590	---	18 L	A or N+T	---
ASME SA-182/SA-182M	Grade F 5	K41545	---	---	---	275	40	485	70	20	A, N+T	143-217 HBW
ASTM A182/A182M-15	Grade F 5	K41545	---	---	---	275	40	485	70	20	A, N+T	143-217 HBW
JIS G 3203:1988 A1:2008	Grade SFVA F 5 B	---	---	---	---	275	---	480-660	---	18 L	A or N+T	---
ASME SA-336/SA-336M	Grade F5A	K42544	---	---	---	345	50	550-725 L	80-105 L	19 L	A, N, N+T or Q+T	---
ASTM A336/A336M-10a	Grade F5A	K42544	---	---	---	345	50	550-725 L	80-105 L	19 L	A, N+T or Q+T	---
JIS G 3203:1988 A1:2008	Grade SFVA F 5 C	---	---	---	---	345	---	550-730	---	18 L	A or N+T	---
ASME SA-182/SA-182M	Grade F 5a	K42544	---	---	---	450	65	620	90	22	A, N+T	187-248 HBW
ASTM A182/A182M-15	Grade F 5a	K42544	---	---	---	450	65	620	90	22	A, N+T	187-248 HBW
EN 10222-2:1999	X16CrMo5-1	---	1.7366	t ≤ 300	---	195	---	410-510	---	18 L, 16 T	A	see standard for impact data
				t ≤ 300	---	405	---	640-780	---	16 L, 14 T	N+T	see standard for impact data
JIS G 3203:1988 A1:2008	Grade SFVA F 5 D	---	---	---	---	450	---	620-780	---	18 L	A or N+T	---

6.2.2.8A Chemical Composition of 9Cr-1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-182/SA-182M	Grade F 9	K90941	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	8.0-10.0	---	0.90-1.10	---
ASME SA-336/SA-336M	Grade F9	K90941	---	0.15	0.30-0.60	0.50-1.00	0.025	0.025	8.0-10.0	---	0.90-1.10	---
ASTM A182/A182M-15	Grade F 9	K90941	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	8.0-10.0	---	0.90-1.10	---
ASTM A336/A336M-10a	Grade F9	K90941	---	0.15	0.30-0.60	0.50-1.00	0.025	0.025	8.0-10.0	---	0.90-1.10	---
EN 10222-2:1999	X10CrMoVNb9-1	---	1.4903	0.08-0.12	0.30-0.60	0.50	0.025	0.015	8.00-9.50	0.40	0.85-1.05	V 0.18-0.25; Al 0.040; Cu 0.30; Nb 0.06-0.10; N 0.030-0.070
JIS G 3203:1988 A1:2008	Grade SFVA F 9	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	8.00-10.0	---	0.90-1.10	---

6.2.2.8B Mechanical Properties of 9Cr-1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-182/SA-182M	Grade F 9	K90941	---	---	---	380	55	585	85	20	A, N+T	179-217 HBW
ASME SA-336/SA-336M	Grade F9	K90941	---	---	---	380	55	585-760 L	85-110 L	20 L	A, N, N+T or Q+T	---
ASTM A182/A182M-15	Grade F 9	K90941	---	---	---	380	55	585	85	20	A, N+T	179-217 HBW
ASTM A336/A336M-10a	Grade F9	K90941	---	---	---	380	55	585-760 L	85-110 L	20 L	A, N+T or Q+T	---
EN 10222-2:1999	X10CrMoVNb9-1	---	1.4903	t ≤ 130	---	435	---	630-730	---	19 L, 17 T	N+T	see standard for impact data
JIS G 3203:1988 A1:2008	Grade SFVA F 9	---	---	---	---	380	---	590-760	---	18 L	A or N+T	---

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.9A Chemical Composition of 11Cr-½Ni-1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10222-2:1999	X20CrMoV11-1	---	1.4922	0.17-0.23	0.30-1.00	0.40	0.025	0.015	10.00-12.50	0.30-0.80	0.80-1.20	V 0.20-0.35; Cu 0.30; Nb 0.01
ISO 9327-2:1999	Type X20CrMoV12-1	---	---	0.17-0.23	0.30-1.00	0.40	0.035	0.030	10.00-12.50	0.30-1.00	0.80-1.20	V 0.20-0.35; Al 0.025

6.2.2.9B Mechanical Properties of 11Cr-½Ni-1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
EN 10222-2:1999	X20CrMoV11-1	---	1.4922	t ≤ 100	---	485	---	700-850	---	16 L, 14 T	Q+T	see standard for impact data
				100 < t ≤ 250	---	485	---	700-850	---	16 L, 14 T	Q+T	
				250 < t ≤ 330	---	485	---	700-850	---	16 L, 14 T	Q+T	
ISO 9327-2:1999	Type X20CrMoV12-1	---	---	t ≤ 100	---	500	---	700-850	---	16 L, 14 T	N+T or Q+T	see standard for impact data
				100 < t ≤ 200	---	500	---	700-850	---	16 L, 14 T	N+T or Q+T	
				200 < t ≤ 300	---	600	---	700-850	---	14 L, 14 T	N+T or Q+T	

6.2.2.10A Chemical Composition of Ni Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10222-3:1998	15NiMn6	---	1.6228	0.18	0.80-1.50	0.35	0.025	0.015	0.30	1.30-1.70	0.08	V 0.05; Cu 0.30; (Cr+Cu+Mo) 0.50
ISO 9327-3:1999	Type 15NiMn6	---	---	0.18	0.80-1.50	0.35	0.025	0.020	---	1.30-1.70	---	V 0.05
ASME SA-350/SA-350M	Grade LF3, Class 1	K32025	---	0.20	0.90	0.20-0.35	0.035	0.040	0.30	3.3-3.7	0.12	V 0.03; Cu 0.40; Cb 0.02; (Cr+Mo) 0.32
	Grade LF3, Class 2	K32025	---	0.20	0.90	0.20-0.35	0.035	0.040	0.30	3.3-3.7	0.12	V 0.03; Cu 0.40; Cb 0.02; (Cr+Mo) 0.32
ASTM A350/A350M-15	Grade LF3, Class 1	K32025	---	0.20	0.90	0.20-0.35	0.035	0.040	0.30	3.3-3.7	0.12	V 0.03; Cu 0.40; Cb 0.02; (Cr+Mo) 0.32
	Grade LF3, Class 2	K32025	---	0.20	0.90	0.20-0.35	0.035	0.040	0.30	3.3-3.7	0.12	V 0.03; Cu 0.40; Cb 0.02; (Cr+Mo) 0.32
EN 10222-3:1998	12Ni14	---	1.5637	0.15	0.30-0.80	0.35	0.020	0.010	0.30	3.25-3.75	0.08	V 0.05; Cu 0.30; (Cr+Cu+Mo) 0.50
ISO 9327-3:1999	Type 12Ni14G1	---	---	0.15	0.30-0.80	0.35	0.025	0.020	---	3.25-3.75	---	V 0.05
	Type 12Ni14G2	---	---	0.15	0.30-0.80	0.35	0.025	0.020	---	3.25-3.75	---	V 0.05
JIS G 3205:1988 A1:2008	Symbol SFL 3	---	---	0.20	0.90	0.35	0.030	0.030	---	3.25-3.75	---	---
EN 10222-3:1998	X12Ni5	---	1.5680	0.15	0.30-0.80	0.35	0.020	0.010	0.30	4.75-5.25	0.08	V 0.05; Cu 0.30; (Cr+Cu+Mo) 0.50
ISO 9327-3:1999	Type 12Ni19	---	---	0.15	0.30-0.80	0.35	0.025	0.020	---	4.50-5.30	---	V 0.05
EN 10222-3:1998	X8Ni9	---	1.5662	0.10	0.30-0.80	0.35	0.020	0.010	0.30	8.50-10.00	0.10	V 0.05; Cu 0.30; (Cr+Cu+Mo) 0.50
ISO 9327-3:1999	Type X8Ni9	---	---	0.10	0.30-0.80	0.35	0.025	0.020	---	8.00-10.00	0.10	V 0.05

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.10B Mechanical Properties of Ni Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
EN 10222-3:1998	15NiMn6	---	1.6228	$t \leq 35$	---	355	---	470-640	---	20 L, 20 T	N, N+T or Q+T	see standard for impact data
				$35 < t \leq 50$	---	345	---	470-640	---	20 L, 20 T	N, N+T or Q+T	
ISO 9327-3:1999	Type 15NiMn6	---	---	$t \leq 30$	---	355	---	490-640	---	22 L, 22 T	N, N+T or Q+T	
				$30 < t \leq 50$	---	345	---	490-640	---	22 L, 22 T	N, N+T or Q+T	
ASME SA-350/SA-350M	Grade LF3, Class 1	K32025	---	---	---	260	37.5	485-655	70-95	22	N, N+T or Q+T	see standard for impact data
	Grade LF3, Class 2	K32025	---	---	---	260	37.5	485-655	70-95	22	N, N+T or Q+T	see standard for impact data
ASTM A350/A350M-15	Grade LF3, Class 1	K32025	---	---	---	260	37.5	485-655	70-95	22	N, N+T or Q+T	see standard for impact data
	Grade LF3, Class 2	K32025	---	---	---	260	37.5	485-655	70-95	22	N, N+T or Q+T	see standard for impact data
EN 10222-3:1998	12Ni14	---	1.5637	$t \leq 35$	---	355	---	470-640	---	20 L, 20 T	N, N+T or Q+T	see standard for impact data
				$35 < t \leq 50$	---	345	---	470-640	---	20 L, 20 T	N, N+T or Q+T	
				$50 < t \leq 70$	---	335	---	470-640	---	20 L, 20 T	N, N+T or Q+T	
ISO 9327-3:1999	Type 12Ni14G1	---	---	$t \leq 30$	---	285	---	450-600	---	23 L, 23 T	N, N+T or Q+T	see standard for impact data
				$30 < t \leq 50$	---	275	---	450-600	---	23 L, 23 T	N, N+T or Q+T	
	Type 12Ni14G2	---	---	$t \leq 30$	---	355	---	470-620	---	22 L, 22 T	N, N+T or Q+T	see standard for impact data
				$30 < t \leq 50$	---	345	---	470-620	---	22 L, 22 T	N, N+T or Q+T	
JIS G 3205:1988 A1:2008	Symbol SFL 3	---	---	---	---	255	---	490-640	---	19 L	A, N+T or Q+T	27 J @ -101°C
EN 10222-3:1998	X12Ni5	---	1.5680	$t \leq 35$	---	390	---	510-710	---	19 L, 19 T	N, N+T or Q+T	see standard for impact data
				$35 < t \leq 50$	---	380	---	510-710	---	19 L, 19 T	N, N+T or Q+T	
ISO 9327-3:1999	Type 12Ni19	---	---	$t \leq 30$	---	390	---	510-710	---	19 L, 19 T	N, N+T or Q+T	see standard for impact data
				$30 < t \leq 50$	---	380	---	510-710	---	19 L, 19 T	N, N+T or Q+T	
EN 10222-3:1998	X8Ni9	---	1.5662	$t \leq 35$	---	490	---	640-840	---	18 L, 18 T	NN+T or Q+T	see standard for impact data
				$35 < t \leq 50$	---	480	---	640-840	---	18 L, 18 T	NN+T or Q+T	
				$50 < t \leq 70$	---	470	---	640-840	---	18 L, 18 T	NN+T or Q+T	
ISO 9327-3:1999	Type X8Ni9	---	---	$t \leq 30$	---	490	---	640-840	---	18 L, 18 T	NN+T or Q+T	see standard for impact data
				$30 < t \leq 50$	---	480	---	640-840	---	18 L, 18 T	NN+T or Q+T	

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.11A Chemical Composition of Ni-Mn Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
EN 10222-3:1998	13MnNi6-3	---	1.6217	0.16	0.85-1.70	0.50	0.025	0.015	0.30	0.30-0.85	0.08	V 0.05; Al 0.020 min.; Cu 0.30; Nb 0.05; (Cr+Cu+Mo) 0.50
ISO 9327-3:1999	Type 11MnNi5-3	---	---	0.14	0.70-1.50	0.50	0.025	0.020	---	0.30-0.80	---	V 0.05; Al 0.020 min.; Nb 0.05
	Type 13MnNi6-3	---	---	0.16	0.65-1.65	0.50	0.025	0.020	---	0.30-0.85	---	V 0.05; Al 0.020 min.; Nb 0.05
EN 10222-4:1998 A1:2001	P420NH	---	1.8932	0.20	1.00-1.70	0.10-0.60	0.025	0.015	0.30	1.00	0.10	V 0.20; Al 0.020-0.060; Cu 0.20; Nb 0.05; N 0.020; (Nb+V) 0.22
	P420QH	---	1.8936	0.20	1.00-1.70	0.10-0.60	0.025	0.015	0.30	1.00	0.10	V 0.20; Al 0.020-0.060; Cu 0.20; Nb 0.05; N 0.020; (Nb+V) 0.22
ISO 9327-4:1999	Type P 42	---	---	0.20	1.00-1.70	0.10-0.60	0.035	0.030	0.30	1.00	0.10	V 0.20; Al 0.020 min.; Cu 0.30; Ti 0.20; Nb 0.05; N 0.020; (Nb+Ti+V) 0.22
	Type PH 42	---	---	0.20	1.00-1.70	0.10-0.60	0.035	0.030	0.30	1.00	0.10	V 0.20; Al 0.020 min.; Cu 0.30; Ti 0.20; Nb 0.05; N 0.020; (Nb+Ti+V) 0.22
	Type PL 42	---	---	0.20	1.00-1.70	0.10-0.60	0.025	0.020	0.30	1.00	0.10	V 0.20; Al 0.020 min.; Cu 0.30; Ti 0.20; Nb 0.05; N 0.020; (Nb+Ti+V) 0.22
	Type PLH 42	---	---	0.20	1.00-1.70	0.10-0.60	0.025	0.020	0.30	1.00	0.10	V 0.20; Al 0.020 min.; Cu 0.30; Ti 0.20; Nb 0.05; N 0.020; (Nb+Ti+V) 0.22

6.2.2.11B Mechanical Properties of Ni-Mn Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
EN 10222-3:1998	13MnNi6-3	---	1.6217	t ≤ 35	---	285	---	420-610	---	22 L, 22 T	N+T	see standard for impact data
				35 < t ≤ 50	---	275	---	420-610	---	22 L, 22 T	N+T	
				50 < t ≤ 70	---	265	---	420-610	---	22 L, 22 T	N+T	
ISO 9327-3:1999	Type 11MnNi5-3	---	---	t ≤ 30	---	285	---	420-530	---	24 L, 24 T	N+T	see standard for impact data
				30 < t ≤ 50	---	275	---	420-530	---	24 L, 24 T	N+T	
	Type 13MnNi6-3	---	---	t ≤ 30	---	355	---	490-610	---	22 L, 22 T	N+T	see standard for impact data
				30 < t ≤ 50	---	345	---	490-610	---	22 L, 22 T	N+T	

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.11B Mechanical Properties of Ni-Mn Alloy Steel Forgings for Piping, Pressure Vessel and Components (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
EN 10222-4:1998 A1:2001	P420NH	---	1.8932	$t \leq 16$	---	405	---	530-680	---	20 L, 19 T	N	see standard for impact data
				$16 < t \leq 35$	---	395	---	530-680	---	20 L, 19 T	N	
				$35 < t \leq 70$	---	370	---	530-680	---	20 L, 19 T	N	
				$70 < t \leq 100$	---	350	---	530-680	---	20 L, 19 T	N	
				$100 < t \leq 250$	---	330	---	530-680	---	20 L, 19 T	N	
				$250 < t \leq 400$	---	315	---	530-680	---	20 L, 19 T	N	
	P420QH	---	1.8936	$t \leq 16$	---	405	---	510-670	---	18 L, 17 T	Q+T	see standard for impact data
				$16 < t \leq 35$	---	395	---	510-670	---	18 L, 17 T	Q+T	
				$35 < t \leq 70$	---	370	---	510-670	---	18 L, 17 T	Q+T	
				$70 < t \leq 100$	---	350	---	510-670	---	18 L, 17 T	Q+T	
				$100 < t \leq 250$	---	330	---	510-670	---	18 L, 17 T	Q+T	
				$250 < t \leq 400$	---	315	---	510-670	---	18 L, 17 T	Q+T	
ISO 9327-4:1999	Type P 42	---	---	$t \leq 16$	---	420	---	540-880	---	21 L, 19 T	N or Q+T	see standard for impact data
				$16 < t \leq 35$	---	410	---	540-880	---	21 L, 19 T	N or Q+T	
				$35 < t \leq 50$	---	400	---	540-880	---	21 L, 19 T	N or Q+T	
				$50 < t \leq 70$	---	380	---	540-880	---	21 L, 19 T	N or Q+T	
				$70 < t \leq 100$	---	365	---	510-870	---	20 L, 18 T	N or Q+T	
				$100 < t \leq 250$	---	345	---	510-870	---	19 L, 17 T	N or Q+T	
	Type PH 42	---	---	$t \leq 16$	---	420	---	540-880	---	21 L, 19 T	N or Q+T	see standard for impact data
				$16 < t \leq 35$	---	410	---	540-880	---	21 L, 19 T	N or Q+T	
				$35 < t \leq 50$	---	400	---	540-880	---	21 L, 19 T	N or Q+T	
				$50 < t \leq 70$	---	380	---	540-880	---	21 L, 19 T	N or Q+T	
				$70 < t \leq 100$	---	365	---	510-870	---	20 L, 18 T	N or Q+T	
				$100 < t \leq 250$	---	345	---	510-870	---	19 L, 17 T	N or Q+T	
	Type PL 42	---	---	$t \leq 16$	---	420	---	540-880	---	21 L, 19 T	N or Q+T	see standard for impact data
				$16 < t \leq 35$	---	410	---	540-880	---	21 L, 19 T	N or Q+T	
				$35 < t \leq 50$	---	400	---	540-880	---	21 L, 19 T	N or Q+T	
				$50 < t \leq 70$	---	380	---	540-880	---	21 L, 19 T	N or Q+T	
				$70 < t \leq 100$	---	365	---	510-870	---	20 L, 18 T	N or Q+T	
				$100 < t \leq 250$	---	345	---	510-870	---	19 L, 17 T	N or Q+T	
	Type PLH 42	---	---	$t \leq 16$	---	420	---	540-880	---	21 L, 19 T	N or Q+T	see standard for impact data
				$16 < t \leq 35$	---	410	---	540-880	---	21 L, 19 T	N or Q+T	
				$35 < t \leq 50$	---	400	---	540-880	---	21 L, 19 T	N or Q+T	
				$50 < t \leq 70$	---	380	---	540-880	---	21 L, 19 T	N or Q+T	
				$70 < t \leq 100$	---	365	---	510-870	---	20 L, 18 T	N or Q+T	
				$100 < t \leq 250$	---	345	---	510-870	---	19 L, 17 T	N or Q+T	

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.12A Chemical Composition of $\frac{1}{4}\text{Ni}-\frac{1}{2}\text{Cr}-\text{Mo}$ Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-508/SA-508M	Grade 2, Class 1	K12766	---	0.27	0.50-1.00	0.40	0.025	0.025	0.25-0.45	0.50-1.00	0.55-0.75	V 0.05; Cu 0.20; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025
ASME SA-541/SA-541M	Grade 2, Class 1	K12765	---	0.27	0.50-0.90	0.35	0.025	0.025	0.25-0.45	0.50-1.00	0.55-0.70	V 0.05
ASTM A508/A508M-14	Grade 2, Class 1	K12766	---	0.27	0.50-1.00	0.40	0.025	0.025	0.25-0.45	0.50-1.00	0.55-0.75	V 0.05; Cu 0.20; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025
ASTM A541/A541M-05 (2015)	Grade 2, Class 1	K12765	---	0.27	0.50-0.90	0.35	0.025	0.025	0.25-0.45	0.50-1.00	0.55-0.70	V 0.05
JIS G 3204:1988 A1:2008	Grade SFVQ 2 A	---	---	0.27	0.50-1.00	0.40	0.030	0.030	0.25-0.45	0.50-1.00	0.55-0.70	V 0.05
ASME SA-508/SA-508M	Grade 2, Class 2	K12766	---	0.27	0.50-1.00	0.40	0.025	0.025	0.25-0.45	0.50-1.00	0.55-0.75	V 0.05; Cu 0.20; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025
ASME SA-541/SA-541M	Grade 2, Class 2	K12765	---	0.27	0.50-0.90	0.35	0.025	0.025	0.25-0.45	0.50-1.00	0.55-0.70	V 0.05
ASTM A508/A508M-14	Grade 2, Class 2	K12766	---	0.27	0.50-1.00	0.40	0.025	0.025	0.25-0.45	0.50-1.00	0.55-0.75	V 0.05; Cu 0.20; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025
ASTM A541/A541M-05 (2015)	Grade 2, Class 2	K12765	---	0.27	0.50-0.90	0.35	0.025	0.025	0.25-0.45	0.50-1.00	0.55-0.70	V 0.05
JIS G 3204:1988 A1:2008	Grade SFVQ 2 B	---	---	0.27	0.50-1.00	0.40	0.030	0.030	0.25-0.45	0.50-1.00	0.55-0.70	V 0.05

6.2.2.12B Mechanical Properties of $\frac{1}{4}\text{Ni}-\frac{1}{2}\text{Cr}-\text{Mo}$ Alloy Steels Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-508/SA-508M	Grade 2, Class 1	K12766	---	---	---	345	50	550-725	80-105	18	Q	41 J @ 4.4°C
ASME SA-541/SA-541M	Grade 2, Class 1	K12765	---	---	---	345	50	550-725	80-105	18	Q+T	41 J @ 4.4°C
ASTM A508/A508M-14	Grade 2, Class 1	K12766	---	---	---	345	50	550-725	80-105	18	Q+T	41 J @ 4.4°C
ASTM A541/A541M-05 (2015)	Grade 2, Class 1	K12765	---	---	---	345	50	550-725	80-105	18	Q+T	41 J @ 4.4°C
JIS G 3204:1988 A1:2008	Grade SFVQ 2 A	---	---	---	---	345	---	550-730	---	16 L	Q+T	40 J @ 0°C
ASME SA-508/SA-508M	Grade 2, Class 2	K12766	---	---	---	450	65	620-795	90-115	16	Q	48 J @ 21°C
ASME SA-541/SA-541M	Grade 2, Class 2	K12765	---	---	---	450	65	620-795	90-115	16	Q+T	47 J @ 21°C
ASTM A508/A508M-14	Grade 2, Class 2	K12766	---	---	---	450	65	620-795	90-115	16	Q+T	48 J @ 21°C
ASTM A541/A541M-05 (2015)	Grade 2, Class 2	K12765	---	---	---	450	65	620-795	90-115	16	Q+T	47 J @ 21°C
JIS G 3204:1988 A1:2008	Grade SFVQ 2 B	---	---	---	---	450	---	620-790	---	14 L	Q+T	47 J @ 20°C

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.13A Chemical Composition of $\frac{3}{4}\text{Ni}-\frac{1}{2}\text{Mo}$ Alloy Steel Forgings for Piping, Pressure Vessel and Components (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-508/SA-508M	Grade 3, Class 1	K12042	---	0.25	1.20-1.50	0.40	0.025	0.025	0.25	0.40-1.00	0.45-0.60	V 0.05; Cu 0.20; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025
ASME SA-541/SA-541M	Grade 3, Class 1	K12045	---	0.25	1.20-1.50	0.35	0.025	0.025	0.25	0.40-1.00	0.45-0.60	V 0.05
ASTM A508/A508M-14	Grade 3, Class 1	K12042	---	0.25	1.20-1.50	0.40	0.025	0.025	0.25	0.40-1.00	0.45-0.60	V 0.05; Cu 0.20; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025
ASTM A541/A541M-05 (2015)	Grade 3, Class 1	K12045	---	0.25	1.20-1.50	0.35	0.025	0.025	0.25	0.40-1.00	0.45-0.60	V 0.05
JIS G 3204:1988 A1:2008	Grade SFVQ 1 A	---	---	0.25	1.20-1.50	0.40	0.030	0.030	0.25	0.40-1.00	0.45-0.60	V 0.05
ASME SA-508/SA-508M	Grade 3, Class 2	K12042	---	0.25	1.20-1.50	0.40	0.025	0.025	0.25	0.40-1.00	0.45-0.60	V 0.05; Cu 0.20; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025
ASME SA-541/SA-541M	Grade 3, Class 2	K12045	---	0.25	1.20-1.50	0.35	0.025	0.025	0.25	0.40-1.00	0.45-0.60	V 0.05
ASTM A508/A508M-14	Grade 3, Class 2	K12042	---	0.25	1.20-1.50	0.40	0.025	0.025	0.25	0.40-1.00	0.45-0.60	V 0.05; Cu 0.20; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025
ASTM A541/A541M-05 (2015)	Grade 3, Class 2	K12045	---	0.25	1.20-1.50	0.35	0.025	0.025	0.25	0.40-1.00	0.45-0.60	V 0.05
JIS G 3204:1988 A1:2008	Grade SFVQ 1 B	---	---	0.25	1.20-1.50	0.40	0.030	0.030	0.25	0.40-1.00	0.45-0.60	V 0.05

6.2.2.13B Mechanical Properties of $\frac{3}{4}\text{Ni}-\frac{1}{2}\text{Mo}$ Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-508/SA-508M	Grade 3, Class 1	K12042	---	---	---	345	50	550-725	80-105	18	Q	41 J @ 4.4°C
ASME SA-541/SA-541M	Grade 3, Class 1	K12045	---	---	---	345	50	550-725	80-105	18	Q+T	41 J @ 4°C
ASTM A508/A508M-14	Grade 3, Class 1	K12042	---	---	---	345	50	550-725	80-105	18	Q+T	41 J @ 4.4°C
ASTM A541/A541M-05 (2015)	Grade 3, Class 1	K12045	---	---	---	345	50	550-725	80-105	18	Q+T	41 J @ 4°C
JIS G 3204:1988 A1:2008	Grade SFVQ 1 A	---	---	---	---	345	---	550-730	---	16 L	Q+T	40 J @ 0°C
ASME SA-508/SA-508M	Grade 3, Class 2	K12042	---	---	---	450	65	620-795	90-115	16	Q	48 J @ 21°C
ASME SA-541/SA-541M	Grade 3, Class 2	K12045	---	---	---	450	65	620-795	90-115	16	Q+T	47 J @ 21°C
ASTM A508/A508M-14	Grade 3, Class 2	K12042	---	---	---	450	65	620-795	90-115	16	Q+T	48 J @ 21°C
ASTM A541/A541M-05 (2015)	Grade 3, Class 2	K12045	---	---	---	450	65	620-795	90-115	16	Q+T	47 J @ 21°C
JIS G 3204:1988 A1:2008	Grade SFVQ 1 B	---	---	---	---	450	---	620-790	---	14 L	Q+T	47 J @ 20°C

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.14A Chemical Composition of 3¼Ni-1¼Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-508/SA-508M	Grade 4N, Class 3	K42343	---	0.23	0.20-0.40	0.40	0.020	0.020	1.50-2.00	2.8-3.9	0.40-0.60	V 0.03; Cu 0.25; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025
ASME SA-541/SA-541M	Grade 4N, Class 3	K42343	---	0.23	0.20-0.40	0.30	0.025	0.025	1.25-2.00	2.8-3.9	0.40-0.60	V 0.03
ASTM A508/A508M-14	Grade 4N, Class 3	K42343	---	0.23	0.20-0.40	0.40	0.020	0.020	1.50-2.00	2.8-3.9	0.40-0.60	V 0.03; Cu 0.25; Cb 0.01; Ca 0.015; B 0.003; Ti 0.015; Al 0.025
ASTM A541/A541M-05 (2015)	Grade 4N, Class 3	K42343	---	0.23	0.20-0.40	0.30	0.025	0.025	1.25-2.00	2.8-3.9	0.40-0.60	V 0.03
JIS G 3204:1988 A1:2008	Grade SFVQ 3	---	---	0.23	0.20-0.40	0.40	0.020	0.020	1.50-2.00	2.75-3.90	0.40-0.60	V 0.03

6.2.2.14B Mechanical Properties of 3¼Ni-1¼Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-508/SA-508M	Grade 4N, Class 3	K42343	---	---	---	485	70	620-795	90-115	20	Q	48 J @ -29°C
ASME SA-541/SA-541M	Grade 4N, Class 3	K42343	---	---	---	485	70	620-795	90-115	20	Q+T	47 J @ 4°C
ASTM A508/A508M-14	Grade 4N, Class 3	K42343	---	---	---	485	70	620-795	90-115	20	Q+T	48 J @ -29°C
ASTM A541/A541M-05 (2015)	Grade 4N, Class 3	K42343	---	---	---	485	70	620-795	90-115	20	Q+T	47 J @ 4°C
JIS G 3204:1988 A1:2008	Grade SFVQ 3	---	---	---	---	490	---	620-790	---	18 L	Q+T	47 J @ -30°C

6.3 Stainless Steel Forgings

6.3.1A Chemical Composition of Martensitic Stainless Steel Forgings

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-182/SA-182M	Grade F 6a, Class 1	S41000	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.50	---	---
	Grade F 6a, Class 2	S41000	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.50	---	---
	Grade F 6a, Class 3	S41000	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.50	---	---
	Grade F 6a, Class 4	S41000	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.50	---	---
ASTM A1021-05 (2015)	Grade A, Class 1	S41000	---	0.15	1.00	1.00	0.018	0.015	11.5-13.5	0.75	0.50	---
	Grade A, Class 2	S41000	---	0.15	1.00	1.00	0.018	0.015	11.5-13.5	0.75	0.50	---
	Grade B, Class 1	S41005	---	0.10-0.15	0.25-0.80	0.50	0.018	0.015	11.5-13.0	0.75	0.50	Al 0.025; Cu 0.50; Ti 0.05; W 0.10; Cb 0.20; N 0.08; Sn 0.05
ASTM A182/A182M-15	Grade F 6a, Class 1	S41000	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.50	---	---
	Grade F 6a, Class 2	S41000	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.50	---	---
	Grade F 6a, Class 3	S41000	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.50	---	---
	Grade F 6a, Class 4	S41000	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.50	---	---
ASTM A473-15	Type 410	S41000	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.75	---	---
EN 10250-4:1999	X12Cr13	---	1.4006	0.08-0.15	1.50	1.00	0.040	0.030	11.50-13.50	0.75	---	---
JIS G 3214:1991 A1:2009	Symbol SUS F 410-A	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.50	---	---
	Symbol SUS F 410-B	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.50	---	---
	Symbol SUS F 410-C	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.50	---	---
	Symbol SUS F 410-D	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.50	---	---
ASME SA-182/SA-182M	Grade F 6b	S41026	---	0.15	1.00	1.00	0.020	0.020	11.5-13.5	1.00-2.00	0.40-0.60	Cu 0.50
ASTM A182/A182M-15	Grade F 6b	S41026	---	0.15	1.00	1.00	0.020	0.020	11.5-13.5	1.00-2.00	0.40-0.60	Cu 0.50
JIS G 3214:1991 A1:2009	Symbol SUS F 6B	---	---	0.15	1.00	1.00	0.020	0.020	11.50-13.50	1.00-2.00	0.40-0.60	Cu 0.50
ASME SA-182/SA-182M	Grade F 6NM	S41500	---	0.05	0.50-1.00	0.60	0.030	0.030	11.5-14.0	3.5-5.5	0.50-1.00	---
ASTM A182/A182M-15	Grade F 6NM	S41500	---	0.05	0.50-1.00	0.60	0.030	0.030	11.5-14.0	3.5-5.5	0.50-1.00	---
ASTM A473-15	---	S41500	---	0.05	0.5-1.0	0.60	0.030	0.030	11.5-14.0	3.5-5.5	0.40-0.80	---
EN 10222-5:1999	X3 CrNiMo 13-4	---	1.4313	0.05	1.50	0.70	0.040	0.015	12.00-14.00	3.50-4.50	0.30-0.70	N 0.020 min.
EN 10250-4:1999	X3CrNiMo13-4	---	1.4313	0.05	1.50	0.70	0.040	0.015	12.00-14.00	3.50-4.50	0.30-0.70	N 0.020 min.
JIS G 3214:1991 A1:2009	Symbol SUS F 6NM	---	---	0.05	0.50-1.00	0.60	0.030	0.030	11.50-14.00	3.50-5.50	0.50-1.00	---

6.3 Stainless Steel Forgings

6.3.1B Mechanical Properties of Martensitic Stainless Steel Forgings

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-182/SA-182M	Grade F 6a, Class 1	S41000	---	---	---	275	40	485	70	18	A, N+T or T	143-207 HBW
	Grade F 6a, Class 2	S41000	---	---	---	380	55	585	85	18	A, N+T or T	167-229 HBW
	Grade F 6a, Class 3	S41000	---	---	---	585	85	760	110	15	A or N+T	235-302 HBW
	Grade F 6a, Class 4	S41000	---	---	---	760	110	895	130	12	A or N+T	263-321 HBW
ASTM A1021-05 (2015)	Grade A, Class 1	---	---	---	---	485	70	690	100	20	HT+Q+T	255 max HB; 26 max HRC; 41 J @ RT
	Grade A, Class 2	---	---	---	---	550	80	760	110	18	HT+Q+T	269 max HB; 28 max HRC; 34 J @ RT
	Grade B, Class 1	S41005	---	---	---	620	90	760	110	18	HT+Q+T	269 max HB; 28 max HRC; 41 J @ RT
ASTM A182/A182M-15	Grade F 6a, Class 1	S41000	---	---	---	275	40	485	70	18	A, N+T or T	143-207 HBW
	Grade F 6a, Class 2	S41000	---	---	---	380	55	585	85	18	A, N+T or T	167-229 HBW
	Grade F 6a, Class 3	S41000	---	---	---	585	85	760	110	15	A or N+T	235-302 HBW
	Grade F 6a, Class 4	S41000	---	---	---	760	110	895	130	12	A or N+T	263-321 HBW
ASTM A473-15	Type 410	S41000	---	---	---	275	40	485	70	20	A	223 max HB
EN 10250-4:1999	X12Cr13	---	1.4006	---	---	---	---	730 max	---	---	A	220 max HB
				t ≤ 160	---	450	---	650-850	---	15 L	Q+T	L: 25 J @ RT
JIS G 3214:1991 A1:2009	Symbol SUS F 410-A	---	---	---	---	275	---	480	---	16 L	Q+T	143-187 HBW
	Symbol SUS F 410-B	---	---	---	---	380	---	590	---	16 L	Q+T	167-229 HBW
	Symbol SUS F 410-C	---	---	---	---	585	---	760	---	14 L	Q+T	217-302 HBW
	Symbol SUS F 410-D	---	---	---	---	760	---	900	---	11 L	Q+T	262-321 HBW
ASME SA-182/SA-182M	Grade F 6b	S41026	---	---	---	620	90	760-930	110-135	16	N+T or A	235-285 HBW
ASTM A182/A182M-15	Grade F 6b	S41026	---	---	---	620	90	760-930	110-135	16	N+T or A	235-285 HBW
JIS G 3214:1991 A1:2009	Symbol SUS F 6B	---	---	---	---	620	---	760-930	---	15 L	Q+T	217-285 HBW
ASME SA-182/SA-182M	Grade F 6NM	S41500	---	---	---	620	90	790	115	15	N+T	295 max HBW
ASTM A182/A182M-15	Grade F 6NM	S41500	---	---	---	620	90	790	115	15	N+T	295 max HBW
ASTM A473-15	---	S41500	---	---	---	620	90	795	115	15	N+T	295 max HB
EN 10222-5:1999	X3 CrNiMo13-4	---	1.4313	t ≤ 250	---	650	---	780-930	---	17 L, 15 T	Q+T	see standard for impact data
				t ≤ 350	---	550	---	750-900	---	17 L, 16 T	QT+T	
EN 10250-4:1999	X3CrNiMo13-4	---	1.4313	---	---	---	---	1100 max.	---	---	A	320 max HB
				t ≤ 450	---	520	---	650-830	---	15 L, 12 T	Q+T	see standard for impact data
				t ≤ 450	---	620	---	780-980	---	15 L, 12 T	Q+T	
				t ≤ 450	---	800	---	900-1100	---	12 L, 10 T	Q+T	
JIS G 3214:1991 A1:2009	Symbol SUS F 6NM	---	---	---	---	620	---	790	---	14 L	Q+T	295 max HBW

6.3 Stainless Steel Forgings

6.3.2A Chemical Composition of Ferritic Stainless Steel Forgings

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-182/SA-182M	Grade F 430	S43000	---	0.12	1.00	0.75	0.040	0.030	16.0-18.0	0.50	---	---
ASTM A182/A182M-15	Grade F 430	S43000	---	0.12	1.00	0.75	0.040	0.030	16.0-18.0	0.50	---	---
ASTM A473-15	Type 430	S43000	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	0.75	---	---
EN 10250-4:1999	X6Cr17	---	1.4016	0.08	1.00	1.00	0.040	0.030	16.00-18.00	---	---	---

6.3.2B Mechanical Properties of Ferritic Stainless Steel Forgings

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-182/SA-182M	Grade F 430	S43000	---	---	---	240	35	415	60	20	A	190 max HBW
ASTM A182/A182M-15	Grade F 430	S43000	---	---	---	240	35	415	60	20	A	190 max HBW
ASTM A473-15	Type 430	S43000	---	---	---	240	35	485	70	20	A	217 max HB
EN 10250-4:1999	X6Cr17	---	1.4016	t ≤ 100	---	240	---	400-630	---	---	A	200 max HB

6.3 Stainless Steel Forgings

6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-182/SA-182M	Grade F 304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10
ASME SA-403/SA-403M	Grade WP 304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
	Grade CR 304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A182/A182M-15	Grade F 304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10
ASTM A403/A403M-15	Grade WP304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
	Grade CR304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A473-15	Type 304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10
ASTM A965/A965M-14	Grade F304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
EN 10222-5:1999	X5 CrNi 18-10	---	1.4301	0.07	2.00	1.00	0.045	0.015	17.00-19.50	8.00-10.50	---	N 0.11
EN 10250-4:1999	X5CrNi18-10	---	1.4301	0.07	2.00	1.00	0.045	0.030	17.00-19.50	8.00-10.50	---	N 0.11
ISO 9327-5:1999	Type X5CrNi18-9	---	---	0.07	2.00	1.00	0.045	0.030	17.00-19.00	8.00-11.00	---	---
JIS G 3214:1991 A1:2009	Symbol SUS F 304	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	8.00-11.00	---	---
ASME SA-182/SA-182M	Grade F 316N	S31651	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	N 0.10-0.16
ASTM A182/A182M-15	Grade F 316N	S31651	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	N 0.10-0.16
ASTM A965/A965M-14	Grade F316N	S31651	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-13.0	2.00-3.00	N 0.10-0.16
JIS G 3214:1991 A1:2009	Symbol SUS F 316N	---	---	0.08	2.00	0.75	0.040	0.030	16.00-18.00	11.00-14.00	2.00-3.00	N 0.10-0.16
ASME SA-182/SA-182M	Grade F 304L	S30403	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-13.0	---	N 0.10
ASME SA-403/SA-403M	Grade WP 304L	S30403	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
	Grade CR 304L	S30403	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
ASTM A182/A182M-15	Grade F 304L	S30403	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-13.0	---	N 0.10
ASTM A403/A403M-15	Grade WP403L	S30403	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
	Grade CR403L	S30403	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
ASTM A473-15	Type 304L	S30403	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10
ASTM A965/A965M-14	Grade F304L	S30403	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
EN 10222-5:1999	X2 CrNi 18-9	---	1.4307	0.030	2.00	1.00	0.045	0.015	17.50-19.50	8.00-10.00	---	N 0.11
EN 10250-4:1999	X2CrNi19-11	---	1.4306	0.030	2.00	1.00	0.045	0.030	18.00-20.00	10.00-12.00	---	N 0.11
	X2CrNi18-9	---	1.4307	0.030	2.00	1.00	0.045	0.030	17.50-19.50	8.00-10.00	---	N 0.11
ISO 9327-5:1999	Type X2CrNi18-10	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	---
JIS G 3214:1991 A1:2009	Symbol SUS F 304L	---	---	0.030	2.00	1.00	0.040	0.030	18.00-20.00	9.00-13.00	---	---
ASME SA-182/SA-182M	Grade F 304H	S30409	---	0.04-0.10	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A182/A182M-15	Grade F 304H	S30409	---	0.04-0.10	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A965/A965M-14	Grade F304H	S30409	---	0.04-0.10	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
EN 10222-5:1999	X6 CrNi 18-10	---	1.4948	0.04-0.08	2.00	1.00	0.035	0.015	17.00-19.00	8.00-11.00	---	N 0.11
ISO 9327-5:1999	Type X7CrNi18-9	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.00-19.00	8.00-11.00	---	---
JIS G 3214:1991 A1:2009	Symbol SUS F 304H	---	---	0.04-0.10	2.00	1.00	0.040	0.030	18.00-20.00	8.00-12.00	---	---

6.3 Stainless Steel Forgings

6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-182/SA-182M	Grade F 304N	S30451	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10-0.16
ASTM A182/A182M-15	Grade F 304N	S30451	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10-0.16
ASTM A965/A965M-14	Grade F304N	S30451	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
JIS G 3214:1991 A1:2009	Symbol SUS F 304N	---	---	0.08	2.00	0.75	0.040	0.030	18.00-20.00	8.00-11.00	---	N 0.10-0.16
ASME SA-182/SA-182M	Grade F 304LN	S30453	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10-0.16
ASME SA-403/SA-403M	Grade WP 304LN	S30453	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
	Grade CR 304 LN	S30453	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
ASTM A182/A182M-15	Grade F 304LN	S30453	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10-0.16
ASTM A403/A403M-15	Grade WP304LN	S30453	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
	Grade CR304LN	S30453	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
ASTM A965/A965M-14	Grade F304LN	S30453	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
EN 10222-5:1999	X2CrNiN 18-10	---	1.4311	0.030	2.00	1.00	0.045	0.015	17.00-19.50	8.50-11.50	---	N 0.12-0.22
EN 10250-4:1999	X2CrNiN18-10	---	1.4311	0.030	2.00	1.00	0.045	0.030	17.00-19.50	8.50-11.50	---	N 0.12-0.22
ISO 9327-5:1999	Type X2CrNiN18-10	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
JIS G 3214:1991 A1:2009	Symbol SUS F 304LN	---	---	0.030	2.00	1.00	0.040	0.030	18.00-20.00	8.00-11.00	---	N 0.10-0.16
ASME SA-182/SA-182M	Grade F 310	S31000	---	0.25	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
	Grade F 310H	S31009	---	0.04-0.10	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASME SA-403/SA-403M	Grade WP 310S	S31008	---	0.08	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
	Grade CR 310S	S31008	---	0.08	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A182/A182M-15	Grade F 310	S31000	---	0.25	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
	Grade F 310H	S31009	---	0.04-0.10	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A403/A403M-15	Grade WP310S	S31008	---	0.08	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
	Grade CR310S	S31008	---	0.08	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A473-15	Type 310	S31000	---	0.25	2.00	1.50	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A965/A965M-14	Grade F310	S31000	---	0.15	2.00	1.00	0.045	0.030	24.0-26.00	19.0-22.0	---	---
	Grade F310H	S31009	---	0.04-0.10	2.00	1.00	0.045	0.030	24.0-26.00	19.0-22.0	---	---
ISO 9327-5:1999	Type X6CrNi25-21	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-23.00	---	---
JIS G 3214:1991 A1:2009	Symbol SUS F 310	---	---	0.15	2.00	1.00	0.040	0.030	24.00-26.00	19.00-22.00	---	---

6.3 Stainless Steel Forgings

6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
ASME SA-182/SA-182M	Grade F 316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASME SA-403/SA-403M	Grade WP 316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
	Grade CR 316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A182/A182M-15	Grade F 316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASTM A403/A403M-15	Grade WP316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
	Grade CR316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A473-15	Type 316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASTM A965/A965M-14	Grade F316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
EN 10222-5:1999	X5 CrNiMo 17-12-2	---	1.4401	0.07	2.00	1.00	0.045	0.015	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X3 CrNiMo 17-13-3	---	1.4436	0.05	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.00	2.50-3.00	N 0.11
EN 10250-4:1999	X5CrNiMo17-12-2	---	1.4401	0.07	2.00	1.00	0.045	0.030	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X3CrNiMo17-13-3	---	1.4436	0.05	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.00	2.50-3.00	N 0.11
ISO 9327-5:1999	Type X5CrNiMo17-12	---	---	0.07	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.00-2.50	---
	Type X5CrNiMo17-13	---	---	0.07	2.00	1.00	0.045	0.030	16.50-18.50	11.00-14.00	2.50-3.00	---
JIS G 3214:1991 A1:2009	Symbol SUS F 316	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
ASME SA-182/SA-182M	Grade F 316L	S31603	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-15.0	2.00-3.00	N 0.10
ASME SA-403/SA-403M	Grade WP 316L	S31603	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
	Grade CR 316L	S31603	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A182/A182M-15	Grade F 316L	S31603	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-15.0	2.00-3.00	N 0.10
ASTM A403/A403M-15	Grade WP316L	S31603	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
	Grade CR316L	S31603	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A473-15	Type 316L	S31603	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASTM A965/A965M-14	Grade F316L	S31603	---	0.035	2.00	1.00	0.040	0.030	16.0-18.0	10.0-15.0	2.00-3.00	---
EN 10222-5:1999	X2 CrNiMo 17-12-2	---	1.4404	0.030	2.00	1.00	0.045	0.015	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X2 CrNiMo 17-12-3	---	1.4432	0.030	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.00	2.50-3.00	N 0.11
	X2 CrNiMo 18-14-3	---	1.4435	0.030	2.00	1.00	0.045	0.015	17.00-19.00	12.50-15.00	2.50-3.00	N 0.11
EN 10250-4:1999	X2CrNiMo17-12-2	---	1.4404	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X2CrNiMo18-14-3	---	1.4435	0.030	2.00	1.00	0.045	0.030	17.00-19.00	12.50-15.00	2.50-3.00	N 0.11
ISO 9327-5:1999	Type X2CrNiMo17-12	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	11.00-14.00	2.00-2.50	---
	Type X2CrNiMo17-13	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	11.50-14.50	2.50-3.00	---
JIS G 3214:1991 A1:2009	Symbol SUS F 316L	---	---	0.030	2.00	1.00	0.040	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---

6.3 Stainless Steel Forgings

6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-182/SA-182M	Grade F 316LN	S31653	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	N 0.10-0.16
ASTM A182/A182M-15	Grade F 316LN	S31653	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	N 0.10-0.16
ASTM A965/A965M-14	Grade F316LN	S31653	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-13.0	2.00-3.00	N 0.10-0.16
EN 10222-5:1999	X2 CrNiMoN 17-11-2	---	1.4406	0.030	2.00	1.00	0.045	0.015	16.50-18.50	10.00-12.00	2.00-2.50	N 0.12-0.22
	X2 CrNiMoN 17-13-3	---	1.4429	0.030	2.00	1.00	0.045	0.015	16.50-18.50	11.00-14.00	2.50-3.00	N 0.12-0.22
EN 10250-4:1999	X2CrNiMoN17-11-2	---	1.4406	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.00-12.00	2.00-2.50	N 0.12-0.22
	X2CrNiMoN17-13-3	---	1.4429	0.030	2.00	1.00	0.045	0.015	16.50-18.50	11.00-14.00	2.50-3.00	N 0.12-0.22
ISO 9327-5:1999	Type X2CrNiMoN17-12	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.00-2.50	N 0.12-0.22
	Type X2CrNiMoN17-13	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	11.50-14.50	2.50-3.00	N 0.12-0.22
JIS G 3214:1991 A1:2009	Symbol SUS F 316LN	---	---	0.030	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10-0.16
ASME SA-182/SA-182M	Grade F 316H	S31609	---	0.04-0.10	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A182/A182M-15	Grade F 316H	S31609	---	0.04-0.10	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A965/A965M-14	Grade F316H	S31609	---	0.04-0.10	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ISO 9327-5:1999	Type X7CrNiMo17-12	---	---	0.40-0.10	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.00-2.50	---
JIS G 3214:1991 A1:2009	Symbol SUS F 316H	---	---	0.04-0.10	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
ASME SA-182/SA-182M	Grade F 317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASME SA-403/SA-403M	Grade WP 317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
	Grade CR 317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASTM A182/A182M-15	Grade F 317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASTM A403/A403M-15	Grade WP317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
	Grade CR317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASTM A473-15	Type 317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	N 0.10
EN 10250-4:1999	X6CrNiMoTi17-12-2	---	1.4571	0.08	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.00-2.50	Ti 5xC to 0.70
ISO 9327-5:1999	Type X6CrNiMoTi17-12	---	---	0.08	2.00	1.00	0.045	0.030	16.50-18.50	11.00-14.00	2.00-2.50	Ti 5xC to 0.80
JIS G 3214:1991 A1:2009	Symbol SUS F 317	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
ASME SA-182/SA-182M	Grade F 317L	S31703	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASME SA-403/SA-403M	Grade WP 317L	S31703	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
	Grade CR 317L	S31703	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASTM A182/A182M-15	Grade F 317L	S31703	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASTM A403/A403M-15	Grade WP317L	S31703	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
	Grade CR317L	S31703	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASTM A774/A774M-14	Grade TP 317L	S31703	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	N 0.10
JIS G 3214:1991 A1:2009	Symbol SUS F 317L	---	---	0.030	2.00	1.00	0.040	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---

6.3 Stainless Steel Forgings

6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-182/SA-182M	Grade F 321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70
ASME SA-403/SA-403M	Grade WP 321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5x(C+N) to 0.70
	Grade CR 321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5x(C+N) to 0.70
ASTM A182/A182M-15	Grade F 321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70
ASTM A403/A403M-15	Grade WP321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5x(C+N) to 0.70
	Grade CR321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5x(C+N) to 0.70
ASTM A473-15	Type 321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5xC min.
ASTM A774/A774M-14	Grade TP 321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5x(C+N) to 0.70
ASTM A965/A965M-14	Grade F321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	N 0.10; Ti 5x(C+N) to 0.70
EN 10222-5:1999	X6 CrNiTi 18-10	---	1.4541	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Ti 5xC to 0.70
EN 10250-4:1999	X6CrNiTi18-10	---	1.4541	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5xC to 0.70
ISO 9327-5:1999	Type X6CrNiTi18-10	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5xC to 0.80
JIS G 3214:1991 A1:2009	Symbol SUS F 321	---	---	0.08	2.00	1.00	0.040	0.030	17.00 min.	9.00-12.00	---	Ti 5xC to 0.60
ASME SA-182/SA-182M	Grade F 321H	S32109	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 4xC to 0.70
ASTM A182/A182M-15	Grade F 321H	S32109	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 4xC to 0.70
ASTM A965/A965M-14	Grade F321H	S32109	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 4x(C+N) to 0.70
ISO 9327-5:1999	Type X7CrNiTi18-10	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5xC to 0.80
JIS G 3214:1991 A1:2009	Symbol SUS F 321H	---	---	0.04-0.10	2.00	1.00	0.040	0.030	17.00 min.	9.00-12.00	---	Ti 4xC to 0.60

6.3 Stainless Steel Forgings

6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-182/SA-182M	Grade F 347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Cb 10xC to 1.10
	Grade F 348	S34800	---	0.08	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Cb 10xC to 1.10; Co 0.20; Ta 0.10
ASME SA-403/SA-403M	Grade WP 347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 10xC to 1.10
	Grade CR 347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 10xC to 1.10
ASTM A182/A182M-15	Grade F 347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Cb 10xC to 1.10
	Grade F 348	S34800	---	0.08	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Cb 10xC to 1.10; Co 0.20; Ta 0.10
ASTM A403/A403M-15	Grade WP347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 10xC to 1.10
	Grade CR347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 10xC to 1.10
ASTM A473-15	Type 347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-13.0	---	(Cb+Ta) 10xC min.
ASTM A965/A965M-14	Grade F347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 10xC to 1.10
	Grade F 348	S34800	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	(Cb+Ta) 10xC to 1.10; Co 0.020; Ta 0.10
EN 10222-5:1999	X6 CrNiNb 18-10	---	1.4550	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Nb 10xC to 1.00
ISO 9327-5:1999	Type X6CrNiNb18-10	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Nb 10xC to 1.00
JIS G 3214:1991 A1:2009	Symbol SUS F 347	---	---	0.08	2.00	1.00	0.040	0.030	17.00-20.00	9.00-13.00	---	Nb 10xC to 1.00
ASME SA-182/SA-182M	Grade F 347H	S34709	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Cb 8xC to 1.10
ASTM A182/A182M-15	Grade F 347H	S34709	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Cb 8xC to 1.10
EN 10222-5:1999	X7 CrNiNb 18-10	---	1.4912	0.04-0.10	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Nb 10xC to 1.20
ISO 9327-5:1999	Type X7CrNiNb18-10	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Nb 10xC to 1.20
JIS G 3214:1991 A1:2009	Symbol SUS F 347H	---	---	0.04-0.10	2.00	1.00	0.040	0.030	17.00-20.00	9.00-13.00	---	Nb 8xC to 1.00
EN 10250-4:1999	X1NiCrMoCu25-20-5	---	1.4539	0.020	2.00	0.70	0.030	0.010	19.00-21.00	24.00-26.00	4.00-5.00	Cu 1.20-2.00; N 0.15
ISO 9327-5:1999	Type X2NiCrMoCu25-20-5	---	---	0.025	2.00	1.00	0.030	0.020	19.00-22.00	24.00-27.00	4.00-5.00	Cu 1.00-2.00; N 0.15

6.3 Stainless Steel Forgings

6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-182/SA-182M	Grade F 304	S30400	---	$t \leq 130$	$t \leq 5$	205	30	515	75	30	ST+Q	---
				$t > 130$	$t > 5$	205	30	485	70	30	ST+Q	---
ASME SA-403/SA-403M	Grade WP 304	S30400	---	---	---	205	30	515	75	28 L, 20 T	SA	---
	Grade CR 304	S30400	---	---	---	205	30	515	75	28 L, 20 T	SA	---
ASTM A182/A182M-15	Grade F 304	S30400	---	$t \leq 130$	$t \leq 5$	205	30	515	75	30	ST+Q	---
				$t > 130$	$t > 5$	205	30	485	70	30	ST+Q	---
ASTM A403/A403M-15	Grade WP304	S30400	---	---	---	205	30	515	75	28 L, 20 T	SA+Q or RC	---
	Grade CR304	S30400	---	---	---	205	30	515	75	28 L, 20 T	SA+Q or RC	---
ASTM A473-15	Type 304	S30400	---	$t \leq 127$	$t \leq 5$	205	30	515	75	40	SHT	---
				$t > 127$	$t > 5$	205	30	485	70	40	SHT	---
ASTM A965/A965M-14	Grade F304	S30400	---	---	---	205	30	485	70	40	SA+Q	---
EN 10222-5:1999	X5 CrNi 18-10	---	1.4301	$t \leq 250$	---	200	---	500-700	---	45 L, 35 T	ST	see standard for impact data
EN 10250-4:1999	X5CrNi18-10	---	1.4301	$t \leq 250$	---	190	---	500-700	---	35 T	SA	see standard for impact data
ISO 9327-5:1999	Type X5CrNi18-9	---	---	$t \leq 250$	---	195	---	500-700	---	30 L, 30 T	Q+T	see standard for impact data
JIS G 3214:1991 A1:2009	Symbol SUS F 304	---	---	$t < 130$	---	205	---	520	---	43 L	ST	187 max HB
				$130 \leq t \leq 200$	---	205	---	480	---	29 L	ST	187 max HB
ASME SA-182/SA-182M	Grade F 316N	S31651	---	---	---	240	35	550	80	30 L, 25 T	ST+Q	---
ASTM A182/A182M-15	Grade F 316N	S31651	---	---	---	240	35	550	80	30 L, 25 T	ST+Q	---
ASTM A965/A965M-14	Grade F316N	S31651	---	---	---	240	35	550	80	25	SA+Q	---
JIS G 3214:1991 A1:2009	Symbol SUS F 316N	---	---	$t < 130$	---	240	---	550	---	29 L	ST	217 max HB
				$130 \leq t \leq 200$	---	240	---	550	---	24 L	ST	217 max HB
ASME SA-182/SA-182M	Grade F 304L	S30403	---	$t \leq 130$	$t \leq 5$	170	25	485	70	30	ST+Q	---
				$t > 130$	$t > 5$	170	25	450	65	30	ST+Q	---
ASME SA-403/SA-403M	Grade WP 304L	S30403	---	---	---	170	25	485	70	28 L, 20 T	SA	---
	Grade CR 304L	S30403	---	---	---	170	25	485	70	28 L, 20 T	SA	---
ASTM A182/A182M-15	Grade F 304L	S30403	---	$t \leq 130$	$t \leq 5$	170	25	485	70	30	ST+Q	---
				$t > 130$	$t > 5$	170	25	450	65	30	ST+Q	---
ASTM A403/A403M-15	Grade WP304L	S30403	---	---	---	170	25	485	70	28 L, 20 T	SA+Q or RC	---
	Grade CR304L	S30403	---	---	---	170	25	485	70	28 L, 20 T	SA+Q or RC	---
ASTM A473-15	Type 304L	S30403	---	---	---	170	25	450	65	40	SHT	---
ASTM A965/A965M-14	Grade F304L	S30403	---	---	---	170	25	450	65	30	SA+Q	---
EN 10222-5:1999	X2 CrNi 18-9	---	1.4307	$t \leq 250$	---	200	---	500-700	---	45 L, 35 T	ST	see standard for impact data
EN 10250-4:1999	X2CrNi19-11	---	1.4306	$t \leq 250$	---	180	---	460-680	---	35 T	SA	see standard for impact data
	X2CrNi18-9	---	1.4307	$t \leq 250$	---	175	---	450-680	---	35 T	SA	---
ISO 9327-5:1999	Type X2CrNi18-10	---	---	$t \leq 250$	---	180	---	480-680	---	30 L, 30 T	Q+T	see standard for impact data
JIS G 3214:1991 A1:2009	Symbol SUS F 304L	---	---	$t < 130$	---	175	---	480	---	29 L	ST	187 max HB
				$130 \leq t \leq 200$	---	175	---	450	---	29 L	ST	187 max HB

6.3 Stainless Steel Forgings

6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-182/SA-182M	Grade F 304H	S30409	---	t ≤ 130	t ≤ 5	205	30	515	75	30	ST+Q	---
				t > 130	t > 5	205	30	485	70	30	ST+Q	---
ASTM A182/A182M-15	Grade F 304H	S30409	---	t ≤ 130	t ≤ 5	205	30	515	75	30	ST+Q	---
				t > 130	t > 5	205	30	485	70	30	ST+Q	---
ASTM A965/A965M-14	Grade F304H	S30409	---	---	---	205	30	485	70	30	SA+Q	---
EN 10222-5:1999	X6 CrNi 18-10	---	1.4948	t ≤ 250	---	195	---	490-690	---	45 L, 35 T	ST	see standard for impact data
ISO 9327-5:1999	Type X7CrNi18-9	---	---	t ≤ 250	---	195	---	490-690	---	30 L, 30 T	Q+T	see standard for impact data
JIS G 3214:1991 A1:2009	Symbol SUS F 304H	---	---	t < 130	---	205	---	520	---	43 L	ST	187 max HB
				130 ≤ t ≤ 200	---	205	---	480	---	29 L	ST	187 max HB
ASME SA-182/SA-182M	Grade F 304N	S30451	---	---	---	240	35	550	80	30 L, 25 T	ST+Q	---
ASTM A182/A182M-15	Grade F 304N	S30451	---	---	---	240	35	550	80	30 L, 25 T	ST+Q	---
ASTM A965/A965M-14	Grade F304N	S30451	---	---	---	240	35	550	80	25	SA+Q	---
JIS G 3214:1991 A1:2009	Symbol SUS F 304N	---	---	t < 130	---	240	---	550	---	29 L	ST	217 max HB
				130 ≤ t ≤ 200	---	240	---	550	---	24 L	ST	217 max HB
ASME SA-182/SA-182M	Grade F 304LN	S30453	---	t ≤ 130	t ≤ 5	205	30	515	75	30	ST+Q	---
				t > 130	t > 5	205	30	485	70	30	ST+Q	---
ASTM A182/A182M-15	Grade F 304LN	S30453	---	t ≤ 130	t ≤ 5	205	30	515	75	30	ST+Q	---
				t > 130	t > 5	205	30	485	70	30	ST+Q	---
ASTM A965/A965M-14	Grade F304LN	S30453	---	---	---	205	30	485	70	30	SA+Q	---
EN 10222-5:1999	X2CrNiN 18-10	---	1.4311	t ≤ 250	---	270	---	550-750	---	45 L, 35 T	ST	see standard for impact data
EN 10250-4:1999	X2CrNiN18-10	---	1.4311	t ≤ 250	---	270	---	550-760	---	30 T	SA	see standard for impact data
ISO 9327-5:1999	Type X2CrNiN18-10	---	---	t ≤ 250	---	270	---	550-750	---	30 L, 30 T	Q+T	see standard for impact data
JIS G 3214:1991 A1:2009	Symbol SUS F 304LN	---	---	t < 130	---	205	---	520	---	29 L	ST	187 max HB
				130 ≤ t ≤ 200	---	205	---	480	---	29 L	ST	187 max HB

6.3 Stainless Steel Forgings

6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-182/SA-182M	Grade F 310	S31000	---	t ≤ 130	t ≤ 5	205	30	515	75	30	ST+Q	---
				t > 130	t > 5	205	30	485	70	30	ST+Q	---
	Grade F 310H	S31009	---	t ≤ 130	t ≤ 5	205	30	515	75	30	ST+Q	---
				t > 130	t > 5	205	30	485	70	30	ST+Q	---
ASME SA-403/SA-403M	Grade WP 310S	S31008	---	---	---	205	30	515	75	28 L, 20 T	SA	---
	Grade CR 310S	S31008	---	---	---	205	30	515	75	28 L, 20 T	SA	---
ASTM A182/A182M-15	Grade F 310	S31000	---	t ≤ 130	t ≤ 5	205	30	515	75	30	ST+Q	---
				t > 130	t > 5	205	30	485	70	30	ST+Q	---
	Grade F 310H	S31009	---	t ≤ 130	t ≤ 5	205	30	515	75	30	ST+Q	---
				t > 130	t > 5	205	30	485	70	30	ST+Q	---
ASTM A403/A403M-15	Grade WP310S	S31008	---	---	---	205	30	515	75	28 L, 20 T	SA+Q or RC	---
	Grade CR310S	S31008	---	---	---	205	30	515	75	28 L, 20 T	SA+Q or RC	---
ASTM A473-15	Type 310	S31000	---	---	---	205	30	515	75	40	SHT	---
ASTM A965/A965M-14	Grade F310	S31000	---	---	---	205	30	515	75	30	SA+Q	---
	Grade F310H	S31009	---	---	---	205	30	485	70	30	SA+Q	---
ISO 9327-5:1999	Type X6CrNi25-21	---	---	t ≤ 160	---	210	---	500-700	---	30 L, 30 T	Q+T	see standard for impact data
JIS G 3214:1991 A1:2009	Symbol SUS F 310	---	---	t < 130	---	205	---	520	---	34 L	ST	187 max HB
				130 ≤ t ≤ 200	---	205	---	480	---	29 L	ST	187 max HB
ASME SA-182/SA-182M	Grade F 316	S31600	---	t ≤ 130	t ≤ 5	205	30	515	75	30	ST+Q	---
				t > 130	t > 5	205	30	485	70	30	ST+Q	---
ASME SA-403/SA-403M	Grade WP 316	S31600	---	---	---	205	30	515	75	28 L, 20 T	SA	---
	Grade CR 316	S31600	---	---	---	205	30	515	75	28 L, 20 T	SA	---
ASTM A182/A182M-15	Grade F 316	S31600	---	t ≤ 130	t ≤ 5	205	30	515	75	30	ST+Q	---
				t > 130	t > 5	205	30	485	70	30	ST+Q	---
ASTM A403/A403M-15	Grade WP316	S31600	---	---	---	205	30	515	75	28 L, 20 T	SA+Q or RC	---
	Grade CR316	S31600	---	---	---	205	30	515	75	28 L, 20 T	SA+Q or RC	---
ASTM A473-15	Type 316	S31600	---	t ≤ 127	t ≤ 5	205	30	515	75	40	SHT	---
				t > 127	t > 5	205	30	485	70	40	SHT	---
ASTM A965/A965M-14	Grade F316	S31600	---	---	---	205	30	485	70	30	SA+Q	---
EN 10222-5:1999	X5 CrNiMo 17-12-2	---	1.4401	t ≤ 250	---	205	---	510-710	---	45 L, 35 T	ST	see standard for impact data
	X3 CrNiMo 17-13-3	---	1.4436	t ≤ 250	---	205	---	510-710	---	45 L, 35 T	ST	---
EN 10250-4:1999	X5CrNiMo17-12-2	---	1.4401	t ≤ 250	---	200	---	500-700	---	30 T	SA	see standard for impact data
	X3CrNiMo17-13-3	---	1.4436	t ≤ 250	---	200	---	500-700	---	30 T	SA	---
ISO 9327-5:1999	Type X5CrNiMo17-12	---	---	t ≤ 250	---	205	---	510-710	---	30 L, 30 T	Q+T	see standard for impact data
	Type X5CrNiMo17-13	---	---	t ≤ 250	---	205	---	510-710	---	30 L, 30 T	Q+T	see standard for impact data
JIS G 3214:1991 A1:2009	Symbol SUS F 316	---	---	t < 130	---	205	---	520	---	43 L	ST	187 max HB
				130 ≤ t ≤ 200	---	205	---	480	---	29 L	ST	187 max HB

6.3 Stainless Steel Forgings

6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-182/SA-182M	Grade F 316L	S31603	---	$t \leq 130$	$t \leq 5$	170	25	485	70	30	ST+Q	---
				$t > 130$	$t > 5$	170	25	450	65	30	ST+Q	---
ASME SA-403/SA-403M	Grade WP 316L	S31603	---	---	---	170	25	485	70	28 L, 20 T	SA	---
	Grade CR 316L	S31603	---	---	---	170	25	485	70	28 L, 20 T	SA	---
ASTM A182/A182M-15	Grade F 316L	S31603	---	$t \leq 130$	$t \leq 5$	170	25	485	70	30	ST+Q	---
				$t > 130$	$t > 5$	170	25	450	65	30	ST+Q	---
ASTM A403/A403M-15	Grade WP316L	S31603	---	---	---	170	25	485	70	28 L, 20 T	SA+Q or RC	---
	Grade CR316L	S31603	---	---	---	170	25	485	70	28 L, 20 T	SA+Q or RC	---
ASTM A473-15	Type 316L	S31603	---	---	---	170	25	450	65	40	SHT	---
ASTM A965/A965M-14	Grade F316L	S31603	---	---	---	170	25	450	65	30	SA+Q	---
EN 10222-5:1999	X2 CrNiMo 17-12-2	---	1.4404	$t \leq 250$	---	190	---	490-690	---	45 L, 35 T	ST	see standard for impact data
	X2 CrNiMo 17-12-3	---	1.4432	$t \leq 250$	---	190	---	490-690	---	45 L, 35 T	ST	
	X2 CrNiMo 18-14-3	---	1.4435	$t \leq 75$	---	200	---	520-670	---	45 T	ST	
EN 10250-4:1999	X2CrNiMo17-12-2	---	1.4404	$t \leq 250$	---	200	---	500-700	---	30 T	SA	see standard for impact data
	X2CrNiMo18-14-3	---	1.4435	$t \leq 250$	---	200	---	500-700	---	30 T	SA	
ISO 9327-5:1999	Type X2CrNiMo17-12	---	---	$t \leq 250$	---	190	---	490-690	---	30 L, 30 T	Q+T	see standard for impact data
	Type X2CrNiMo17-13	---	---	$t \leq 250$	---	190	---	490-690	---	30 L, 30 T	Q+T	see standard for impact data
JIS G 3214:1991 A1:2009	Symbol SUS F 316L	---	---	$t < 130$	---	175	---	480	---	29 L	ST	187 max HB
				$130 \leq t \leq 200$	---	175	---	450	---	29 L	ST	187 max HB
ASME SA-182/SA-182M	Grade F 316LN	S31653	---	$t \leq 130$	$t \leq 5$	205	30	515	75	30	ST+Q	---
				$t > 130$	$t > 5$	205	30	485	70	30	ST+Q	---
ASTM A182/A182M-15	Grade F 316LN	S31653	---	$t \leq 130$	$t \leq 5$	205	30	515	75	30	ST+Q	---
				$t > 130$	$t > 5$	205	30	485	70	30	ST+Q	---
ASTM A965/A965M-14	Grade F316LN	S31653	---	---	---	205	30	485	70	30	SA+Q	---
EN 10222-5:1999	X2 CrNiMoN 17-11-2	---	1.4406	$t \leq 160$	---	280	---	580-780	---	45 L, 35 T	ST	see standard for impact data
	X2 CrNiMoN 17-13-3	---	1.4429	$t \leq 160$	---	280	---	580-780	---	45 L, 35 T	ST	
EN 10250-4:1999	X2CrNiMoN17-11-2	---	1.4406	$t \leq 250$	---	280	---	580-800	---	30 T	SA	see standard for impact data
	X2CrNiMoN17-13-3	---	1.4429	$t \leq 400$	---	280	---	580-800	---	30 T	SA	
ISO 9327-5:1999	Type X2CrNiMoN17-12	---	---	$t \leq 160$	---	280	---	580-780	---	30 L, 30 T	Q+T	see standard for impact data
	Type X2CrNiMoN17-13	---	---	$t \leq 160$	---	280	---	580-780	---	30 L, 30 T	Q+T	see standard for impact data
JIS G 3214:1991 A1:2009	Symbol SUS F 316LN	---	---	$t < 130$	---	205	---	520	---	29 L	ST	187 max HB
				$130 \leq t \leq 200$	---	205	---	480	---	29 L	ST	187 max HB

6.3 Stainless Steel Forgings

6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-182/SA-182M	Grade F 316H	S31609	---	$t \leq 130$	$t \leq 5$	205	30	515	75	30	ST+Q	---
				$t > 130$	$t > 5$	205	30	485	70	30	ST+Q	---
ASTM A182/A182M-15	Grade F 316H	S31609	---	$t \leq 130$	$t \leq 5$	205	30	515	75	30	ST+Q	---
				$t > 130$	$t > 5$	205	30	485	70	30	ST+Q	---
ASTM A965/A965M-14	Grade F316H	S31609	---	---	---	205	30	485	70	30	SA+Q	---
ISO 9327-5:1999	Type X7CrNiMo17-12	---	---	$t \leq 250$	---	205	---	510-710	---	30 L, 30 T	Q+T	see standard for impact data
JIS G 3214:1991 A1:2009	Symbol SUS F 316H	---	---	$t < 130$	---	205	---	520	---	43 L	ST	187 max HB
				$130 \leq t \leq 200$	---	205	---	480	---	29 L	ST	187 max HB
ASME SA-182/SA-182M	Grade F 317	S31700	---	$t \leq 130$	$t \leq 5$	205	30	515	75	30	ST+Q	---
				$t > 130$	$t > 5$	205	30	485	70	30	ST+Q	---
ASME SA-403/SA-403M	Grade WP 317	S31700	---	---	---	205	30	515	75	28 L, 20 T	SA	---
	Grade CR 317	S31700	---	---	---	205	30	515	75	28 L, 20 T	SA	---
ASTM A182/A182M-15	Grade F 317	S31700	---	$t \leq 130$	$t \leq 5$	205	30	515	75	30	ST+Q	---
				$t > 130$	$t > 5$	205	30	485	70	30	ST+Q	---
ASTM A403/A403M-15	Grade WP317	S31700	---	---	---	205	30	515	75	28 L, 20 T	SA+Q or RC	---
	Grade CR317	S31700	---	---	---	205	30	515	75	28 L, 20 T	SA+Q or RC	---
ASTM A473-15	Type 317	S31700	---	---	---	205	30	515	75	40	SHT	---
EN 10250-4:1999	X6CrNiMoTi17-12-2	---	1.4571	$t \leq 450$	---	200	---	500-700	---	30 T	SA	see standard for impact data
ISO 9327-5:1999	Type X6CrNiMoTi17-12	---	---	$t \leq 450$	---	210	---	510-710	---	30 L, 30 T	Q+T	see standard for impact data
JIS G 3214:1991 A1:2009	Symbol SUS F 317	---	---	$t < 130$	---	205	---	520	---	29 L	ST	187 max HB
				$130 \leq t \leq 200$	---	205	---	480	---	29 L	ST	187 max HB
ASME SA-182/SA-182M	Grade F 317L	S31703	---	$t \leq 130$	$t \leq 5$	170	25	485	70	30	ST+Q	---
				$t > 130$	$t > 5$	170	25	450	65	30	ST+Q	---
ASME SA-403/SA-403M	Grade WP 317L	S31703	---	---	---	205	30	515	75	28 L, 20 T	SA	---
	Grade CR 317L	S31703	---	---	---	205	30	515	75	28 L, 20 T	SA	---
ASTM A182/A182M-15	Grade F 317L	S31703	---	$t \leq 130$	$t \leq 5$	170	25	485	70	30	ST+Q	---
				$t > 130$	$t > 5$	170	25	450	65	30	ST+Q	---
ASTM A403/A403M-15	Grade WP317L	S31703	---	---	---	205	30	515	75	28 L, 20 T	SA+Q or RC	---
	Grade CR317L	S31703	---	---	---	205	30	515	75	28 L, 20 T	SA+Q or RC	---
ASTM A774/A774M-14	Grade TP 317L	S31703	---	$1.6 \leq t \leq 12.7$	$0.062 \leq t \leq 0.500$	205	30	515-690	75-100	35.0	---	217 max HB; 95 max HRB
JIS G 3214:1991 A1:2009	Symbol SUS F 317L	---	---	$t < 130$	---	175	---	480	---	29 L	ST	187 max HB
				$130 \leq t \leq 200$	---	175	---	450	---	29 L	ST	187 max HB

6.3 Stainless Steel Forgings

6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-182/SA-182M	Grade F 321	S32100	---	$t \leq 130$	$t \leq 5$	205	30	515	75	30	ST+Q	---
				$t > 130$	$t > 5$	205	30	485	70	30	ST+Q	---
ASME SA-403/SA-403M	Grade WP 321	S32100	---	---	---	205	30	515	75	28 L, 20 T	SA	---
	Grade CR 321	S32100	---	---	---	205	30	515	75	28 L, 20 T	SA	---
ASTM A182/A182M-15	Grade F 321	S32100	---	$t \leq 130$	$t \leq 5$	205	30	515	75	30	ST+Q	---
				$t > 130$	$t > 5$	205	30	485	70	30	ST+Q	---
ASTM A403/A403M-15	Grade WP321	S32100	---	---	---	205	30	515	75	28 L, 20 T	SA+Q or RC	---
				---	$t \leq 0.375$	205	30	515	75	28 L, 20 T	SA+Q or RC	---
				---	$t > 0.375$	170	25	485	70	28 L, 20 T	SA+Q or RC	---
	Grade CR321	S32100	---	---	---	205	30	515	75	28 L, 20 T	SA+Q or RC	---
				---	$t \leq 0.375$	205	30	515	75	28 L, 20 T	SA+Q or RC	---
				---	$t > 0.375$	170	25	485	70	28 L, 20 T	SA+Q or RC	---
ASTM A473-15	Type 321	S32100	---	---	---	205	30	515	75	40	SHT	---
ASTM A774/A774M-14	Grade TP 321	S32100	---	$1.6 \leq t \leq 12.7$	$0.062 \leq t \leq 0.500$	205	30	515-690	75-100	40.0	---	217 max HB; 95 max HRB
ASTM A965/A965M-14	Grade F321	S32100	---	---	---	205	30	485	70	30	SA+Q	---
EN 10222-5:1999	X6 CrNiTi 18-10	---	1.4541	$t \leq 450$	---	200	---	510-710	---	40 L, 30 T	ST	see standard for impact data
EN 10250-4:1999	X6CrNiTi18-10	---	1.4541	$t \leq 450$	---	190	---	500-700	---	30 T	SA	see standard for impact data
ISO 9327-5:1999	Type X6CrNiTi18-10	---	---	$t \leq 450$	---	200	---	510-710	---	30 L, 30 T	Q+T	see standard for impact data
JIS G 3214:1991 A1:2009	Symbol SUS F 321	---	---	$t < 130$	---	205	---	520	---	43 L	ST	187 max HB
				$130 \leq t \leq 200$	---	205	---	480	---	29 L	ST	187 max HB
ASME SA-182/SA-182M	Grade F 321H	S32109	---	$t \leq 130$	$t \leq 5$	205	30	515	75	30	ST+Q	---
				$t > 130$	$t > 5$	205	30	485	70	30	ST+Q	---
ASTM A182/A182M-15	Grade F 321H	S32109	---	$t \leq 130$	$t \leq 5$	205	30	515	75	30	ST+Q	---
				$t > 130$	$t > 5$	205	30	485	70	30	ST+Q	---
ASTM A965/A965M-14	Grade F321H	S32109	---	---	---	205	30	485	70	30	SA+Q	---
ISO 9327-5:1999	Type X7CrNiTi18-10	---	---	$t \leq 450$	---	175	---	490-690	---	30 L, 30 T	Q+T	see standard for impact data
JIS G 3214:1991 A1:2009	Symbol SUS F 321H	---	---	$t < 130$	---	205	---	520	---	43 L	ST	187 max HB
				$130 \leq t \leq 200$	---	205	---	480	---	29 L	ST	187 max HB

6.3 Stainless Steel Forgings

6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-182/SA-182M	Grade F 347	S34700	---	t ≤ 130	t ≤ 5	205	30	515	75	30	ST+Q	---
				t > 130	t > 5	205	30	485	70	30	ST+Q	---
	Grade F 348	S34800	---	t ≤ 130	t ≤ 5	205	30	515	75	30	ST+Q	---
				t > 130	t > 5	205	30	485	70	30	ST+Q	---
ASME SA-403/SA-403M	Grade WP 347	S34700	---	---	---	205	30	515	75	28 L, 20 T	SA	---
	Grade CR 347	S34700	---	---	---	205	30	515	75	28 L, 20 T	SA	---
ASTM A182/A182M-15	Grade F 347	S34700	---	t ≤ 130	t ≤ 5	205	30	515	75	30	ST+Q	---
				t > 130	t > 5	205	30	485	70	30	ST+Q	---
	Grade F 348	S34800	---	t ≤ 130	t ≤ 5	205	30	515	75	30	ST+Q	---
				t > 130	t > 5	205	30	485	70	30	ST+Q	---
ASTM A403/A403M-15	Grade WP347	S34700	---	---	---	205	30	515	75	28 L, 20 T	SA+Q or RC	---
	Grade CR347	S34700	---	---	---	205	30	515	75	28 L, 20 T	SA+Q or RC	---
ASTM A473-15	Type 347	S34700	---	---	---	205	30	515	75	40	SHT	---
ASTM A965/A965M-14	Grade F347	S34700	---	---	---	205	30	485	70	30	SA+Q	---
	Grade F348	S34800	---	---	---	205	30	485	70	30	SA+Q	---
EN 10222-5:1999	X6 CrNiNb 18-10	---	1.4550	t ≤ 450	---	205	---	510-710	---	40 L, 30 T	ST	see standard for impact data
ISO 9327-5:1999	Type X6CrNiNb18-10	---	---	t ≤ 450	---	205	---	510-710	---	30 L, 30 T	Q+T	see standard for impact data
JIS G 3214:1991 A1:2009	Symbol SUS F 347	---	---	t < 130	---	205	---	520	---	43 L	ST	187 max HB
				130 ≤ t ≤ 200	---	205	---	480	---	29 L	ST	187 max HB
ASME SA-182/SA-182M	Grade F 347H	S34709	---	t ≤ 130	t ≤ 5	205	30	515	75	30	ST+Q	---
				t > 130	t > 5	205	30	485	70	30	ST+Q	---
ASTM A182/A182M-15	Grade F 347H	S34709	---	t ≤ 130	t ≤ 5	205	30	515	75	30	ST+Q	---
				t > 130	t > 5	205	30	485	70	30	ST+Q	---
EN 10222-5:1999	X7 CrNiNb 18-10	---	1.4912	t ≤ 450	---	205	---	510-710	---	40 L, 30 T	ST	see standard for impact data
ISO 9327-5:1999	Type X7CrNiNb18-10	---	---	t ≤ 450	---	205	---	510-710	---	30 L, 30 T	Q+T	see standard for impact data
JIS G 3214:1991 A1:2009	Symbol SUS F 347H	---	---	t < 130	---	205	---	520	---	43 L	ST	187 max HB
				130 ≤ t ≤ 200	---	205	---	480	---	29 L	ST	187 max HB
EN 10250-4:1999	X1NiCrMoCu25-20-5	---	1.4539	t ≤ 250	---	230	---	530-730	---	30 T	SA	see standard for impact data
ISO 9327-5:1999	Type X2NiCrMoCu25-20-5	---	---	t ≤ 160	---	220	---	520-720	---	30 L, 30 T	Q+T	see standard for impact data

6.3.4A Chemical Composition of Precipitation-Hardening Stainless Steel Forgings

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
ASME SA-705/SA-705M	Type 630	S17400	---	0.07	1.00	1.00	0.040	0.030	15.00-17.50	3.00-5.00	---	Cu 3.00-5.00; (Cb+Ta) 0.15-0.45
ASTM A705/A705M-13	Type 630	S17400	---	0.07	1.00	1.00	0.040	0.030	15.00-17.50	3.00-5.00	---	Cu 3.00-5.00; (Cb+Ta) 0.15-0.45
EN 10250-4:1999	X5CrNiCuNb16-4	---	1.4542	0.07	1.50	0.70	0.040	0.030	15.00-17.00	3.00-5.00	0.60	Cu 3.00-5.00; Nb 5xC to 0.45
JIS G 3214:1991 A1:2009	Symbol SUS F 630	---	---	0.07	1.00	1.00	0.040	0.030	15.00-17.50	3.00-5.00	---	Cu 3.00-5.00; Nb 0.15-0.45

6.3 Stainless Steel Forgings

6.3.4B Mechanical Properties of Precipitation-Hardening Stainless Steel Forgings

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-705/SA-705M	Type 630	S17400	---	---	---	---	---	---	---	---	ST	363 max HB; 38 max HRC
				t ≤ 75	t ≤ 3	1170	170	1310	190	10 L	AH	388 min HB; 40 min HRC
				t ≤ 75	t ≤ 3	1070	155	1170	170	10 L	AH	375 min HB; 38 min HRC; L: 6.8 J @ RT
				t ≤ 200	t ≤ 8	1000	145	1070	155	12 L	AH	331 min HB; 35 min HRC; L: 20 J @ RT
				t ≤ 200	t ≤ 8	860	125	1000	145	13 L	AH	311 min HB; 32 min HRC; L: 27 J @ RT
				t ≤ 200	t ≤ 8	795	115	965	140	14 L	AH	302 min HB; 31 min HRC; L: 34 J @ RT
				t ≤ 200	t ≤ 8	725	105	930	135	16 L	AH	277 min HB; 28 min HRC; L: 41 J @ RT
				t ≤ 200	t ≤ 8	520	75	795	115	18 L	AH	255 min HB; 24 min HRC; L: 75 J @ RT
ASTM A705/A705M-13	Type 630	S17400	---	---	---	---	---	---	---	---	ST	363 max HB; 38 max HRC
				t ≤ 75	t ≤ 3	1170	170	1310	190	10 L	AH	388 min HB; 40 min HRC
				t ≤ 75	t ≤ 3	1070	155	1170	170	10 L	AH	375 min HB; 38 min HRC; L: 6.8 J @ RT
				t ≤ 200	t ≤ 8	1000	145	1070	155	12 L	AH	331 min HB; 35 min HRC; L: 20 J @ RT
				t ≤ 200	t ≤ 8	860	125	1000	145	13 L	AH	311 min HB; 32 min HRC; L: 27 J @ RT
				t ≤ 200	t ≤ 8	795	115	965	140	14 L	AH	302 min HB; 31 min HRC; L: 34 J @ RT
				t ≤ 200	t ≤ 8	725	105	930	135	16 L	AH	277 min HB; 28 min HRC; L: 41 J @ RT
				t ≤ 200	t ≤ 8	520	75	795	115	18 L	AH	255 min HB; 24 min HRC; L: 75 J @ RT
EN 10250-4:1999	X5CrNiCuNb16-4	---	1.4542	---	---	---	---	1200 max.	---	---	A	360 max HB
				t ≤ 250	---	720	---	930	---	15 L, 12 T	PH	see standard for impact data
				t ≤ 250	---	1000	---	1070	---	12 L, 10 T	PH	
				t ≤ 250	---	1150	---	1300	---	8 L, 6 T	PH	---
JIS G 3214:1991 A1:2009	Symbol SUS F 630	---	---	t ≤ 200	---	860	---	1000	---	12 L	HT	311 min HBW; 27 J @ RT
				t ≤ 200	---	795	---	970	---	13 L	HT	302 min HBW; 34 J @ RT
				t ≤ 200	---	725	---	930	---	15 L	HT	277 min HBW; 41 J @ RT

6.3 Stainless Steel Forgings

6.3.5A Chemical Composition of Duplex (Ferritic-Austenitic) Stainless Steel Forgings

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-182/SA-182M	Grade F 50	S31200	---	0.030	2.00	1.00	0.045	0.030	24.0-26.0	5.5-6.5	1.20-2.00	N 0.14-0.20
ASTM A182/A182M-15	Grade F 50	S31200	---	0.030	2.00	1.00	0.045	0.030	24.0-26.0	5.5-6.5	1.20-2.00	N 0.14-0.20
EN 10250-4:1999	X3CrNiMoN27-5-2	---	1.4460	0.05	2.00	1.00	0.035	0.030	25.00-28.00	4.50-6.50	1.30-2.00	N 0.05-0.20
ASME SA-182/SA-182M	Grade F 51	S31803	---	0.030	2.00	1.00	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
	Grade F 60	S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
ASME SA-815/SA-815M	Grade WPS31803	S31803	---	0.030	2.00	1.0	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
	Grade CRS31803	S31803	---	0.030	2.00	1.0	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
	Grade WPS32205	S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
	Grade CRS32205	S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
ASTM A182/A182M-15	Grade F 51	S31803	---	0.030	2.00	1.00	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
	Grade F 60	S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
ASTM A815/A815M-14	Grade WPS31803	S31803	---	0.030	2.00	1.0	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
	Grade CRS31803	S31803	---	0.030	2.00	1.0	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
	Grade WPS32205	S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
	Grade CRS32205	S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
EN 10222-5:1999	X2 CrNiMoN 22-5-3	---	1.4462	0.030	2.00	1.00	0.035	0.015	21.00-23.00	4.50-6.50	2.50-3.50	N 0.10-0.22
EN 10250-4:1999	X2CrNiMoN22-5-3	---	1.4462	0.030	2.00	1.00	0.035	0.015	21.00-23.00	4.50-6.50	2.50-3.50	N 0.10-0.22
ISO 9327-5:1999	Type X2CrNiMoN22-5-3	---	---	0.030	2.00	1.00	0.035	0.020	21.00-23.00	4.50-6.50	2.50-3.50	N 0.08-0.20
ASME SA-182/SA-182M	Grade F 53	S32750	---	0.030	1.20	0.80	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	Cu 0.50; N 0.24-0.32
ASME SA-815/SA-815M	Grade WPS32750	S32750	---	0.030	1.20	0.8	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	Cu 0.5; N 0.24-0.32
	Grade CRS32750	S32750	---	0.030	1.20	0.8	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	Cu 0.5; N 0.24-0.32
ASTM A182/A182M-15	Grade F 53	S32750	---	0.030	1.20	0.80	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	Cu 0.50; N 0.24-0.32
ASTM A815/A815M-14	Grade WPS32750	S32750	---	0.030	1.20	0.8	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	Cu 0.5; N 0.24-0.32
	Grade CRS32750	S32750	---	0.030	1.20	0.8	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	Cu 0.5; N 0.24-0.32
EN 10222-5:1999	X2 CrNiMoN 25-7-4	---	1.4410	0.030	2.00	1.00	0.035	0.015	24.00-26.00	6.00-8.00	3.00-4.50	N 0.20-0.35
EN 10250-4:1999	X2CrNiMoN25-7-4	---	1.4410	0.030	2.00	1.00	0.035	0.015	24.00-26.00	6.00-8.00	3.00-4.50	N 0.20-0.35

6.3 Stainless Steel Forgings

6.3.5A Chemical Composition of Duplex (Ferritic-Austenitic) Stainless Steel Forgings (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
ASME SA-182/SA-182M	Grade F 55	S32760	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 0.40 min.
ASME SA-815/SA-815M	Grade WPS32760	S32760	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 0.40 min.
	Grade CRS32760	S32760	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 0.40 min.
ASTM A182/A182M-15	Grade F 55	S32760	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 0.40 min.
ASTM A473-15	---	S32760	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 0.40 min.
ASTM A815/A815M-14	Grade WPS32760	S32760	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 0.40 min.
	Grade CRS32760	S32760	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30; [Cr+(3.3xMo)+(16xN)] 0.40 min.
EN 10250-4:1999	X2CrNiMoCuWN25-7-4	---	1.4501	0.030	1.00	1.00	0.035	0.015	24.00-26.00	6.00-8.00	3.00-4.00	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30
ASME SA-182/SA-182M	Grade F 59	S32520	---	0.030	1.50	0.80	0.035	0.020	24.0-26.0	5.5-8.0	3.0-5.0	Cu 0.50-3.00; N 0.20-0.35
ASTM A182/A182M-15	Grade F 59	S32520	---	0.030	1.50	0.80	0.035	0.020	24.0-26.0	5.5-8.0	3.0-5.0	Cu 0.50-3.00; N 0.20-0.35
ASTM A473-15	---	S32550	---	0.04	1.50	1.00	0.040	0.030	24.0-27.0	4.5-6.5	2.9-3.9	Cu 1.50-2.50; N 0.10-0.25; [Cr+(3.3xMo)+(16xN)] 0.40 min.
EN 10250-4:1999	X2CrNiMoCuN25-6-3	---	1.4507	0.030	2.00	0.70	0.035	0.015	24.00-26.00	5.50-7.50	2.70-4.00	Cu 1.00-2.50; N 0.15-0.30
EN 10250-4:1999	X2CrNiN23-4	---	1.4362	0.030	2.00	1.00	0.035	0.015	22.00-24.00	3.50-5.50	0.10-0.60	Cu 0.10-0.60; N 0.05-0.20
ISO 9327-5:1999	Type X2CrNiN23-4	---	---	0.030	2.50	1.00	0.035	0.020	22.00-24.00	3.50-5.00	0.60	Cu 0.60; N 0.05-0.20

6.3 Stainless Steel Forgings

6.3.5B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steel Forgings

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-182/SA-182M	Grade F 50	S31200	---	---	---	450	65	690-900	100-130	25	ST+Q	---
ASTM A182/A182M-15	Grade F 50	S31200	---	---	---	450	65	690-900	100-130	25	ST+Q	---
EN 10250-4:1999	X3CrNiMoN27-5-2	---	1.4460	$t \leq 160$	---	460	---	620-880	---	20 L, 15 T	SA	see standard for impact data
ASME SA-182/SA-182M	Grade F 51	S31803	---	---	---	450	65	620	90	25	ST+Q	---
	Grade F 60	S32205	---	---	---	450	65	655	95	25	ST+Q	---
ASME SA-815/SA-815M	Grade WPS31803	S31803	---	---	---	450	65	620	90	20.0	HT+Q or RC	290 max HBW
	Grade CRS31803	S31803	---	---	---	450	65	620	90	20.0	HT+Q or RC	290 max HBW
	Grade WPS32205	S32205	---	---	---	450	65	655	95	20.0	HT+Q	290 max HBW
	Grade CRS32205	S32205	---	---	---	450	65	655	95	20.0	HT+Q	290 max HBW
ASTM A182/A182M-15	Grade F 51	S31803	---	---	---	450	65	620	90	25	ST+Q	---
	Grade F 60	S32205	---	---	---	450	65	655	95	25	ST+Q	---
ASTM A815/A815M-14	Grade WPS31803	S31803	---	---	---	450	65	620	90	20.0	HT+Q or RC	290 max HBW
	Grade CRS31803	S31803	---	---	---	450	65	620	90	20.0	HT+Q or RC	290 max HBW
	Grade WPS32205	S32205	---	---	---	450	65	655	95	20.0	HT+Q	290 max HBW
	Grade CRS32205	S32205	---	---	---	450	65	655	95	20.0	HT+Q	290 max HBW
EN 10222-5:1999	X2 CrNiMoN 22-5-3	---	1.4462	$t \leq 350$	---	450	---	680-880	---	30 L, 25 T	ST	see standard for impact data
EN 10250-4:1999	X2CrNiMoN22-5-3	---	1.4462	$t \leq 350$	---	450	---	650-880	---	25 L, 20 T	SA	see standard for impact data
ISO 9327-5:1999	Type X2CrNiMoN22-5-3	---	---	$t \leq 250$	---	450	---	600-860	---	25 L, 20 T	Q+T	see standard for impact data
ASME SA-182/SA-182M	Grade F 53	S32750	---	$t \leq 50$	$t \leq 2$	550	80	800	116	15	ST+Q	310 max HBW
				$t > 50$	$t > 2$	515	75	730	106	15	ST+Q	310 max HBW
ASME SA-815/SA-815M	Grade WPS32750	S32750	---	---	---	550	80	800-965	116-140	15.0	HT+Q or RC	310 max HBW
	Grade CRS32750	S32750	---	---	---	550	80	800-965	116-140	15.0	HT+Q or RC	310 max HBW
ASTM A182/A182M-15	Grade F 53	S32750	---	$t \leq 50$	$t \leq 2$	550	80	800	116	15	ST+Q	310 max HBW
				$t > 50$	$t > 2$	515	75	730	106	15	ST+Q	310 max HBW
ASTM A815/A815M-14	Grade WPS32750	S32750	---	---	---	550	80	800-965	116-140	15.0	HT+Q or RC	310 max HBW
	Grade CRS32750	S32750	---	---	---	550	80	800-965	116-140	15.0	HT+Q or RC	310 max HBW
EN 10222-5:1999	X2 CrNiMoN 25-7-4	---	1.4410	$t \leq 160$	---	500	---	800-1000	---	30 L, 25 T	ST	see standard for impact data
EN 10250-4:1999	X2CrNiMoN25-7-4	---	1.4410	$t \leq 160$	---	530	---	730-930	---	25 L, 20 T	SA	see standard for impact data

6.3 Stainless Steel Forgings

6.3.5B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steel Forgings (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi	% min.		
ASME SA-182/SA-182M	Grade F 55	S32760	---	---	---	550	80	750-895	109-130	25	ST+Q	---
ASME SA-815/SA-815M	Grade WPS32760	S32760	---	---	---	550	80	750-895	109-130	25.0	HT+Q or RC	270 max HBW
	Grade CRS32760	S32760	---	---	---	550	80	750-895	109-130	25.0	HT+Q or RC	270 max HBW
ASTM A182/A182M-15	Grade F 55	S32760	---	---	---	550	80	750-895	109-130	25	ST+Q	---
ASTM A473-15	---	S32760	---	---	---	550	80	750	109	25	A	290 max HB
ASTM A815/A815M-14	Grade WPS32760	S32760	---	---	---	550	80	750-895	109-130	25.0	HT+Q or RC	270 max HBW
	Grade CRS32760	S32760	---	---	---	550	80	750-895	109-130	25.0	HT+Q or RC	270 max HBW
EN 10250-4:1999	X2CrNiMoCuWN25-7-4	---	1.4501	$t \leq 160$	---	530	---	730-930	---	25 L, 20 T	SA	see standard for impact data
ASME SA-182/SA-182M	Grade F 59	S32520	---	---	---	550	80	770	112	25	ST+Q	---
ASTM A182/A182M-15	Grade F 59	S32520	---	---	---	550	80	770	112	25	ST+Q	---
ASTM A473-15	---	S32550	---	---	---	550	80	750	109	25.0	A+Q or RC	290 max HB
EN 10250-4:1999	X2CrNiMoCuN25-6-3	---	1.4507	$t \leq 160$	---	500	---	700-900	---	25 L, 20 T	SA	see standard for impact data
EN 10250-4:1999	X2CrNiN23-4	---	1.4362	$t \leq 160$	---	400	---	600-830	---	25 L, 20 T	SA	see standard for impact data
ISO 9327-5:1999	Type X2CrNiN23-4	---	---	$t \leq 160$	---	400	---	600-820	---	25 L, 20 T	Q+T	see standard for impact data

Chapter

7

STEEL CASTINGS

AFNOR Standards

AFNOR NF A 32-058:1984	Cast Steels and White Cast Iron Resistant to Abrasion

ASME Standards

ASME SA-216/SA-216M	Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service
ASME SA-217/SA-217M	Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service
ASME SA-351/SA-351	Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
ASME SA-352/SA-352M	Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service
ASME SA-487/SA-487M	Steel Castings Suitable for Pressure Service

ASTM Standards

ASTM A27/A27M-13	Steel Castings, Carbon, for General Application
ASTM A128/A128M-93 (2012)	Steel Castings, Austenitic Manganese
ASTM A148/A148 M-14	Steel Castings, High Strength, for Structural Purposes
ASTM A216/A216M-14e1	Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A217/A217M-14	Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service
ASTM A297/A297M-14	Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for General Application <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A351/A351M-14	Castings, Austenitic, for Pressure-Containing Parts
ASTM A352/A352M-06 (2012)	Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service
ASTM A389/A389M-13	Steel Castings, Alloy, Specially Heat-Treated, for Pressure-Containing Parts, Suitable for High-Temperature Service
ASTM A447/A447M-11	Steel Castings, Chromium-Nickel-Iron Alloy (25-12 Class), for High-Temperature Service
ASTM A487/A487M-14	Steel Castings Suitable for Pressure Service
ASTM A608/A608M-14	Centrifugally Cast Iron-Chromium-Nickel High-Alloy Tubing for Pressure Application at High Temperatures <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A743/A743M-13ae1	Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A744/A744M-13	Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A757/A757M-15	Steel Castings, Ferritic and Martensitic, for Pressure-Containing and Other Applications, for Low-Temperature Service
ASTM A958/A958M-14	Steel Castings, Carbon and Alloy, with Tensile Requirements, Chemical Requirements Similar to Standard Wrought Grades

EN Standards

EN 10213:2007 C1:2008	Steel castings for pressure purposes
EN 10283:2010	Corrosion resistant steel castings
EN 10293:2015	Steel castings – Steel castings for general engineering uses
EN 10295:2002	Heat resistant steel castings

GB Standards

GB/T 5680-1998	Austenitic Manganese Steel Castings
GB 7659-87	Carbon Steel Castings Suitable for Welded Structure
GB 11352-89	Carbon Steel Castings for General Engineering Purposes
GB/T 14408-93	Low Alloy Steel Castings for General Engineering and Structural Purposes
GB/T 16253-1996	Steel Castings for Pressure Purposes

ISO Standards

ISO 3755:1991	Cast Carbon Steels for General Engineering Purposes
ISO 4991:1994	Steel Castings for Pressure Purposes
ISO 9477:1992	High Strength Cast Steels for General Engineering and Structural Purposes
ISO 11972:1998	Corrosion-Resistant Cast Steels for General Applications
ISO 11973:1999	Heat-Resistant Cast Steels and Alloys for General Applications
ISO 13521:1999	Austenitic Manganese Steel Castings
ISO 14737:2003	Cast Non-Alloy and Low Alloy Steels for General Applications

JIS Standards

JIS G 5101:1991	Carbon steel castings
JIS G 5102:1991	Steel castings for welded structure
JIS G 5111:1991	High tensile strength carbon steel castings and low alloy steel castings for structural purposes
JIS G 5121:2003	Corrosion-resistant cast steels for general applications
JIS G 5122:2003	Heat-resistant cast steels and alloys for general applications
JIS G 5131:2008	High manganese steel castings
JIS G 5151:1991	Steel castings for high temperature and high pressure service
JIS G 5152:1991	Steel castings for low temperature and high pressure service

Heat Treatment Terms Applicable to this Chapter

Standard	Heat Treatment Terms
AFNOR NF A 32-058:1984	Q: water quenched
ASME SA-216/SA-216M	A: annealed; N: normalized; N+T: normalized and tempered
ASME SA-217/SA-217M	N+T: normalized and tempered
ASME SA-351/SA-351	Q: quenched; AC: as-cast
ASME SA-352/SA-352M	N+T: normalized and tempered; Q+T: quenched and tempered
ASME SA-487/SA-487M	N+T: normalized and tempered; Q+T: quenched and tempered
ASTM A27/A27M-13	FA: full annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
ASTM A128/A128M-93 (2012)	Q: quenched
ASTM A148/A148 M-14	FA: full annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
ASTM A216/A216M-14e1	A: annealed; N: normalized; N+T: normalized and tempered
ASTM A217/A217M-14	N+T: normalized and tempered
ASTM A297/A297M-14	AC: as cast; BA: by agreement
ASTM A351/A351M-14	Q: quenched; AC: as-cast
ASTM A352/A352M-06 (2012)	N+T: normalized and tempered; Q+T: quenched and tempered
ASTM A389/A389M-13	N+T: normalized and tempered
ASTM A447/A447M-11	---
ASTM A487/A487M-14	N+T: normalized and tempered; Q+T: quenched and tempered
ASTM A608/A608M-14	---
ASTM A743/A743M-13ae1	A: annealed; N+T: normalized and tempered; Q: quenched; AC: as-cast
ASTM A744/A744M-13	Q: quenched
ASTM A757/A757M-15	N+T: normalized and tempered; Q+T: quenched and tempered
ASTM A958/A958M-14	N: normalized; N+T: normalized and tempered; HT+Q+T: heat treated and quenched, then tempered
EN 10213:2007 C1:2008	N: normalized; Q+T: quenched and tempered; SA+Q: solution annealed and water quenched
EN 10283:2010	Q+T: quenched and tempered; SA+Q: solution annealed and water quenched
EN 10293:2015	N: normalized; Q+T: quenched and tempered
EN 10295:2002	A: annealed
GB/T 5680-1998	Q: water quenched
GB 7659-87	A: annealed; N: normalized; N+T: normalized and tempered
GB 11352-89	A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
GB/T 14408-93	A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
GB/T 16253-1996	A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered; N+C(A)+T: normalized and rapid air cooled and tempered; ST: solution treated
ISO 3755:1991	AM: at discretion of the manufacturer
ISO 4991:1994	A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered; ST: solution treated
ISO 9477:1992	AM: at discretion of the manufacturer
ISO 11972:1998	N+T: normalized and tempered; ST+Q: solution treated and quenched
ISO 11973:1999	A: annealed; AC: as-cast
ISO 13521:1999	ST+Q: solution treated and water quenched
JIS G 5101:1991	A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
JIS G 5102:1991	A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
JIS G 5111:1991	N+T: normalized and tempered; Q+T: quenched and tempered
JIS G 5121:2003	Q+T: quenched and tempered; ST: solution treated
JIS G 5122:2003	A: annealed; AC: as cast; BA: by agreement
JIS G 5131:2008	Q: water toughened
JIS G 5151:1991	A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered
JIS G 5152:1991	A: annealed; N: normalized; N+T: normalized and tempered; Q+T: quenched and tempered

Impact Testing Notes Applicable to this Chapter

see standard for impact data: impact testing requirements are listed in the standard for multiple test temperatures.

7.1 Cast Carbon Steels

7.1.1A Mechanical Properties of Cast Carbon Steel for General and Structural Applications

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
JIS G 5101:1991	Class SC 360	---	---	---	175	---	360	---	23	A, N, N+T or Q+T	---
EN 10293:2015	GE200	---	1.0420	$t \leq 300$	200	---	380-530	---	25	N	27 J @ RT
	GS200	---	1.0449	$t \leq 100$	200	---	380-530	---	25	N	35 J @ RT
GB 11352-89	Grade ZG 200-400	---	---	$t \leq 100$	200	---	400	---	25	A, N, N+T or Q+T	30 J @ RT
GB 7659-87	Grade ZG200-400H	---	---	---	200	---	400	---	25	A, N or N+T	see standard for impact data
ISO 3755:1991	Grade 200-400	---	---	$t \leq 28$	200	---	400-550	---	25	AM	30 J @ 23°C ± 5
	Grade 200-400W	---	---	$t \leq 28$	200	---	400-550	---	25	AM	45 J @ 23°C ± 5
JIS G 5101:1991	Class SC 410	---	---	---	205	---	410	---	21	A, N, N+T or Q+T	---
JIS G 5102:1991	Class SCW 410	---	---	---	235	---	410	---	21	A, N, N+T or Q+T	27 J @ 0°C
ASTM A27/A27M-13	Grade 60-30 [415-205]	J03000	---	---	205	30	415	60	24	FA, N, N+T or Q+T	---
	Grade U-60-30 [415-205]	J02500	---	---	205	30	415	60	22	---	---
JIS G 5101:1991	Class SC 450	---	---	---	225	---	450	---	19	A, N, N+T or Q+T	---
GB 11352-89	Grade ZG 230-450	---	---	$t \leq 100$	230	---	450	---	22	A, N, N+T or Q+T	25 J @ RT
GB 7659-87	Grade ZG230-450H	---	---	---	230	---	450	---	22	A, N or N+T	see standard for impact data
ISO 3755:1991	Grade 230-450	---	---	$t \leq 28$	230	---	450-600	---	22	AM	25 J @ 23°C ± 5
	Grade 230-450W	---	---	$t \leq 28$	230	---	450-600	---	22	AM	45 J @ 23°C ± 5
ASTM A27/A27M-13	Grade 65-35 [450-240]	J03001	---	---	240	35	450	65	24	FA, N, N+T or Q+T	---
ASTM A958/A958M-14	Grade SC 1020, Class 65/35	J02003	---	---	240	35	450	65	24	N	---
	Grade SC 1025, Class 65/35	J02508	---	---	240	35	450	65	24	N	---
	Grade SC 1030, Class 65/35	J03012	---	---	240	35	450	65	24	N	---
EN 10293:2015	GE240	---	1.0446	$t \leq 300$	240	---	450-600	---	22	N	27 J @ RT
	GS240	---	1.0455	$t \leq 100$	240	---	450-600	---	22	N	31 J @ RT
	G17Mn5	---	1.1131	$t \leq 50$	240	---	450-600	---	24	Q+T	see standard for impact data
JIS G 5102:1991	Class SCW 450	---	---	---	255	---	450	---	20	A, N, N+T or Q+T	27 J @ 0°C

7.1 Cast Carbon Steels

7.1.1A Mechanical Properties of Cast Carbon Steel for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
JIS G 5101:1991	Class SC 480	---	---	---	245	---	480	---	17	A, N, N+T or Q+T	---
GB/T 14408-93	Grade ZGD270-480	---	---	---	270	---	480	---	18	A, N, N+T or Q+T	---
ISO 3755:1991	Grade 270-480	---	---	t ≤ 28	270	---	480-630	---	18	AM	22 J @ 23°C ± 5
				28 < t ≤ 40	260	---	500-650	---	---	AM	---
	Grade 270-480W	---	---	t ≤ 28	270	---	480-630	---	18	AM	22 J @ 23°C ± 5
				28 < t ≤ 40	260	---	500-650	---	---	AM	---
JIS G 5102:1991	Class SCW 480	---	---	---	275	---	480	---	20	A, N, N+T or Q+T	27 J @ 0°C
EN 10293:2015	G20Mn5	---	1.6220	t ≤ 30	300	---	480-620	---	20	N	see standard for impact data
				t ≤ 100	300	---	500-650	---	22	Q+T	
ASTM A27/A27M-13	Grade 70-36 [485-250]	J03501	---	---	250	36	485	70	22	FA, N, N+T or Q+T	---
	Grade 70-40 [485-275]	J02501	---	---	275	40	485	70	22	FA, N, N+T or Q+T	---
ASTM A958/A958M-14	Grade SC 1020, Class 70/36	J02003	---	---	250	36	485	70	22	N	---
	Grade SC 1025, Class 70/36	J02508	---	---	250	36	485	70	22	N	---
	Grade SC 1030, Class 70/36	J03012	---	---	250	36	485	70	22	N+T	---
	Grade SC 1040, Class 70/36	J04003	---	---	250	36	485	70	22	N+T	---
GB 7659-87	Grade ZG275-485H	---	---	---	275	---	485	---	20	A, N or N+T	see standard for impact data
GB 11352-89	Grade ZG 270-500	---	---	t ≤ 100	270	---	500	---	18	A, N, N+T or Q+T	22 J @ RT
GB/T 14408-93	Grade ZGD290-510	---	---	---	290	---	510	---	16	A, N, N+T or Q+T	---
	Grade ZGD345-570	---	---	---	345	---	570	---	14	A, N, N+T or Q+T	---
JIS G 5111:1991	Class SCC 3A	---	---	---	265	---	520	---	13	N+T	143 min. HB
	Class SCMn 1A	---	---	---	275	---	540	---	17	N+T	143 min. HB
ASTM A148/A148 M-14	Grade 80-40 [550-275]	D50400	---	---	275	40	550	80	18	FA, N, N+T or Q+T	---
	Grade 80-50 [550-345]	D50500	---	---	345	50	550	80	22	FA, N, N+T or Q+T	---
ASTM A958/A958M-14	Grade SC 1030, Class 80/40	J03012	---	---	275	40	550	80	18	HT+Q+T	---
	Grade SC 1030, Class 80/50	J03012	---	---	345	50	550	80	22	HT+Q+T	---
	Grade SC 1040, Class 80/40	J04003	---	---	275	40	550	80	18	N+T	---
	Grade SC 1040, Class 80/50	J04003	---	---	345	50	550	80	22	N+T	---
	Grade SC 1045, Class 80/40	J04502	---	---	275	40	550	80	18	N+T	---
	Grade SC 1045, Class 80/50	J04502	---	---	345	50	550	80	22	N+T	---
ISO 3755:1991	Grade 340-550	---	---	t ≤ 28	340	---	550-700	---	15	AM	20 J @ 23°C ± 5
				28 < t ≤ 40	300	---	570-720	---	---	AM	---
	Grade 340-550W	---	---	t ≤ 28	340	---	550-700	---	15	AM	20 J @ 23°C ± 5
				28 < t ≤ 40	300	---	570-720	---	---	AM	---
JIS G 5102:1991	Class SCW 550	---	---	---	355	---	550	---	18	A, N, N+T or Q+T	27 J @ 0°C

7.1 Cast Carbon Steels

7.1.1A Mechanical Properties of Cast Carbon Steel for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
GB 11352-89	Grade ZG 310-570	---	---	$t \leq 100$	310	---	570	---	15	A, N, N+T or Q+T	15 J @ RT
JIS G 5111:1991	Class SCMn 2A	---	---	---	345	---	590	---	16	N+T	163 min. HB
	Class SCSiMn 2A	---	---	---	295	---	590	---	13	N+T	163 min. HB
	Class SCMn 1B	---	---	---	390	---	590	---	17	Q+T	170 min. HB
EN 10293:2015	GE300	---	1.0558	$t \leq 30$	300	---	600-750	---	15	N	27 J @ RT
				$30 < t \leq 100$	300	---	520-670	---	18	N	31 J @ RT
JIS G 5111:1991	Class SCC 5A	---	---	---	295	---	620	---	9	N+T	163 min. HB
	Class SCMn 3A	---	---	---	370	---	640	---	13	N+T	170 min. HB
	Class SCC 3B	---	---	---	370	---	620	---	13	Q+T	183 min. HB
	Class SCSiMn 2B	---	---	---	440	---	640	---	17	Q+T	183 min. HB
	Class SCMn 2B	---	---	---	440	---	640	---	16	Q+T	183 min. HB
GB/T 14408-93	Grade ZGD410-620	---	---	---	410	---	620	---	13	A, N, N+T or Q+T	---
ISO 9477:1992	Grade 410-620	---	---	---	410	---	620-770	---	16	AM	20 J @ 23°C ± 5
ASTM A148/A148 M-14	Grade 90-60 [620-415]	D50600	---	---	415	60	620	90	20	FA, N, N+T or Q+T	---
ASTM A958/A958M-14	Grade SC 1040, Class 90/60	J04003	---	---	415	60	620	90	18	N+T	---
	Grade SC 1045, Class 90/60	J04502	---	---	415	60	620	90	18	N+T	---
JIS G 5102:1991	Class SCW 620	---	---	---	430	---	620	---	17	A, N, N+T or Q+T	27 J @ 0°C
GB 11352-89	Grade ZG 340-640	---	---	$t \leq 100$	340	---	640	---	10	A, N, N+T or Q+T	10 J @ RT
JIS G 5111:1991	Class SCMn 5A	---	---	---	390	---	690	---	9	N+T	183 min. HB
	Class SCC 5B	---	---	---	440	---	690	---	9	Q+T	201 min. HB
	Class SCMn 3B	---	---	---	490	---	690	---	13	Q+T	197 min. HB
EN 10293:2015	G24Mn6	---	1.1118	$t \leq 50$	550	---	700-800	---	12	Q+T	27 J @ -20°C
				$t \leq 100$	500	---	650-800	---	15	Q+T	27 J @ -30°C
				$t \leq 150$	400	---	600-800	---	18	Q+T	27 J @ -30°C
	G28Mn6	---	1.1165	$t \leq 50$	550	---	700-850	---	10	Q+T	31 J @ RT
				$t \leq 100$	450	---	600-750	---	14	Q+T	35 J @ RT
				$t \leq 250$	260	---	520-670	---	18	N	27 J @ RT

7.1 Cast Carbon Steels

7.1.1A Mechanical Properties of Cast Carbon Steel for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
GB/T 14408-93	Grade ZGD535-720	---	---	---	535	---	720	---	12	A, N, N+T or Q+T	---
ISO 9477:1992	Grade 540-720	---	---	---	540	---	720-870	---	14	AM	20 J @ 23°C ± 5
ASTM A148/A148 M-14	Grade 105-85 [725-585]	D50850	---	---	585	85	725	105	17	FA, N, N+T or Q+T	---
ASTM A958/A958M-14	Grade SC 1045, Class 105/85	J04502	---	---	585	85	725	105	17	N+T	---
JIS G 5111:1991	Class SCMn 5B	---	---	---	540	---	740	---	9	Q+T	212 min. HB
ASTM A148/A148 M-14	Grade 115-95 [795-655]	D50950	---	---	655	95	795	115	14	FA, N, N+T or Q+T	---
ISO 9477:1992	Grade 620-820	---	---	---	620	---	820-970	---	11	AM	18 J @ 23°C ± 5
GB/T 14408-93	Grade ZGD650-830	---	---	---	650	---	830	---	10	A, N, N+T or Q+T	---
ASTM A148/A148 M-14	Grade 130-115 [895-795]	D51150	---	---	795	115	895	130	11	FA, N, N+T or Q+T	---
GB/T 14408-93	Grade ZGD730-910	---	---	---	730	---	910	---	8	A, N, N+T or Q+T	---
GB/T 14408-93	Grade ZGD840-1030	---	---	---	840	---	1030	---	6	A, N, N+T or Q+T	---
ISO 9477:1992	Grade 840-1030	---	---	---	840	---	1030-1180	---	7	AM	15 J @ 23°C ± 5
ASTM A148/A148 M-14	Grade 150-135 [1035-930]	D51350	---	---	930	135	1035	150	7	FA, N, N+T or Q+T	---

7.1.1B Chemical Composition of Cast Carbon Steel for General and Structural Applications

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 5101:1991	Class SC 360	---	---	0.20	---	---	0.040	0.040	---	---	---	---
EN 10293:2015	GE200	---	1.0420	---	---	---	0.035	0.030	0.30	0.40	0.12	V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00
	GS200	---	1.0449	0.18	1.20	0.60	0.030	0.025	0.30	0.40	0.12	V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00
GB 11352-89	Grade ZG 200-400	---	---	0.20	0.80	0.50	0.04	0.04	0.35	0.30	0.20	V 0.05; Cu 0.30
GB 7659-87	Grade ZG200-400H	---	---	0.20	0.80	0.50	0.04	0.04	0.30	0.30	0.15	V 0.05; Cu 0.30
ISO 3755:1991	Grade 200-400	---	---	---	---	---	0.035	0.035	---	---	---	---
	Grade 200-400W	---	---	0.25	1.00	0.60	0.035	0.035	---	---	---	---

7.1 Cast Carbon Steels

7.1.1B Chemical Composition of Cast Carbon Steel for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 5101:1991	Class SC 410	---	---	0.30	---	---	0.040	0.040	---	---	---	---
JIS G 5102:1991	Class SCW 410	---	---	0.22	1.50	0.80	0.040	0.040	---	---	---	---
ASTM A27/A27M-13	Grade 60-30 [415-205]	J03000	---	0.30	0.60	0.80	0.035	0.035	---	---	---	---
	Grade U-60-30 [415-205]	J02500	---	0.25	0.75	0.80	0.035	0.035	---	---	---	---
JIS G 5101:1991	Class SC 450	---	---	0.35	---	---	0.040	0.040	---	---	---	---
GB 11352-89	Grade ZG 230-450	---	---	0.30	0.90	0.50	0.04	0.04	0.35	0.30	0.20	V 0.05; Cu 0.30
GB 7659-87	Grade ZG230-450H	---	---	0.20	1.20	0.50	0.04	0.04	0.30	0.30	0.15	V 0.05; Cu 0.30
ISO 3755:1991	Grade 230-450	---	---	---	---	---	0.035	0.035	---	---	---	---
	Grade 230-450W	---	---	0.25	1.20	0.60	0.035	0.035	---	---	---	---
ASTM A27/A27M-13	Grade 65-35 [450-240]	J03001	---	0.30	0.70	0.80	0.035	0.035	---	---	---	---
ASTM A958/A958M-14	Grade SC 1020, Class 65/35	J02003	---	0.18-0.23	0.40-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	Grade SC 1025, Class 65/35	J02508	---	0.22-0.28	0.40-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	Grade SC 1030, Class 65/35	J03012	---	0.28-0.34	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
EN 10293:2015	GE240	---	1.0446	---	---	---	0.035	0.030	0.30	0.40	0.12	V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00
	GS240	---	1.0455	0.23	1.20	0.60	0.030	0.025	0.30	0.40	0.12	V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00
	G17Mn5	---	1.1131	0.15-0.20	1.00-1.60	0.60	0.020	0.020	0.30	0.40	0.12	V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00
JIS G 5102:1991	Class SCW 450	---	---	0.22	1.50	0.80	0.040	0.040	---	---	---	---
JIS G 5101:1991	Class SC 480	---	---	0.40	---	---	0.040	0.040	---	---	---	---
GB/T 14408-93	Grade ZGD270-480	---	---	---	---	---	0.040	0.040	---	---	---	---
ISO 3755:1991	Grade 270-480	---	---	---	---	---	0.035	0.035	---	---	---	---
	Grade 270-480W	---	---	0.25	1.20	0.60	0.035	0.035	---	---	---	---
JIS G 5102:1991	Class SCW 480	---	---	0.22	1.50	0.80	0.040	0.040	0.50	0.50	---	---
EN 10293:2015	G20Mn5	---	1.6220	0.17-0.23	1.00-1.60	0.60	0.020	0.020	0.30	0.80	0.12	V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00
ASTM A27/A27M-13	Grade 70-36 [485-250]	J03501	---	0.35	0.70	0.80	0.035	0.035	---	---	---	---
	Grade 70-40 [485-275]	J02501	---	0.25	1.20	0.80	0.035	0.035	---	---	---	---
ASTM A958/A958M-14	Grade SC 1020, Class 70/36	J02003	---	0.18-0.23	0.40-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	Grade SC 1025, Class 70/36	J02508	---	0.22-0.28	0.40-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	Grade SC 1030, Class 70/36	J03012	---	0.28-0.34	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
	Grade SC 1040, Class 70/36	J04003	---	0.37-0.44	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
GB 7659-87	Grade ZG275-485H	---	---	0.25	1.20	0.50	0.04	0.04	0.30	0.30	0.15	V 0.05; Cu 0.30

7.1 Cast Carbon Steels

7.1.1B Chemical Composition of Cast Carbon Steel for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
GB 11352-89	Grade ZG 270-500	---	---	0.40	0.90	0.50	0.04	0.04	0.35	0.30	0.20	V 0.05; Cu 0.30
GB/T 14408-93	Grade ZGD290-510	---	---	---	---	---	0.040	0.040	---	---	---	---
	Grade ZGD345-570	---	---	---	---	---	0.040	0.040	---	---	---	---
JIS G 5111:1991	Class SCC 3A	---	---	0.30-0.40	0.50-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	Class SCMn 1A	---	---	0.20-0.30	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
ASTM A148/A148 M-14	Grade 80-40 [550-275]	D50400	---	---	---	---	0.05	0.06	---	---	---	---
	Grade 80-50 [550-345]	D50500	---	---	---	---	0.05	0.06	---	---	---	---
ASTM A958/A958M-14	Grade SC 1030, Class 80/40	J03012	---	0.28-0.34	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
	Grade SC 1030, Class 80/50	J03012	---	0.28-0.34	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
	Grade SC 1040, Class 80/40	J04003	---	0.37-0.44	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
	Grade SC 1040, Class 80/50	J04003	---	0.37-0.44	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
	Grade SC 1045, Class 80/40	J04502	---	0.43-0.50	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
	Grade SC 1045, Class 80/50	J04502	---	0.43-0.50	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
ISO 3755:1991	Grade 340-550	---	---	---	---	---	0.035	0.035	---	---	---	---
	Grade 340-550W	---	---	0.25	1.50	0.60	0.035	0.035	---	---	---	---
JIS G 5102:1991	Class SCW 550	---	---	0.22	1.50	0.80	0.040	0.040	0.50	2.50	0.30	V 0.20
GB 11352-89	Grade ZG 310-570	---	---	0.50	0.90	0.60	0.04	0.04	0.35	0.30	0.20	V 0.05; Cu 0.30
JIS G 5111:1991	Class SCMn 2A	---	---	0.25-0.35	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
	Class SCSiMn 2A	---	---	0.25-0.35	0.90-1.20	0.50-0.80	0.040	0.040	---	---	---	---
	Class SCMn 1B	---	---	0.20-0.30	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
EN 10293:2015	GE300	---	1.0558	---	---	---	0.035	0.030	0.30	0.40	0.12	V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00
JIS G 5111:1991	Class SCC 5A	---	---	0.40-0.50	0.50-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	Class SCMn 3A	---	---	0.30-0.40	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
	Class SCC 3B	---	---	0.30-0.40	0.50-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	Class SCSiMn 2B	---	---	0.25-0.35	0.90-1.20	0.50-0.80	0.040	0.040	---	---	---	---
	Class SCMn 2B	---	---	0.25-0.35	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
GB/T 14408-93	Grade ZGD410-620	---	---	---	---	---	0.040	0.040	---	---	---	---
ISO 9477:1992	Grade 410-620	---	---	---	---	0.60	0.035	0.035	---	---	---	---
ASTM A148/A148 M-14	Grade 90-60 [620-415]	D50600	---	---	---	---	0.05	0.06	---	---	---	---
ASTM A958/A958M-14	Grade SC 1040, Class 90/60	J04003	---	0.37-0.44	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
	Grade SC 1045, Class 90/60	J04502	---	0.43-0.50	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
JIS G 5102:1991	Class SCW 620	---	---	0.22	1.50	0.80	0.040	0.040	0.50	2.50	0.30	V 0.20
GB 11352-89	Grade ZG 340-640	---	---	0.60	0.90	0.60	0.04	0.04	0.35	0.30	0.20	V 0.05; Cu 0.30

7.1 Cast Carbon Steels

7.1.1B Chemical Composition of Cast Carbon Steel for General and Structural Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 5111:1991	Class SCMn 5A	---	---	0.40-0.50	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
	Class SCC 5B	---	---	0.40-0.50	0.50-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	Class SCMn 3B	---	---	0.30-0.40	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
EN 10293:2015	G24Mn6	---	1.1118	0.20-0.25	1.50-1.80	0.60	0.020	0.015	0.30	0.40	0.12	V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00
	G28Mn6	---	1.1165	0.25-0.32	1.20-1.80	0.60	0.035	0.030	0.30	0.40	0.12	V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00
GB/T 14408-93	Grade ZGD535-720	---	---	---	---	---	0.040	0.040	---	---	---	---
ISO 9477:1992	Grade 540-720	---	---	---	---	0.60	0.035	0.035	---	---	---	---
ASTM A148/A148 M-14	Grade 105-85 [725-585]	D50850	---	---	---	---	0.05	0.06	---	---	---	---
ASTM A958/A958M-14	Grade SC 1045, Class 105/85	J04502	---	0.43-0.50	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
JIS G 5111:1991	Class SCMn 5B	---	---	0.40-0.50	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
ASTM A148/A148 M-14	Grade 115-95 [795-655]	D50950	---	---	---	---	0.05	0.06	---	---	---	---
ISO 9477:1992	Grade 620-820	---	---	---	---	0.60	0.035	0.035	---	---	---	---
GB/T 14408-93	Grade ZGD650-830	---	---	---	---	---	0.040	0.040	---	---	---	---
ASTM A148/A148 M-14	Grade 130-115 [895-795]	D51150	---	---	---	---	0.05	0.06	---	---	---	---
GB/T 14408-93	Grade ZGD730-910	---	---	---	---	---	0.035	0.035	---	---	---	---
GB/T 14408-93	Grade ZGD840-1030	---	---	---	---	---	0.035	0.035	---	---	---	---
ISO 9477:1992	Grade 840-1030	---	---	---	---	0.60	0.035	0.035	---	---	---	---
ASTM A148/A148 M-14	Grade 150-135 [1035-930]	D51350	---	---	---	---	0.05	0.06	---	---	---	---

7.1 Cast Carbon Steels

7.1.2A Mechanical Properties of Cast Carbon Steel for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
JIS G 5151:1991	Class SCPH 1	---	---	---	205	---	410	---	21	A, N, N+T or Q+T	---
ASME SA-216/SA-216M	Grade WCA	J02502	---	---	205	30	415-585	60-85	24	A, N or N+T	---
ASTM A216/A216M-14e1	Grade WCA	J02502	---	---	205	30	415-585	60-85	24	A, N or N+T	---
EN 10213:2007 C1:2008	GP240GH	---	1.0619	$t \leq 100$	240	---	420-600	---	22	N	27 J @ RT
				$t \leq 100$	240	---	420-600	---	22	Q+T	40 J @ RT
GB/T 16253-1996	Grade ZG240-450A	---	---	---	240	---	450-600	---	22	A, N, N+T or Q+T	27 J @ RT
	Grade ZG240-450AG	---	---	---	240	---	450-600	---	22	N, N+T or Q+T	27 J @ RT
	Grade ZG240-450B	---	---	---	240	---	450-600	---	22	A, N, N+T or Q+T	45 J @ RT
	Grade ZG240-450BG	---	---	---	240	---	450-600	---	22	N, N+T or Q+T	45 J @ RT
ISO 4991:1994	Type C23-45A	---	---	---	240	---	450-600	---	22	A, N, N+T or Q+T	27 J @ RT
	Type C23-45AH	---	---	---	240	---	450-600	---	22	N, N+T or Q+T	27 J @ RT
	Type C23-45B	---	---	---	240	---	450-600	---	22	A, N, N+T or Q+T	45 J @ RT
	Type C23-45BH	---	---	---	240	---	450-600	---	22	N, N+T or Q+T	45 J @ RT
JIS G 5151:1991	Class SCPH 2	---	---	---	245	---	480	---	19	A, N, N+T or Q+T	---
EN 10213:2007 C1:2008	GP280GH	---	1.0625	$t \leq 100$	280	---	480-640	---	22	N	27 J @ RT
				$t \leq 100$	280	---	480-640	---	22	Q+T	35 J @ RT
ASME SA-216/SA-216M	Grade WCB	J03002	---	---	250	36	485-655	70-95	22	A, N or N+T	---
	Grade WCC	J02503	---	---	275	40	485-655	70-95	22	A, N or N+T	---
ASTM A216/A216M-14e1	Grade WCB	J03002	---	---	250	36	485-655	70-95	22	A, N or N+T	---
	Grade WCC	J02503	---	---	275	40	485-655	70-95	22	A, N or N+T	---
GB/T 16253-1996	Grade ZG280-520	---	---	---	280	---	520-670	---	18	A, N, N+T or Q+T	35 J @ RT
	Grade ZG280-520G	---	---	---	280	---	520-670	---	18	N, N+T or Q+T	35 J @ RT
ISO 4991:1994	Type C26-52	---	---	---	280	---	520-670	---	18	A, N, N+T or Q+T	35 J @ RT
	Type C26-52H	---	---	---	280	---	520-670	---	18	N, N+T or Q+T	35 J @ RT

7.1 Cast Carbon Steels

7.1.2B Chemical Composition of Cast Carbon Steel for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
JIS G 5151:1991	Class SCPH 1	---	---	0.25	0.70	0.60	0.040	0.040	0.25	0.50	0.25	Cu 0.50; (Cu+Ni+Cr+Mo) 1.00
ASME SA-216/SA-216M	Grade WCA	J02502	---	0.25	0.70	0.60	0.04	0.045	0.50	0.50	0.20	V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00
ASTM A216/A216M-14e1	Grade WCA	J02502	---	0.25	0.70	0.60	0.035	0.035	0.50	0.50	0.20	V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00
EN 10213:2007 C1:2008	GP240GH	---	1.0619	0.18-0.23	0.50-1.20	0.60	0.030	0.020	0.30	0.40	0.12	V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00
GB/T 16253-1996	Grade ZG240-450A	---	---	0.25	1.20	0.60	0.035	0.035	0.40	0.40	0.15	V 0.03; Cu 0.40
	Grade ZG240-450AG	---	---	0.25	1.20	0.60	0.035	0.035	0.40	0.40	0.15	V 0.03; Cu 0.40
	Grade ZG240-450B	---	---	0.20	1.00-1.60	0.60	0.035	0.035	0.40	0.40	0.15	V 0.03; Cu 0.40
	Grade ZG240-450BG	---	---	0.20	1.00-1.60	0.60	0.035	0.035	0.40	0.40	0.15	V 0.03; Cu 0.40
ISO 4991:1994	Type C23-45A	---	---	0.25	1.20	0.60	0.035	0.035	---	---	---	---
	Type C23-45AH	---	---	0.25	1.20	0.60	0.035	0.035	0.40	0.40	0.15	(Cr+Mo+Ni+V+Cu) 1.00; V 0.03; Cu 0.40
	Type C23-45B	---	---	0.20	1.00-1.60	0.60	0.035	0.035	0.40	0.40	0.15	(Cr+Mo+Ni+V+Cu) 1.00; V 0.03; Cu 0.40
	Type C23-45BH	---	---	0.20	1.00-1.60	0.60	0.035	0.035	0.40	0.40	0.15	(Cr+Mo+Ni+V+Cu) 1.00; V 0.03; Cu 0.40
JIS G 5151:1991	Class SCPH 2	---	---	0.30	1.00	0.60	0.040	0.040	0.25	0.50	0.25	Cu 0.50; (Cu+Ni+Cr+Mo) 1.00
EN 10213:2007 C1:2008	GP280GH	---	1.0625	0.18-0.25	0.80-1.20	0.60	0.030	0.020	0.30	0.40	0.12	V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00
ASME SA-216/SA-216M	Grade WCB	J03002	---	0.30	1.00	0.60	0.04	0.045	0.50	0.50	0.20	V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00
	Grade WCC	J02503	---	0.25	1.20	0.60	0.04	0.045	0.50	0.50	0.20	V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00
ASTM A216/A216M-14e1	Grade WCB	J03002	---	0.30	1.00	0.60	0.035	0.035	0.50	0.50	0.20	V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00
	Grade WCC	J02503	---	0.25	1.20	0.60	0.035	0.035	0.50	0.50	0.20	V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00
GB/T 16253-1996	Grade ZG280-520	---	---	0.25	1.20	0.60	0.035	0.035	0.40	0.40	0.15	V 0.03; Cu 0.40
	Grade ZG280-520G	---	---	0.25	1.20	0.60	0.035	0.035	0.40	0.40	0.15	V 0.03; Cu 0.40
ISO 4991:1994	Type C26-52	---	---	0.25	1.20	0.60	0.035	0.035	0.40	0.40	0.15	(Cr+Mo+Ni+V+Cu) 1.00; V 0.03; Cu 0.40
	Type C26-52H	---	---	0.25	1.20	0.60	0.035	0.035	0.40	0.40	0.15	(Cr+Mo+Ni+V+Cu) 1.00; V 0.03; Cu 0.40

7.1 Cast Carbon Steels

7.1.3A Mechanical Properties of Cast Carbon Steel for Pressure Purposes at Low Temperatures

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
ASME SA-352/SA-352M	Grade LCA	J02504	---	---	205	30.0	415-585	60.0-85.0	24	N+T or Q+T	18 J @ -32°C
	Grade LCB	J03003	---	---	240	35.0	450-620	65.0-90.0	24	N+T or Q+T	18 J @ -46°C
	Grade LCC	J02505	---	---	275	40.0	485-655	70.0-95.0	22	N+T or Q+T	20 J @ -46°C
ASTM A352/A352M-06 (2012)	Grade LCA	J02504	---	---	205	30.0	415-585	60.0-85.0	24	N+T or Q+T	18 J @ -32°C
	Grade LCB	J03003	---	---	240	35.0	450-620	65.0-90.0	24	N+T or Q+T	18 J @ -46°C
	Grade LCC	J02505	---	---	275	40.0	485-655	70.0-95.0	22	N+T or Q+T	20 J @ -46°C
ASTM A757/A757M-15	Grade A1Q	J03002	---	---	240	35	450	65	24	Q+T	L: 17 J @ -46°C
	Grade A2Q	J02503	---	---	275	40	485	70	22	Q+T	L: 20 J @ -46°C
EN 10213:2007 C1:2008	G17Mn5	---	1.1131	$t \leq 50$	240	---	450-600	---	24	Q+T	27 J @ -40°C
	G20Mn5	---	1.6220	$t \leq 30$	300	---	480-620	---	20	N	27 J @ -30°C
				$t \leq 100$	300	---	500-650	---	22	Q+T	27 J @ -40°C
GB/T 16253-1996	Grade ZG240-450BD	---	---	---	240	---	450-600	---	22	N, N+T or Q+T	27 J @ -40°C
	Grade ZG280-520D	---	---	---	280	---	520-670	---	18	N+T or Q+T	27 J @ -35°C
ISO 4991:1994	Type C23-45BL	---	---	---	240	---	450-600	---	22	N+T or Q+T	27 J @ -40°C
	Type C26-52L	---	---	---	280	---	520-670	---	18	N+T or Q+T	27 J @ -35°C
JIS G 5152:1991	Class SCPL 1	---	---	---	245	---	450	---	21	A, N, N+T or Q+T	see standard for impact data

7.1 Cast Carbon Steels

7.1.3B Chemical Composition of Cast Carbon Steel for Pressure Purposes at Low Temperatures

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
ASME SA-352/SA-352M	Grade LCA	J02504	---	0.25	0.70	0.60	0.04	0.045	0.50	0.50	0.20	V 0.03; Cu 0.30; (Cr+Ni+V) 1.00
	Grade LCB	J03003	---	0.30	1.00	0.60	0.04	0.045	0.50	0.50	0.20	V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00
	Grade LCC	J02505	---	0.25	1.20	0.60	0.04	0.045	0.50	0.50	0.20	V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00
ASTM A352/A352M-06 (2012)	Grade LCA	J02504	---	0.25	0.70	0.60	0.04	0.045	0.50	0.50	0.20	V 0.03; Cu 0.30; (Cr+Ni+V) 1.00
	Grade LCB	J03003	---	0.30	1.00	0.60	0.04	0.045	0.50	0.50	0.20	V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00
	Grade LCC	J02505	---	0.25	1.20	0.60	0.04	0.045	0.50	0.50	0.20	V 0.03; Cu 0.30; (Cr+Ni+Mo+V+Cu) 1.00
ASTM A757/A757M-15	Grade A1Q	J03002	---	0.30	1.00	0.60	0.025	0.025	0.40	0.50	0.25	V 0.03; Cu 0.50; (V+Cr+Ni+Mo+Cu+P+S) 1.00
	Grade A2Q	J02503	---	0.25	1.20	0.60	0.025	0.025	0.40	0.50	0.25	V 0.03; Cu 0.50; (V+Cr+Ni+Mo+Cu+P+S) 1.00
EN 10213:2007 C1:2008	G17Mn5	---	1.1131	0.15-0.20	1.00-1.60	0.60	0.020	0.020	0.30	0.40	0.12	V 0.03; Cu 0.30; (Cr+Mo+Ni+V+Cu) 1.00
	G20Mn5	---	1.6220	0.17-0.23	1.00-1.60	0.60	0.020	0.020	0.30	0.80	0.12	V 0.03; Cu 0.30
GB/T 16253-1996	Grade ZG240-450BD	---	---	0.20	1.00-1.60	0.60	0.030	0.030	0.40	0.40	0.15	V 0.03; Cu 0.40
	Grade ZG280-520D	---	---	0.25	1.20	0.60	0.030	0.030	0.40	0.40	0.15	V 0.03; Cu 0.40
ISO 4991:1994	Type C23-45BL	---	---	0.20	1.00-1.60	0.60	0.030	0.030	0.40	0.40	0.15	(Cr+Mo+Ni+V+Cu) 1.00; V 0.03; Cu 0.40
	Type C26-52L	---	---	0.25	1.20	0.60	0.030	0.030	0.40	0.40	0.15	(Cr+Mo+Ni+V+Cu) 1.00; V 0.03; Cu 0.40
JIS G 5152:1991	Class SCPL 1	---	---	0.30	1.00	0.60	0.040	0.040	0.25	0.50	---	Cu 0.50; (Cr+Ni+Cu) 1.00

7.2 Cast Manganese Steels

7.2A Chemical Composition of Cast Manganese Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 32-058:1984	Grade Z 100 MD 6 1-M	---	---	0.8-1.2	5-7	1	0.08	0.03	---	---	0.8-1.2	---
ASTM A128/A128M-93 (2012)	Grade F	J91340	---	1.05-1.35	6.0-8.0	1.00	0.07	---	---	---	0.9-1.2	---
ISO 13521:1999	Grade GX120MnMo7-1	---	---	1.05-1.35	6.00-8.00	0.30-0.90	0.060	0.045	---	---	0.90-1.20	---
AFNOR NF A 32-058:1984	Grade Z 120 M 12-M	---	---	1.1-1.4	11-14	1	0.08	0.03	---	---	---	[(Mn-2)/10] Cmax.; C (Mn/10)max.
ASTM A128/A128M-93 (2012)	Grade A	J91109	---	1.05-1.35	11.0 min.	1.00	0.07	---	---	---	---	---
	Grade B-1	J91119	---	0.9-1.05	11.5-14.0	1.00	0.07	---	---	---	---	---
	Grade B-2	J91129	---	1.05-1.2	11.5-14.0	1.00	0.07	---	---	---	---	---
	Grade B-3	J91139	---	1.12-1.28	11.5-14.0	1.00	0.07	---	---	---	---	---
	Grade B-4	J91149	---	1.2-1.35	11.5-14.0	1.00	0.07	---	---	---	---	---
GB/T 5680-1998	Grade ZGMn13-1	---	---	1.00-1.45	11.00-14.00	0.30-1.00	0.090	0.040	---	---	---	---
	Grade ZGMn13-2	---	---	0.90-1.35	11.00-14.00	0.30-1.00	0.070	0.040	---	---	---	---
	Grade ZGMn13-3	---	---	0.95-1.35	11.00-14.00	0.30-0.80	0.070	0.035	---	---	---	---
ISO 13521:1999	Grade GX100Mn13	---	---	0.90-1.05	11.00-14.00	0.30-0.90	0.060	0.045	---	---	---	---
	Grade GX120Mn13	---	---	1.05-1.35	11.00-14.00	0.30-0.90	0.060	0.045	---	---	---	---
JIS G 5131:2008	Class SCMnH 1	---	---	0.90-1.30	11.00-14.00	---	0.100	0.050	---	---	---	---
	Class SCMnH 2	---	---	0.90-1.20	11.00-14.00	0.80	0.070	0.040	---	---	---	---
	Class SCMnH 3	---	---	0.90-1.20	11.00-14.00	0.30-0.80	0.050	0.035	---	---	---	---
AFNOR NF A 32-058:1984	Grade Z 120 MC 12-M	---	---	1.1-1.4	11-14	1	0.08	0.03	1-2.5	---	---	---
ASTM A128/A128M-93 (2012)	Grade C	J91309	---	1.05-1.35	11.5-14.0	1.00	0.07	---	1.5-2.5	---	---	---
GB/T 5680-1998	Grade ZGMn13-4	---	---	0.90-1.30	11.00-14.00	0.30-0.80	0.070	0.040	1.50-2.50	---	---	---
ISO 13521:1999	Grade GX120MnCr13-2	---	---	1.05-1.35	11.00-14.00	0.30-0.90	0.060	0.045	1.50-2.50	---	---	---
JIS G 5131:2008	Class SCMnH 11	---	---	0.90-1.30	11.00-14.00	0.80	0.070	0.040	1.50-2.50	---	---	---
AFNOR NF A 32-058:1984	Grade Z 100 MN 13 4-M	---	---	0.7-1.3	12-15	1	0.08	0.03	---	2-5	---	---
ASTM A128/A128M-93 (2012)	Grade D	J91459	---	0.7-1.3	11.5-14.0	1.00	0.07	---	---	3.0-4.0	---	---
ISO 13521:1999	Grade GX120MnNi13-3	---	---	1.05-1.35	11.00-14.00	0.30-0.90	0.060	0.045	---	3.00-4.00	---	---
AFNOR NF A 32-058:1984	Grade Z 110 MD 12 1-M	---	---	0.8-1.3	11-14	1	0.08	0.03	---	---	0.8-1.2	---
ASTM A128/A128M-93 (2012)	Grade E-1	J91249	---	0.7-1.3	11.5-14.0	1.00	0.07	---	---	---	0.9-1.2	---
GB/T 5680-1998	Grade ZGMn13-5	---	---	0.75-1.30	11.00-14.00	0.30-1.00	0.070	0.040	---	---	0.90-1.20	---
ISO 13521:1999	Grade GX110MnMo13-1	---	---	0.75-1.35	11.00-14.00	0.30-0.90	0.060	0.045	---	---	0.90-1.20	---
ASTM A128/A128M-93 (2012)	Grade E-2	J91339	---	1.05-1.45	11.5-14.0	1.00	0.07	---	---	---	1.8-2.1	---
ISO 13521:1999	Grade GX90MnMo14	---	---	0.70-1.00	13.00-15.00	0.30-0.60	0.070	0.045	---	---	1.00-1.80	---
AFNOR NF A 32-058:1984	Grade Z 120MC 17 2-M	---	---	1.1-1.4	16-18	1	0.08	0.03	1.8-2.3	---	---	---
ISO 13521:1999	Grade GX120MnCr17-2	---	---	1.05-1.35	16.00-19.00	0.30-0.90	0.060	0.045	1.50-2.50	---	---	---

7.2 Cast Manganese Steels

7.2B Mechanical Properties of Cast Manganese Steels

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
AFNOR NF A 32-058:1984	Grade Z 100 MD 6 1-M	---	---	$t \leq 100$	---	---	---	---	---	Q	55 - 58 HRC; 200 - 230 HBW
ASTM A128/A128M-93 (2012)	Grade F	J91340	---	---	---	---	---	---	---	Q	---
ISO 13521:1999	Grade GX120MnMo7-1	---	---	---	---	---	---	---	---	ST+Q	---
AFNOR NF A 32-058:1984	Grade Z 120 M 12-M	---	---	$t \leq 200$	---	---	---	---	---	Q	45 - 50 HRC; 180 - 250 HBW
ASTM A128/A128M-93 (2012)	Grade A	J91109	---	---	---	---	---	---	---	Q	---
	Grade B-1	J91119	---	---	---	---	---	---	---	Q	---
	Grade B-2	J91129	---	---	---	---	---	---	---	Q	---
	Grade B-3	J91139	---	---	---	---	---	---	---	Q	---
	Grade B-4	J91149	---	---	---	---	---	---	---	Q	---
GB/T 5680-1998	Grade ZGMn13-1	---	---	---	---	---	635	---	20	Q	---
	Grade ZGMn13-2	---	---	---	---	---	685	---	25	Q	---
	Grade ZGMn13-3	---	---	---	---	---	735	---	30	Q	---
ISO 13521:1999	Grade GX100Mn13	---	---	---	---	---	---	---	---	ST+Q	---
	Grade GX120Mn13	---	---	---	---	---	---	---	---	ST+Q	---
JIS G 5131:2008	Class SCMnH 1	---	---	---	---	---	---	---	---	Q	---
	Class SCMnH 2	---	---	---	---	---	740	---	35	Q	---
	Class SCMnH 3	---	---	---	---	---	740	---	35	Q	---
AFNOR NF A 32-058:1984	Grade Z 120 MC 12-M	---	---	$t \leq 100$	---	---	---	---	---	Q	45 - 50 HRC; 180 - 250 HBW
ASTM A128/A128M-93 (2012)	Grade C	J91309	---	---	---	---	---	---	---	Q	---
GB/T 5680-1998	Grade ZGMn13-4	---	---	---	390	---	735	---	20	Q	---
ISO 13521:1999	Grade GX120MnCr13-2	---	---	---	---	---	---	---	---	ST+Q	---
JIS G 5131:2008	Class SCMnH 11	---	---	---	390	---	740	---	20	Q	---
AFNOR NF A 32-058:1984	Grade Z 100 MN 13 4-M	---	---	$t > 100$	---	---	---	---	---	Q	45 - 50 HRC; 180 - 250 HBW
ASTM A128/A128M-93 (2012)	Grade D	J91459	---	---	---	---	---	---	---	Q	---
ISO 13521:1999	Grade GX120MnNi13-3	---	---	---	---	---	---	---	---	ST+Q	---
AFNOR NF A 32-058:1984	Grade Z 110 MD 12 1-M	---	---	$t \leq 200$	---	---	---	---	---	Q	45 - 50 HRC; 180 - 250 HBW
ASTM A128/A128M-93 (2012)	Grade E-1	J91249	---	---	---	---	---	---	---	Q	---
ISO 13521:1999	Grade GX110MnMo13-1	---	---	---	---	---	---	---	---	ST+Q	---
ASTM A128/A128M-93 (2012)	Grade E-2	J91339	---	---	---	---	---	---	---	Q	---
ISO 13521:1999	Grade GX90MnMo14	---	---	---	---	---	---	---	---	ST+Q	---
AFNOR NF A 32-058:1984	Grade Z 120MC 17 2-M	---	---	$t \leq 100$	---	---	---	---	---	Q	45 - 50 HRC; 180 - 250 HBW
ISO 13521:1999	Grade GX120MnCr17-2	---	---	---	---	---	---	---	---	ST+Q	---

7.3 Cast Alloy Steels

7.3.1A Chemical Composition of Cast Alloy Steels for General and Structural Purposes

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10293:2015	G26CrMo4	---	1.7221	0.22-0.29	0.50-0.80	0.60	0.025	0.020	0.80-1.20	0.40	0.15-0.30	V 0.05; Cu 0.30
ISO 14737:2003	Grade G25CrMo4	---	---	0.20-0.29	0.50-0.80	0.60	0.025	0.020	0.80-1.20	0.40	0.15-0.25	V 0.05; Cu 0.30
JIS G 5111:1991	Class SCCrM 1A	---	---	0.20-0.30	0.50-0.80	0.30-0.60	0.040	0.040	0.80-1.20	---	0.15-0.35	---
ASTM A958/A958M-14	Grade SC 4130, Class 65/35	J13502	---	0.28-0.33	0.40-0.80	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4130, Class 70/36	J13502	---	0.28-0.33	0.40-0.80	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4130, Class 80/40	J13502	---	0.28-0.33	0.40-0.80	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4130, Class 80/50	J13502	---	0.28-0.33	0.40-0.80	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4130, Class 90/60	J13502	---	0.28-0.33	0.40-0.80	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4130, Class 105/85	J13502	---	0.28-0.33	0.40-0.80	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4130, Class 115/95	J13502	---	0.28-0.33	0.40-0.80	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4130, Class 130/115	J13502	---	0.28-0.33	0.40-0.80	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4130, Class 135/125	J13502	---	0.28-0.33	0.40-0.80	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4130, Class 150/135	J13502	---	0.28-0.33	0.40-0.80	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ISO 14737:2003	Grade G32CrMo4	---	---	0.28-0.35	0.50-0.80	0.60	0.025	0.020	0.80-1.20	0.40	0.15-0.25	V 0.05; Cu 0.30
JIS G 5111:1991	Class SCCrM 3A	---	---	0.30-0.40	0.50-0.80	0.30-0.60	0.040	0.040	0.80-1.20	---	0.15-0.35	---
ASTM A958/A958M-14	Grade SC 4140, Class 65/35	J14045	---	0.38-0.43	0.70-1.10	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4140, Class 70/36	J14045	---	0.38-0.43	0.70-1.10	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4140, Class 80/40	J14045	---	0.38-0.43	0.70-1.10	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4140, Class 80/50	J14045	---	0.38-0.43	0.70-1.10	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4140, Class 90/60	J14045	---	0.38-0.43	0.70-1.10	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4140, Class 105/85	J14045	---	0.38-0.43	0.70-1.10	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4140, Class 115/95	J14045	---	0.38-0.43	0.70-1.10	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4140, Class 130/115	J14045	---	0.38-0.43	0.70-1.10	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4140, Class 135/125	J14045	---	0.38-0.43	0.70-1.10	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4140, Class 150/135	J14045	---	0.38-0.43	0.70-1.10	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4140, Class 160/145	J14045	---	0.38-0.43	0.70-1.10	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
	Grade SC 4140, Class 165/150	J14045	---	0.38-0.43	0.70-1.10	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
EN 10293:2015	G42CrMo4	---	1.7231	0.38-0.45	0.60-1.00	0.60	0.025	0.020	0.80-1.20	0.40	0.15-0.30	V 0.05; Cu 0.30
ISO 14737:2003	Grade G42CrMo4	---	---	0.38-0.45	0.60-0.90	0.60	0.025	0.020	0.80-1.20	0.40	0.15-0.25	V 0.05; Cu 0.30

7.3 Cast Alloy Steels

7.3.1A Chemical Composition of Cast Alloy Steels for General and Structural Purposes (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
ASTM A958/A958M-14	Grade SC 4330, Class 65/35	J23259	---	0.28-0.33	0.60-0.90	0.30-0.60	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
	Grade SC 4330, Class 70/36	J23259	---	0.28-0.33	0.60-0.90	0.30-0.60	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
	Grade SC 4330, Class 80/40	J23259	---	0.28-0.33	0.60-0.90	0.30-0.60	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
	Grade SC 4330, Class 80/50	J23259	---	0.28-0.33	0.60-0.90	0.30-0.60	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
	Grade SC 4330, Class 90/60	J23259	---	0.28-0.33	0.60-0.90	0.30-0.60	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
	Grade SC 4330, Class 105/85	J23259	---	0.28-0.33	0.60-0.90	0.30-0.60	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
	Grade SC 4330, Class 115/95	J23259	---	0.28-0.33	0.60-0.90	0.30-0.60	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
	Grade SC 4330, Class 130/115	J23259	---	0.28-0.33	0.60-0.90	0.30-0.60	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
	Grade SC 4330, Class 135/125	J23259	---	0.28-0.33	0.60-0.90	0.30-0.60	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
	Grade SC 4330, Class 150/135	J23259	---	0.28-0.33	0.60-0.90	0.30-0.60	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
	Grade SC 4330, Class 160/145	J23259	---	0.28-0.33	0.60-0.90	0.30-0.60	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
	Grade SC 4330, Class 165/150	J23259	---	0.28-0.33	0.60-0.90	0.30-0.60	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
	Grade SC 4330, Class 210/180	J23259	---	0.28-0.33	0.60-0.90	0.30-0.60	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
JIS G 5111:1991	Class SCNCrM 2A	---	---	0.25-0.35	0.90-1.50	0.30-0.60	0.040	0.040	0.30-0.90	1.60-2.00	0.15-0.35	---
EN 10293:2015	G32NiCrMo8-5-4	---	1.6570	0.28 - 0.35	0.60 - 1.00	0.60	0.020	0.015	1.00 - 1.40	1.60 - 2.10	0.30 - 0.50	V 0.05; Cu 0.30
ISO 14737:2003	Grade G32NiCrMo8-5-4	---	---	0.28 - 0.35	0.60 - 1.00	0.60	0.020	0.015	1.00 - 1.40	1.60 - 2.10	0.30 - 0.50	V 0.05; Cu 0.30

7.3.1B Mechanical Properties of Cast Alloy Steels for General and Structural Purposes

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
EN 10293:2015	G26CrMo4	---	1.7221	t ≤ 100	550	---	700-850	---	10	Q+T	18 J @ RT
				t ≤ 100	450	---	600-750	---	16	Q+T	40 J @ RT
				100 < t ≤ 250	300	---	550-700	---	14	Q+T	27 J @ RT
ISO 14737:2003	Grade G25CrMo4	---	---	t ≤ 100	450	---	600-750	---	16	Q+T	40 J @ RT
				t ≤ 100	550	---	700-850	---	10	Q+T	18 J @ RT
				100 < t ≤ 250	300	---	550-700	---	14	Q+T	27 J @ RT
JIS G 5111:1991	Class SCCrM 1A	---	---	---	390	---	590	---	13	N+T	170 min. HB

7.3 Cast Alloy Steels

7.3.1B Mechanical Properties of Cast Alloy Steels for General and Structural Purposes (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
ASTM A958/A958M-14	Grade SC 4130, Class 65/35	J13502	---	---	240	35	450	65	24	N+T	---
	Grade SC 4130, Class 70/36	J13502	---	---	250	36	485	70	22	N+T	---
	Grade SC 4130, Class 80/40	J13502	---	---	275	40	550	80	18	N+T	---
	Grade SC 4130, Class 80/50	J13502	---	---	345	50	550	80	22	N+T	---
	Grade SC 4130, Class 90/60	J13502	---	---	415	60	620	90	18	N+T; or HT+Q+T	---
	Grade SC 4130, Class 105/85	J13502	---	---	585	85	725	105	17	HT+Q+T	---
	Grade SC 4130, Class 115/95	J13502	---	---	655	95	795	115	14	HT+Q+T	---
	Grade SC 4130, Class 130/115	J13502	---	---	795	115	895	130	11	HT+Q+T	---
	Grade SC 4130, Class 135/125	J13502	---	---	860	125	930	135	9	HT+Q+T	---
ISO 14737:2003	Grade G32CrMo4	---	---	t ≤ 100	930	135	1035	150	7	HT+Q+T	---
				t ≤ 100	270	---	630-780	---	16	N+T	10 J @ RT
				t ≤ 100	540	---	700-850	---	12	Q+T	35 J @ RT
				t ≤ 100	650	---	800-950	---	10	Q+T	18 J @ RT
				100 < t ≤ 150	480	---	620-770	---	10	Q+T	27 J @ RT
JIS G 5111:1991	Class SCCrM 3A	---	---	150 < t ≤ 250	330	---	620-770	---	10	Q+T	16 J @ RT
				---	440	---	690	---	9	N+T	201 min. HB
ASTM A958/A958M-14	Grade SC 4140, Class 65/35	J14045	---	---	240	35	450	65	24	N+T	---
	Grade SC 4140, Class 70/36	J14045	---	---	250	36	485	70	22	N+T	---
	Grade SC 4140, Class 80/40	J14045	---	---	275	40	550	80	18	N+T	---
	Grade SC 4140, Class 80/50	J14045	---	---	345	50	550	80	22	N+T	---
	Grade SC 4140, Class 90/60	J14045	---	---	415	60	620	90	18	N+T	---
	Grade SC 4140, Class 105/85	J14045	---	---	585	85	725	105	17	N+T; or HT+Q+T	---
	Grade SC 4140, Class 115/95	J14045	---	---	655	95	795	115	14	HT+Q+T	---
	Grade SC 4140, Class 130/115	J14045	---	---	795	115	895	130	11	HT+Q+T	---
	Grade SC 4140, Class 135/125	J14045	---	---	860	125	930	135	9	HT+Q+T	---
	Grade SC 4140, Class 150/135	J14045	---	---	930	135	1035	150	7	HT+Q+T	---
	Grade SC 4140, Class 160/145	J14045	---	---	1000	145	1105	160	6	HT+Q+T	---
EN 10293:2015	G42CrMo4	---	1.7231	---	1035	150	1140	165	5	HT+Q+T	---
				t ≤ 100	700	---	850-1000	---	10	Q+T	27 J @ RT
				t ≤ 100	600	---	800-950	---	12	Q+T	31 J @ RT
				100 < t ≤ 150	550	---	700-850	---	10	Q+T	27 J @ RT
ISO 14737:2003	Grade G42CrMo4	---	---	150 < t ≤ 250	350	---	650-800	---	10	Q+T	16 J @ RT
				t ≤ 100	300	---	700-850	---	15	N+T	10 J @ RT
				t ≤ 100	600	---	780-930	---	12	Q+T	31 J @ RT
				t ≤ 100	700	---	850-1000	---	10	Q+T	16 J @ RT
				100 < t ≤ 150	550	---	700-850	---	10	Q+T	27 J @ RT
ISO 14737:2003	Grade G42CrMo4	---	---	150 < t ≤ 250	350	---	650-800	---	10	Q+T	16 J @ RT

7.3 Cast Alloy Steels

7.3.1B Mechanical Properties of Cast Alloy Steels for General and Structural Purposes (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
ASTM A958/A958M-14	Grade SC 4330, Class 65/35	J23259	---	---	240	35	450	65	24	N+T	---
	Grade SC 4330, Class 70/36	J23259	---	---	250	36	485	70	22	N+T	---
	Grade SC 4330, Class 80/40	J23259	---	---	275	40	550	80	18	N+T	---
	Grade SC 4330, Class 80/50	J23259	---	---	345	50	550	80	22	N+T	---
	Grade SC 4330, Class 90/60	J23259	---	---	415	60	620	90	18	N+T; or HT+Q+T	---
	Grade SC 4330, Class 105/85	J23259	---	---	585	85	725	105	17	HT+Q+T	---
	Grade SC 4330, Class 115/95	J23259	---	---	655	95	795	115	14	HT+Q+T	---
	Grade SC 4330, Class 130/115	J23259	---	---	795	115	895	130	11	HT+Q+T	---
	Grade SC 4330, Class 135/125	J23259	---	---	860	125	930	135	9	HT+Q+T	---
	Grade SC 4330, Class 150/135	J23259	---	---	930	135	1035	150	7	HT+Q+T	---
	Grade SC 4330, Class 160/145	J23259	---	---	1000	145	1105	160	6	HT+Q+T	---
	Grade SC 4330, Class 165/150	J23259	---	---	1035	150	1140	165	5	HT+Q+T	---
	Grade SC 4330, Class 210/180	J23259	---	---	1240	180	1450	210	4	HT+Q+T	---
JIS G 5111:1991	Class SCNCrM 2A	---	---	---	590	---	780	---	9	N+T	223 min. HB
EN 10293:2015	G32NiCrMo8-5-4	---	1.6570	$t \leq 100$	950	---	1050-1200	---	10	Q+T	35 J @ RT
				$t \leq 100$	700	---	850-1000	---	16	Q+T	50 J @ RT
				$100 < t \leq 250$	650	---	820-970	---	14	Q+T	35 J @ RT
ISO 14737:2003	Grade G32NiCrMo8-5-4	---	1.6570	$t \leq 100$	950	---	1050-1200	---	10	Q+T	35 J @ RT
				$t \leq 100$	700	---	850-1000	---	16	Q+T	50 J @ RT
				$100 < t \leq 250$	650	---	820-970	---	14	Q+T	35 J @ RT

7.3 Cast Alloy Steels

7.3.2A Chemical Composition of Cast Alloy Steels for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-217/SA-217M	Grade WC1	J12524	---	0.25	0.50-0.80	0.60	0.04	0.045	0.35	0.50	0.45-0.65	Cu 0.50; W 0.10; (Cu+Ni+Cr+W) 1.00
ASTM A217/A217M-14	Grade WC1	J12524	---	0.25	0.50-0.80	0.60	0.04	0.045	0.35	0.50	0.45-0.65	Cu 0.50; W 0.10; (Cu+Ni+Cr+W) 1.00
EN 10213:2007 C1:2008	G20Mo5	---	1.5419	0.15-0.23	0.50-1.00	0.60	0.025	0.020	0.30	0.40	0.40-0.60	V 0.05; Cu 0.30
GB/T 16253-1996	Grade ZG19MoG	---	---	0.15-0.23	0.50-1.00	0.30-0.60	0.035	0.035	0.030	---	0.40-0.60	---
ISO 4991:1994	Type C28H	---	---	0.15-0.23	0.50-1.00	0.30-0.60	0.035	0.035	0.30	---	0.40-0.60	---
JIS G 5151:1991	Class SCPH 11	---	---	0.25	0.50-0.80	0.60	0.040	0.040	0.35	0.50	0.45-0.65	Cu 0.50; W 0.10; (Cu+Ni+Cr+W) 1.00
ASME SA-217/SA-217M	Grade WC6	J12072	---	0.05-0.20	0.50-0.80	0.60	0.04	0.045	1.00-1.50	0.50	0.45-0.65	Cu 0.50; W 0.10; (Cu+Ni+W) 1.00
ASTM A217/A217M-14	Grade WC6	J12072	---	0.05-0.20	0.50-0.80	0.60	0.035	0.035	1.00-1.50	0.50	0.45-0.65	Cu 0.50; W 0.10; (Cu+Ni+W) 1.00
EN 10213:2007 C1:2008	G17CrMo5-5	---	1.7357	0.15-0.20	0.50-1.00	0.60	0.020	0.020	1.00-1.50	0.40	0.45-0.65	V 0.05; Cu 0.30
GB/T 16253-1996	Grade ZG15Cr1MoG	---	---	0.10-0.20	0.50-0.80	0.30-0.60	0.035	0.035	1.00-1.50	---	0.45-0.65	---
ISO 4991:1994	Type C32H	---	---	0.10-0.20	0.50-0.80	0.30-0.60	0.035	0.035	1.00-1.50	---	0.45-0.65	---
JIS G 5151:1991	Class SCPH 21	---	---	0.20	0.50-0.80	0.60	0.040	0.040	1.00-1.50	0.50	0.45-0.65	Cu 0.50; W 0.10; (Cu+Ni+W) 1.00
ASTM A389/A389M-13	Grade C24	J12092	---	0.20	0.30-0.80	0.60	0.035	0.035	0.80-1.25	---	0.90-1.20	V 0.15-0.25
EN 10213:2007 C1:2008	G17CrMoV5-10	---	1.7706	0.15-0.20	0.50-0.90	0.60	0.020	0.015	1.20-1.50	0.40	0.90-1.10	V 0.20-0.30; Cu 0.30; Sn 0.025
GB/T 16253-1996	Grade ZG17Cr1Mo1VG	---	---	0.13-0.20	0.50-0.80	0.30-0.60	0.035	0.035	1.20-1.60	---	0.90-1.20	V 0.15-0.35
ISO 4991:1994	Type C35BH	---	---	0.13-0.20	0.50-0.80	0.30-0.60	0.035	0.035	1.20-1.60	---	0.90-1.20	V 0.15-0.35
JIS G 5151:1991	Class SCPH 23	---	---	0.20	0.50-0.80	0.60	0.040	0.040	1.00-1.50	0.50	0.90-1.20	V 0.15-0.25; Cu 0.50; W 0.10; (Cu+Ni+W) 1.00
ASME SA-217/SA-217M	Grade WC9	J21890	---	0.05-0.18	0.40-0.70	0.60	0.04	0.045	2.00-2.75	0.50	0.90-1.20	Cu 0.50; W 0.10; (Cu+Ni+W) 1.00
ASME SA-487/SA-487M	Grade 8, Class A	J22091	---	0.05-0.20	0.50-0.90	0.80	0.04	0.045	2.00-2.75	---	0.90-1.10	Cu 0.50; W 0.10; V 0.03; (Cu+W+V) 0.60
	Grade 8, Class B	J22091	---	0.05-0.20	0.50-0.90	0.80	0.04	0.045	2.00-2.75	---	0.90-1.10	Cu 0.50; W 0.10; V 0.03; (Cu+W+V) 0.60
	Grade 8, Class C	J22091	---	0.05-0.20	0.50-0.90	0.80	0.04	0.045	2.00-2.75	---	0.90-1.10	Cu 0.50; W 0.10; V 0.03; (Cu+W+V) 0.60
ASTM A217/A217M-14	Grade WC9	J21890	---	0.05-0.18	0.40-0.70	0.60	0.035	0.035	2.00-2.75	0.50	0.90-1.20	Cu 0.50; W 0.10; (Cu+Ni+W) 1.00
ASTM A487/A487M-14	Grade 8, Class A	J22091	---	0.05-0.20	0.50-0.90	0.80	0.035	0.035	2.00-2.75	---	0.90-1.10	Cu 0.50; W 0.10; V 0.03; (Cu+W+V) 0.60
	Grade 8, Class B	J22091	---	0.05-0.20	0.50-0.90	0.80	0.035	0.035	2.00-2.75	---	0.90-1.10	Cu 0.50; W 0.10; V 0.03; (Cu+W+V) 0.60
	Grade 8, Class C	J22091	---	0.05-0.20	0.50-0.90	0.80	0.035	0.035	2.00-2.75	---	0.90-1.10	Cu 0.50; W 0.10; V 0.03; (Cu+W+V) 0.60

Note: This section continued on next page.

7.3 Cast Alloy Steels

7.3.2A Chemical Composition of Cast Alloy Steels for Pressure Purposes at High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
EN 10213:2007 C1:2008	G17CrMo9-10	---	1.7379	0.13-0.20	0.50-0.90	0.60	0.020	0.020	2.00-2.50	0.40	0.90-1.20	V 0.05; Cu 0.30
GB/T 16253-1996	Grade ZG12Cr2Mo1G	---	---	0.08-0.15	0.50-0.80	0.30-0.60	0.035	0.035	2.00-2.50	---	0.90-1.20	---
	Grade ZG16Cr2Mo1G	---	---	0.13-0.20	0.50-0.80	0.30-0.60	0.035	0.035	2.00-2.50	---	0.90-1.20	---
ISO 4991:1994	Type C34AH	---	---	0.08-0.15	0.50-0.80	0.30-0.60	0.035	0.035	2.00-2.50	---	0.90-1.20	---
	Type C34BH	---	---	0.13-0.20	0.50-0.80	0.30-0.60	0.035	0.035	2.00-2.50	---	0.90-1.20	---
JIS G 5151:1991	Class SCPH 32	---	---	0.20	0.50-0.80	0.60	0.040	0.040	2.00-2.75	0.50	0.90-1.20	Cu 0.50; W 0.10; (Cu+Ni+W) 1.00
ASME SA-217/SA-217M	Grade C5	J42045	---	0.20	0.40-0.70	0.75	0.04	0.045	4.00-6.50	0.50	0.45-0.65	Cu 0.50; W 0.10; (Cu+Ni+W) 1.00
ASTM A217/A217M-14	Grade C5	J42045	---	0.20	0.40-0.70	0.75	0.04	0.045	4.00-6.50	0.50	0.45-0.65	Cu 0.50; W 0.10; (Cu+Ni+W) 1.00
EN 10213:2007 C1:2008	GX15CrMo5	---	1.7365	0.12-0.19	0.50-0.80	0.80	0.025	0.025	4.00-6.00	---	0.45-0.65	V 0.05; Cu 0.30
GB/T 16253-1996	Grade ZG16Cr5MoG	---	---	0.12-0.19	0.50-0.80	0.80	0.035	0.035	4.00-6.00	---	0.45-0.65	---
ISO 4991:1994	Type C37H	---	---	0.12-0.19	0.50-0.80	0.80	0.035	0.035	4.00-6.00	---	0.45-0.65	---
JIS G 5151:1991	Class SCPH 61	---	---	0.20	0.50-0.80	0.75	0.040	0.040	4.00-6.50	0.50	0.45-0.65	Cu 0.50; W 0.10; (Cu+Ni+W) 1.00
EN 10295:2002	GX30CrSi7	---	1.4710	0.20-0.35	0.50-1.00	1.00-2.50	0.035	0.030	6.00-8.00	0.50	0.15	---
ISO 11973:1999	Grade GX30CrSi7	---	---	0.20-0.35	0.50-1.00	1.00-2.5	0.040	0.040	6.0-8.0	0.50	0.5	---
ASME SA-217/SA-217M	Grade C12	J82090	---	0.20	0.35-0.65	1.00	0.04	0.045	8.00-10.00	0.50	0.90-1.20	Cu 0.50; W 0.10; (Cu+Ni+W) 1.00
ASTM A217/A217M-14	Grade C12	J82090	---	0.20	0.35-0.65	1.00	0.035	0.035	8.00-10.00	0.50	0.90-1.20	Cu 0.50; W 0.10; Cb 0.03; V 0.06; (Cu+Ni+W) 1.00
GB/T 16253-1996	Grade ZG14Cr9Mo1G	---	---	0.10-0.17	0.50-0.80	0.80	0.035	0.035	8.00-10.0	---	1.00-1.30	---
ISO 4991:1994	Type C38H	---	---	0.10-0.17	0.50-0.80	0.80	0.035	0.035	8.00-10.00	---	1.00-1.30	---
EN 10213:2007 C1:2008	G12MoCrV5-2	---	1.7720	0.10-0.15	0.40-0.70	0.45	0.030	0.020	0.30-0.50	0.40	0.40-0.60	V 0.22-0.30; Cu 0.30; Sn 0.025
GB/T 16253-1996	Grade ZG14MoVG	---	---	0.10-0.17	0.40-0.70	0.30-0.60	0.035	0.035	0.30-0.60	0.40	0.40-0.60	V 0.22-0.32
ISO 4991:1994	Type C33H	---	---	0.10-0.17	0.40-0.70	0.30-0.60	0.035	0.035	0.30-0.60	0.40	0.40-0.60	V 0.22-0.32

7.3.2B Mechanical Properties of Cast Alloy Steels for Pressure Purposes at High Temperatures

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
ASME SA-217/SA-217M	Grade WC1	J12524	---	---	240	35	450-620	65-90	24	N+T	---
ASTM A217/A217M-14	Grade WC1	J12524	---	---	240	35	450-620	65-90	24	N+T	---
EN 10213:2007 C1:2008	G20Mo5	---	1.5419	t ≤ 100	245	---	440-590	---	22	Q+T	27 J @ RT
GB/T 16253-1996	Grade ZG19MoG	---	---	---	250	---	450-600	---	21	N+T or Q+T	25 J @ RT
ISO 4991:1994	Type C28H	---	---	---	250	---	450-600	---	21	N+T or Q+T	25 J @ RT
JIS G 5151:1991	Class SCPH 11	---	---	---	245	---	450	---	22	A, N, N+T or Q+T	---
ASME SA-217/SA-217M	Grade WC6	J12072	---	---	275	40	485-655	70-95	20	N+T	---
ASTM A217/A217M-14	Grade WC6	J12072	---	---	275	40	485-655	70-95	20	N+T	---

Note: This section continued on next page.

7.3 Cast Alloy Steels

7.3.2B Mechanical Properties of Cast Alloy Steels for Pressure Purposes at High Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
EN 10213:2007 C1:2008	G17CrMo5-5	---	1.7357	$t \leq 100$	315	---	490-690	---	20	Q+T	27 J @ RT
GB/T 16253-1996	Grade ZG15Cr1MoG	---	---	---	290	---	490-640	---	18	N+T or Q+T	27 J @ RT
ISO 4991:1994	Type C32H	---	---	---	290	---	490-640	---	18	N+T or Q+T	27 J @ RT
JIS G 5151:1991	Class SCPH 21	---	---	---	275	---	480	---	17	A, N, N+T or Q+T	---
ASTM A389/A389M-13	Grade C24	J12092	---	---	345	50	552	80	15.0	N+T	---
EN 10213:2007 C1:2008	G17CrMoV5-10	---	1.7706	$t \leq 150$	440	---	590-780	---	15	Q+T	27 J @ RT
GB/T 16253-1996	Grade ZG17Cr1Mo1VG	---	---	---	420	---	590-740	---	15	N+T or Q+T	24 J @ RT
ISO 4991:1994	Type C35BH	---	---	---	420	---	590-740	---	15	N+T or Q+T	24 J @ RT
JIS G 5151:1991	Class SCPH 23	---	---	---	345	---	550	---	13	A, N, N+T or Q+T	---
ASME SA-217/SA-217M	Grade WC9	J21890	---	---	275	40	485-655	70-95	20	N+T	---
ASME SA-487/SA-487M	Grade 8, Class A	J22091	---	---	380	55	585-760	85-110	20	N+T	---
	Grade 8, Class B	J22091	---	---	585	85	725	105	17	Q+T	---
	Grade 8, Class C	J22091	---	---	515	75	690	100	17	Q+T	235 max HB; 22 max HRC
	Grade 8, Class C	J22091	---	---	515	75	690	100	17	Q+T	235 max HB; 22 max HRC
ASTM A217/A217M-14	Grade WC9	J21890	---	---	275	40	485-655	70-95	20	N+T	---
ASTM A487/A487M-14	Grade 8, Class A	J22091	---	---	380	55	585-760	85-110	20	N+T	---
	Grade 8, Class B	J22091	---	---	585	85	725	105	17	Q+T	---
	Grade 8, Class C	J22091	---	---	515	75	690	100	17	Q+T	235 max HB; 22 max HRC
EN 10213:2007 C1:2008	G17CrMo9-10	---	1.7379	$t \leq 150$	400	---	590-740	---	18	Q+T	40 J @ RT
GB/T 16253-1996	Grade ZG12Cr2Mo1G	---	---	---	280	---	510-660	---	18	N+T	25 J @ RT
	Grade ZG16Cr2Mo1G	---	---	---	390	---	600-750	---	18	N+T or Q+T	40 J @ RT
ISO 4991:1994	Type C34AH	---	---	---	280	---	510-660	---	18	N+T	25 J @ RT
	Type C34BH	---	---	---	390	---	600-750	---	18	N+T or Q+T	40 J @ RT
JIS G 5151:1991	Class SCPH 32	---	---	---	275	---	480	---	17	A, N, N+T or Q+T	---
ASME SA-217/SA-217M	Grade C5	J42045	---	---	415	60	620-795	90-115	18	N+T	---
ASTM A217/A217M-14	Grade C5	J42045	---	---	415	60	620-795	90-115	18	N+T	---
EN 10213:2007 C1:2008	GX15CrMo5	---	1.7365	$t \leq 150$	420	---	630-760	---	16	Q+T	27 J @ RT
GB/T 16253-1996	Grade ZG16Cr5MoG	---	---	---	420	---	630-780	---	16	N+T	25 J @ RT
ISO 4991:1994	Type C37H	---	---	---	420	---	630-780	---	16	N+T	25 J @ RT
JIS G 5151:1991	Class SCPH 61	---	---	---	410	---	620	---	17	A, N, N+T or Q+T	---
EN 10295:2002	GX30CrSi7	---	1.4710	---	---	---	---	---	---	A	300 max HB
ISO 11973:1999	Grade GX30CrSi7	---	---	---	---	---	---	---	---	A or AC	---
ASME SA-217/SA-217M	Grade C12	J82090	---	---	415	60	620-795	90-115	18	N+T	---
ASTM A217/A217M-14	Grade C12	J82090	---	---	415	60	620-795	90-115	18	N+T	---
GB/T 16253-1996	Grade ZG14Cr9Mo1G	---	---	---	420	---	630-780	---	16	N+T	20 J @ RT
ISO 4991:1994	Type C38H	---	---	---	420	---	630-780	---	16	N+T	20 J @ RT
EN 10213:2007 C1:2008	G12MoCrV5-2	---	1.7720	$t \leq 100$	295	---	510-660	---	17	Q+T	27 J @ RT
GB/T 16253-1996	Grade ZG14MoVG	---	---	---	320	---	500-650	---	17	N+T	13 J @ RT
ISO 4991:1994	Type C33H	---	---	---	320	---	500-650	---	17	N+T	13 J @ RT

7.3 Cast Alloy Steels

7.3.3A Chemical Composition of Cast Alloy Steels for Pressure Purposes at Low Temperatures

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-352/SA-352M	Grade LC1	J12522	---	0.25	0.50-0.80	0.60	0.04	0.045	---	---	0.45-0.65	---
ASTM A352/A352M-06 (2012)	Grade LC1	J12522	---	0.25	0.50-0.80	0.60	0.04	0.045	---	---	0.45-0.65	---
EN 10213:2007 C1:2008	G18Mo5	---	1.5422	0.15-0.20	0.80-1.20	0.60	0.020	0.020	0.30	0.40	0.45-0.65	V 0.05; Cu 0.30
JIS G 5152:1991	Class SCPL 11	---	---	0.25	0.50-0.80	0.60	0.040	0.040	0.35	---	0.45-0.65	Cu 0.50
ASME SA-352/SA-352M	Grade LC2	J22500	---	0.25	0.50-0.80	0.60	0.04	0.045	---	2.00-3.00	---	---
ASTM A352/A352M-06 (2012)	Grade LC2	J22500	---	0.25	0.50-0.80	0.60	0.04	0.045	---	2.00-3.00	---	---
ASTM A757/A757M-15	Grade B2N	J22501	---	0.25	0.50-0.80	0.60	0.025	0.025	0.40	2.0-3.0	0.25	V 0.03; Cu 0.50; (V+Cu+Cr+Mo+P+S) 1.00
	Grade B2Q	J22501	---	0.25	0.50-0.80	0.60	0.025	0.025	0.40	2.0-3.0	0.25	V 0.03; Cu 0.50; (V+Cu+Cr+Mo+P+S) 1.00
EN 10213:2007 C1:2008	G9Ni10	---	1.5636	0.06-0.12	0.50-0.80	0.60	0.020	0.015	0.30	2.00-3.00	0.20	V 0.05; Cu 0.30
JIS G 5152:1991	Class SCPL 21	---	---	0.25	0.50-0.80	0.60	0.040	0.040	0.35	2.00-3.00	---	Cu 0.50
ASME SA-352/SA-352M	Grade LC3	J31550	---	0.15	0.50-0.80	0.60	0.04	0.045	---	3.00-4.00	---	---
ASTM A352/A352M-06 (2012)	Grade LC3	J31550	---	0.15	0.50-0.80	0.60	0.04	0.045	---	3.00-4.00	---	---
ASTM A757/A757M-15	Grade B3N	J31500	---	0.15	0.50-0.80	0.60	0.025	0.025	0.40	3.0-4.0	0.25	V 0.03; Cu 0.50; (V+Cu+Cr+Mo+P+S) 1.00
	Grade B3Q	J31500	---	0.15	0.50-0.80	0.60	0.025	0.025	0.40	3.0-4.0	0.25	V 0.03; Cu 0.50; (V+Cu+Cr+Mo+P+S) 1.00
EN 10213:2007 C1:2008	G9Ni14	---	1.5638	0.06-0.12	0.50-0.80	0.60	0.020	0.015	0.30	3.00-4.00	0.20	V 0.05; Cu 0.30
GB/T 16253-1996	Grade ZG14Ni4D	---	---	0.14	0.50-0.80	0.30-0.60	0.030	0.030	---	3.00-4.00	---	---
ISO 4991:1994	Type C43L	---	---	0.14	0.50-0.80	0.30-0.60	0.030	0.030	---	3.00-4.00	---	---
JIS G 5152:1991	Class SCPL 31	---	---	0.15	0.50-0.80	0.60	0.040	0.040	0.35	3.00-4.00	---	Cu 0.50

7.3 Cast Alloy Steels

7.3.3A Chemical Composition of Cast Alloy Steels for Pressure Purposes at Low Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-352/SA-352M	Grade LC2-1	J42215	---	0.22	0.55-0.75	0.50	0.04	0.045	1.35-1.85	2.50-3.50	0.30-0.60	---
ASTM A352/A352M-06 (2012)	Grade LC2-1	J42215	---	0.22	0.55-0.75	0.50	0.04	0.045	1.35-1.85	2.50-3.50	0.30-0.60	---
ASTM A757/A757M-15	Grade E1Q	J42220	---	0.22	0.50-0.80	0.60	0.025	0.025	1.35-1.85	2.5-3.5	0.35-0.60	V 0.03; Cu 0.50; (V+Cu+P+S) 0.70
	Grade E2N1	J42065	---	0.20	0.40-0.70	0.60	0.020	0.020	1.50-2.0	2.75-3.90	0.40-0.60	V 0.03; Cu 0.50; W 0.10; (V+Cu+W+P+S) 0.70
	Grade E2N2	J42065	---	0.20	0.40-0.70	0.60	0.020	0.020	1.50-2.0	2.75-3.90	0.40-0.60	V 0.03; Cu 0.50; W 0.10; (V+Cu+W+P+S) 0.70
	Grade E2N3	J42065	---	0.20	0.40-0.70	0.60	0.020	0.020	1.50-2.0	2.75-3.90	0.40-0.60	V 0.03; Cu 0.50; W 0.10; (V+Cu+W+P+S) 0.70
	Grade E2Q1	J42065	---	0.20	0.40-0.70	0.60	0.020	0.020	1.50-2.0	2.75-3.90	0.40-0.60	V 0.03; Cu 0.50; W 0.10; (V+Cu+W+P+S) 0.70
	Grade E2Q2	J42065	---	0.20	0.40-0.70	0.60	0.020	0.020	1.50-2.0	2.75-3.90	0.40-0.60	V 0.03; Cu 0.50; W 0.10; (V+Cu+W+P+S) 0.70
	Grade E2Q3	J42065	---	0.20	0.40-0.70	0.60	0.020	0.020	1.50-2.0	2.75-3.90	0.40-0.60	V 0.03; Cu 0.50; W 0.10; (V+Cu+W+P+S) 0.70
EN 10213:2007 C1:2008	G17NiCrMo13-6	---	1.6781	0.15-0.19	0.55-0.80	0.50	0.015	0.015	1.30-1.80	3.00-3.50	0.45-0.65	V 0.05; Cu 0.30
GB/T 16253-1996	Grade ZG22Ni3Cr2MoAD	---	---	0.22	0.40-0.80	0.60	0.030	0.030	1.35-2.00	2.50-3.50	0.35-0.60	---
	Grade ZG22Ni3Cr2MoBD	---	---	0.22	0.40-0.80	0.60	0.030	0.030	1.50-2.00	2.75-3.90	0.35-0.60	---
ISO 4991:1994	Type C43E2aL	---	---	0.22	0.40-0.80	0.60	0.030	0.030	1.35-2.00	2.50-3.50	0.35-0.60	---
	Type C43E2bL	---	---	0.22	0.40-0.80	0.60	0.030	0.030	1.50-2.00	2.75-3.90	0.35-0.60	---
GB/T 16253-1996	Grade ZG29Cr1MoD	---	---	0.29	0.50-0.80	0.30-0.60	0.030	0.030	0.90-1.20	---	0.15-0.30	---
ISO 4991:1994	Type C31L	---	---	0.29	0.50-0.80	0.30-0.60	0.030	0.030	0.90-1.20	---	0.15-0.30	---
ASTM A757/A757M-15	Grade D1N1	J22092	---	0.20	0.40-0.80	0.60	0.025	0.025	2.0-2.75	0.50	0.90-1.20	V 0.03; Cu 0.50; W 0.10; (V+Ni+Cu+W+P+S) 1.00
	Grade D1N2	J22092	---	0.20	0.40-0.80	0.60	0.025	0.025	2.0-2.75	0.50	0.90-1.20	V 0.03; Cu 0.50; W 0.10; (V+Ni+Cu+W+P+S) 1.00
	Grade D1N3	J22092	---	0.20	0.40-0.80	0.60	0.025	0.025	2.0-2.75	0.50	0.90-1.20	V 0.03; Cu 0.50; W 0.10; (V+Ni+Cu+W+P+S) 1.00
	Grade D1Q1	J22092	---	0.20	0.40-0.80	0.60	0.025	0.025	2.0-2.75	0.50	0.90-1.20	V 0.03; Cu 0.50; W 0.10; (V+Ni+Cu+W+P+S) 1.00
	Grade D1Q2	J22092	---	0.20	0.40-0.80	0.60	0.025	0.025	2.0-2.75	0.50	0.90-1.20	V 0.03; Cu 0.50; W 0.10; (V+Ni+Cu+W+P+S) 1.00
	Grade D1Q3	J22092	---	0.20	0.40-0.80	0.60	0.025	0.025	2.0-2.75	0.50	0.90-1.20	V 0.03; Cu 0.50; W 0.10; (V+Ni+Cu+W+P+S) 1.00
GB/T 16253-1996	Grade ZG20Cr2Mo1D	---	---	0.20	0.50-0.80	0.30-0.60	0.030	0.030	2.00-2.50	---	0.90-1.20	---
ISO 4991:1994	Type C34BL	---	---	0.20	0.50-0.80	0.30-0.60	0.030	0.030	2.00-2.50	---	0.90-1.20	---
ASTM A757/A757M-15	Grade C1Q	J12582	---	0.25	1.20	0.60	0.025	0.025	0.40	1.5-2.0	0.15-0.30	V 0.03; Cu 0.50; (Cr+V+Cu+P+S) 1.00
GB/T 16253-1996	Grade ZG24Ni2MoD	---	---	0.24	0.80-1.20	0.30-0.60	0.030	0.030	---	1.50-2.00	0.15-0.30	---
ISO 4991:1994	Type C43C1L	---	---	0.24	0.80-1.20	0.30-0.60	0.030	0.030	---	1.50-2.00	0.15-0.30	---

7.3 Cast Alloy Steels

7.3.3B Mechanical Properties of Cast Alloy Steels for Pressure Purposes at Low Temperatures

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
ASME SA-352/SA-352M	Grade LC1	J12522	---	---	240	35.0	450-620	65.0-90.0	24	N+T or Q+T	18 J @ -59°C
ASTM A352/A352M-06 (2012)	Grade LC1	J12522	---	---	240	35.0	450-620	65.0-90.0	24	N+T or Q+T	18 J @ -59°C
EN 10213:2007 C1:2008	G18Mo5	---	1.5422	$t \leq 100$	240	---	440-790	---	23	Q+T	27 J @ -45°C
JIS G 5152:1991	Class SCPL 11	---	---	---	245	---	450	---	21	A, N, N+T or Q+T	see standard for impact data
ASME SA-352/SA-352M	Grade LC2	J22500	---	---	275	40.0	485-655	70.0-95.0	24	N+T or Q+T	20 J @ -73°C
ASTM A352/A352M-06 (2012)	Grade LC2	J22500	---	---	275	40.0	485-655	70.0-95.0	24	N+T or Q+T	20 J @ -73°C
ASTM A757/A757M-15	Grade B2N	J22501	---	---	275	40	485	70	24	N+T or Q+T	L: 20 J @ -73°C
	Grade B2Q	J22501	---	---	275	40	485	70	24	N+T or Q+T	L: 20 J @ -73°C
EN 10213:2007 C1:2008	G9Ni10	---	1.5636	$t \leq 35$	280	---	480-630	---	24	Q+T	27 J @ -70°C
JIS G 5152:1991	Class SCPL 21	---	---	---	275	---	480	---	21	A, N, N+T or Q+T	see standard for impact data
ASME SA-352/SA-352M	Grade LC3	J31550	---	---	275	40.0	485-655	70.0-95.0	24	N+T or Q+T	20 J @ -101°C
ASTM A352/A352M-06 (2012)	Grade LC3	J31550	---	---	275	40.0	485-655	70.0-95.0	24	N+T or Q+T	20 J @ -101°C
ASTM A757/A757M-15	Grade B3N	J31500	---	---	275	40	485	70	24	N+T or Q+T	L: 20 J @ -101°C
	Grade B3Q	J31500	---	---	275	40	485	70	24	N+T or Q+T	L: 20 J @ -101°C
EN 10213:2007 C1:2008	G9Ni14	---	1.5638	$t \leq 35$	360	---	500-650	---	20	Q+T	27 J @ -90°C
GB/T 16253-1996	Grade ZG14Ni4D	---	---	---	300	---	460-610	---	20	Q+T	27 J @ -70°C
ISO 4991:1994	Type C43L	---	---	---	300	---	460-610	---	20	Q+T	27 J @ -70°C
JIS G 5152:1991	Class SCPL 31	---	---	---	275	---	480	---	21	A, N, N+T or Q+T	see standard for impact data

7.3 Cast Alloy Steels

7.3.3B Mechanical Properties of Cast Alloy Steels for Pressure Purposes at Low Temperatures (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
ASME SA-352/SA-352M	Grade LC2-1	J42215	---	---	550	80.0	725-895	105.0-130.0	18	N+T or Q+T	41 J @ -73°C
ASTM A352/A352M-06 (2012)	Grade LC2-1	J42215	---	---	550	80.0	725-895	105.0-130.0	18	N+T or Q+T	41 J @ -73°C
ASTM A757/A757M-15	Grade E1Q	J42220	---	---	450	65	620	90	22	Q+T	L: 41 J @ -73°C
	Grade E2N1	J42065	---	---	485	70	620-825	90-120	18	N+T or Q+T	L: 41 J @ -73°C
	Grade E2N2	J42065	---	---	585	85	725-930	105-135	15	N+T or Q+T	L: 27 J @ -73°C
	Grade E2N3	J42065	---	---	690	100	795-1000	115-145	13	N+T or Q+T	L: 20 J @ -73°C
	Grade E2Q1	J42065	---	---	485	70	620-825	90-120	18	N+T or Q+T	L: 41 J @ -73°C
	Grade E2Q2	J42065	---	---	585	85	725-930	105-135	15	N+T or Q+T	L: 27 J @ -73°C
	Grade E2Q3	J42065	---	---	690	100	795-1000	115-145	13	N+T or Q+T	L: 20 J @ -73°C
EN 10213:2007 C1:2008	G17NiCrMo13-6	---	1.6781	t ≤ 200	600	---	750-900	---	15	Q+T	27 J @ -80°C
GB/T 16253-1996	Grade ZG22Ni3Cr2MoAD	---	---	---	450	---	620-800	---	16	N+T or Q+T	27 J @ -80°C
	Grade ZG22Ni3Cr2MoBD	---	---	---	655	---	800-950	---	13	N+T or Q+T	27 J @ -60°C
ISO 4991:1994	Type C43E2aL	---	---	---	450	---	620-800	---	16	N+T or Q+T	27 J @ -80°C
	Type C43E2bL	---	---	---	655	---	800-950	---	13	N+T or Q+T	27 J @ -60°C
GB/T 16253-1996	Grade ZG29Cr1MoD	---	---	---	370	---	550-700	---	16	N+T or Q+T	27 J @ -45°C
ISO 4991:1994	Type C31L	---	---	---	370	---	550-700	---	16	N+T or Q+T	27 J @ -45°C
ASTM A757/A757M-15	Grade D1N1	J22092	---	---	380	55	585-795	85-115	20	N+T or Q+T	L: BA J @ BA°C
	Grade D1N2	J22092	---	---	515	75	655-860	95-125	18	N+T or Q+T	L: BA J @ BA°C
	Grade D1N3	J22092	---	---	585	85	725-930	105-135	15	N+T or Q+T	L: BA J @ BA°C
	Grade D1Q1	J22092	---	---	380	55	585-795	85-115	20	N+T or Q+T	L: BA J @ BA°C
	Grade D1Q2	J22092	---	---	515	75	655-860	95-125	18	N+T or Q+T	L: BA J @ BA°C
	Grade D1Q3	J22092	---	---	585	85	725-930	105-135	15	N+T or Q+T	L: BA J @ BA°C
	Grade ZG20Cr2Mo1D	---	---	---	390	---	600-750	---	18	N+T, N+C(A)+T, Q+T	27 J @ -50°C
ISO 4991:1994	Type C34BL	---	---	---	390	---	600-750	---	18	N+T or Q+T	27 J @ 50°C
ASTM A757/A757M-15	Grade C1Q	J12582	---	---	380	55	515	75	22	Q+T	L: 20 J @ -46°C
GB/T 16253-1996	Grade ZG24Ni2MoD	---	---	---	380	---	520-670	---	20	Q+T	27 J @ -35°C
ISO 4991:1994	Type C43C1L	---	---	---	380	---	520-670	---	20	Q+T	27 J @ -35°C

7.4 Cast Stainless Steels

7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications

7.4.1.1A Chemical Composition of Martensitic and Ferritic Stainless Steels for General and Corrosion Resistant Applications

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A743/A743M-13ae1	Grade CA15	J91150	---	0.15	1.00	1.50	0.04	0.04	11.5-14.0	1.00	0.50	---
EN 10283:2010	GX12Cr12	---	1.4011	0.15	1.00	1.00	0.035	0.025	11.50-13.50	1.00	0.50	V 0.08; Cu 0.30
ISO 11972:1998	Grade GX 12 Cr 12	---	---	0.15	0.80	0.80	0.035	0.025	11.5-13.5	1.00	0.50	---
JIS G 5121:2003	Class SCS 1	---	---	0.15	1.00	1.50	0.040	0.040	11.50-14.00	1.00	0.50	---
ASTM A743/A743M-13ae1	Grade CA15M	J91151	---	0.15	1.00	0.65	0.040	0.040	11.5-14.0	1.0	0.15-1.0	---
EN 10283:2010	GX7CrNiMo12-1	---	1.4008	0.10	1.00	1.00	0.035	0.025	12.00-13.50	1.00-2.00	0.20-0.50	V 0.08; Cu 0.30
ISO 11972:1998	Grade GX 8 CrNiMo 12 1	---	---	0.10	0.80	0.80	0.035	0.025	11.5-13.0	0.80-1.80	0.20-0.50	---
JIS G 5121:2003	Class SCS 3	---	---	0.15	1.00	1.00	0.040	0.040	11.50-14.00	0.50-1.50	0.15-1.00	---
ASTM A743/A743M-13ae1	Grade CA40	J91153	---	0.20-0.40	1.00	1.50	0.04	0.04	11.5-14.0	1.0	0.5	---
JIS G 5121:2003	Class SCS 2	---	---	0.16-0.24	1.00	1.50	0.040	0.040	11.50-14.00	1.00	0.50	---
	Class SCS 2A	---	---	0.25-0.40	1.00	1.50	0.040	0.040	11.50-14.00	1.00	0.50	---
EN 10283:2010	GX4CrNi13-4	---	1.4317	0.06	1.00	1.00	0.035	0.025	12.00-13.50	3.50-5.00	0.70	V 0.08; Cu 0.30
ISO 11972:1998	Grade GX 4 CrNi 12 4 (QT1)	---	---	0.06	1.50	1.00	0.035	0.025	11.5-13.0	3.50-5.00	1.00	---
	Grade GX 4 CrNi 12 4 (QT2)	---	---	0.06	1.50	1.00	0.035	0.025	11.5-13.0	3.5-5.00	1.00	---
JIS G 5121:2003	Class SCS 5	---	---	0.06	1.00	1.00	0.040	0.040	11.50-14.00	3.50-4.50	---	---
ASTM A743/A743M-13ae1	Grade CA6NM	J91540	---	0.06	1.00	1.00	0.04	0.03	11.5-14.0	3.5-4.5	0.40-1.0	---
JIS G 5121:2003	Class SCS 6	---	---	0.06	1.00	1.00	0.040	0.030	11.50-14.00	3.50-4.50	0.40-1.00	---
EN 10283:2010	GX4CrNiMo16-5-1	---	1.4405	0.06	1.00	0.80	0.035	0.025	15.00-17.00	4.00-6.00	0.70-1.50	V 0.08; Cu 0.30
ISO 11972:1998	Grade GX 4 CrNiMo 16 5 1	---	---	0.06	0.80	0.80	0.035	0.025	15.0-17.0	4.00-6.00	0.70-1.50	---

7.4 Cast Stainless Steels

7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications

7.4.1.1B Mechanical Properties of Martensitic and Ferritic Stainless Steels for General and Corrosion Resistant Applications

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
ASTM A743/A743M-13ae1*	Grade CA15	J91150	---	---	450	65	620	90	18	N+T or A	---
EN 10283:2010	GX12Cr12	---	1.4011	$t \leq 150$	450	---	620	---	15	Q+T	20 J @ RT
ISO 11972:1998	Grade GX 12 Cr 12	---	---	$t \leq 150$	450	---	620	---	14	N+T	20 J @ RT
JIS G 5121:2003	Class SCS 1	---	---	---	345	---	540	---	18	Q+T	163-229 HB
				---	450	---	620	---	16	Q+T	179-241 HB
ASTM A743/A743M-13ae1*	Grade CA15M	J91151	---	---	450	65	620	90	18	N+T or A	---
EN 10283:2010	GX7CrNiMo12-1	---	1.4008	$t \leq 300$	440	---	590	---	15	Q+T	27 J @ RT
ISO 11972:1998	Grade GX 8 CrNiMo 12 1	---	---	$t \leq 300$	440	---	590	---	15	N+T	27 J @ RT
JIS G 5121:2003	Class SCS 3	---	---	---	440	---	590	---	16	Q+T	170-235 HB
ASTM A743/A743M-13ae1*	Grade CA40	J91153	---	---	485	70	690	100	15	N+T or A	---
JIS G 5121:2003	Class SCS 2	---	---	---	390	---	590	---	16	Q+T	170-235 HB
	Class SCS 2A	---	---	---	485	---	690	---	15	Q+T	269 max. HB
EN 10283:2010	GX4CrNi13-4	---	1.4317	$t \leq 300$	550	---	760	---	15	Q+T	50 J @ RT
				$t \leq 300$	830	---	900	---	12	Q+T	35 J @ RT
				$t \leq 300$	500	---	700	---	16	Q+T	50 J @ RT
ISO 11972:1998	Grade GX 4 CrNi 12 4 (QT1)	---	---	$t \leq 300$	550	---	750	---	15	N+T	45 J @ RT
	Grade GX 4 CrNi 12 4 (QT2)	---	---	$t \leq 300$	830	---	900	---	12	N+T	35 J @ RT
JIS G 5121:2003	Class SCS 5	---	---	---	540	---	740	---	13	Q+T	217-277 HB
ASTM A743/A743M-13ae1*	Grade CA6NM	J91540	---	---	550	80	755	110	15	N+T	---
JIS G 5121:2003	Class SCS 6	---	---	---	550	---	750	---	15	Q+T	285 max. HB
EN 10283:2010	GX4CrNiMo16-5-1	---	1.4405	$t \leq 300$	540	---	760	---	15	Q+T	60 J @ RT
ISO 11972:1998	Grade GX 4 CrNiMo 16 5 1	---	---	$t \leq 300$	540	---	760	---	15	N+T	60 J @ RT

*: See "List of Standards" at the beginning of the chapter.

7.4 Cast Stainless Steels

7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications

7.4.1.2A Chemical Composition of Austenitic Stainless Steels for General and Corrosion Resistant Applications

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A743/A743M-13ae1	Grade CF20	J92602	---	0.20	1.50	2.00	0.04	0.04	18.0-21.0	8.0-11.0	---	---
JIS G 5121:2003	Class SCS 12	---	---	0.20	2.00	2.00	0.040	0.040	18.00-21.00	8.00-11.00	---	---
ASTM A743/A743M-13ae1	Grade CF8	J92600	---	0.08	1.50	2.00	0.04	0.04	18.0-21.0	8.0-11.0	---	---
ASTM A744/A744M-13	Grade CF8	J92600	---	0.08	1.50	2.0	0.04	0.04	18.0-21.0	8.0-11.0	---	---
EN 10283:2010	GX5CrNi19-10	---	1.4308	0.07	1.50	1.50	0.040	0.030	18.00-20.00	8.00-11.00	---	Cu 0.50
ISO 11972:1998	Grade GX 5 CrNi 19 9	---	---	0.07	1.50	1.50	0.040	0.030	18.0-21.0	8.00-11.00	---	---
JIS G 5121:2003	Class SCS 13	---	---	0.08	2.00	2.00	0.040	0.040	18.00-21.00	8.00-11.00	---	---
	Class SCS 13A	---	---	0.08	1.50	2.00	0.040	0.040	18.00-21.00	8.00-11.00	---	---
ASTM A743/A743M-13ae1	Grade CF3	J92500	---	0.03	1.50	2.00	0.04	0.04	17.0-21.0	8.0-12.0	---	---
ASTM A744/A744M-13	Grade CF3	J92500	---	0.03	1.50	2.0	0.04	0.04	17.0-21.0	8.0-12.0	---	---
EN 10283:2010	GX2CrNi19-11	---	1.4309	0.030	2.00	1.50	0.035	0.025	18.00-20.00	9.00-12.00	---	N 0.20; Cu 0.50
ISO 11972:1998	Grade GX 2 CrNi 18 10	---	---	0.03	1.50	1.50	0.040	0.030	17.0-19.0	9.00-12.00	---	---
JIS G 5121:2003	Class SCS 19A	---	---	0.03	1.50	2.00	0.040	0.040	17.00-21.00	8.00-12.00	---	---
	Class SCS 19	---	---	0.03	2.00	2.00	0.040	0.040	17.00-21.00	8.00-12.00	---	---
ASTM A743/A743M-13ae1	Grade CF8C	J92710	---	0.08	1.50	2.00	0.04	0.04	18.0-21.0	9.0-12.0	---	Cb 8xC to 1.0
ASTM A744/A744M-13	Grade CF8C	J92710	---	0.08	1.50	2.0	0.04	0.04	18.0-21.0	9.0-12.0	---	Cb 8xC to 1.0
EN 10283:2010	GX5CrNiNb19-11	---	1.4552	0.07	1.50	1.50	0.040	0.030	18.00-20.00	9.00-12.00	---	(Nb+Ta) 8xC to 1.00; Cu 0.50
ISO 11972:1998	Grade GX 6 CrNiNb 19 10	---	---	0.08	1.50	1.50	0.040	0.030	18.0-21.0	9.00-12.00	---	Nb 8xC to 1.00
JIS G 5121:2003	Class SCS 21	---	---	0.08	2.00	2.00	0.040	0.040	18.00-21.00	9.00-12.00	---	Nb 10xC to 1.35
ASTM A743/A743M-13ae1	Grade CF8M	J92900	---	0.08	1.50	2.00	0.04	0.04	18.0-21.0	9.0-12.0	2.0-3.0	---
ASTM A744/A744M-13	Grade CF8M	J92900	---	0.08	1.50	2.0	0.04	0.04	18.0-21.0	9.0-12.0	2.0-3.0	---
EN 10283:2010	GX5CrNiMo19-11-2	---	1.4408	0.07	1.50	1.50	0.040	0.030	18.00-20.00	9.00-12.00	2.00-2.50	Cu 0.50
ISO 11972:1998	Grade GX 5 CrNiMo 19 11 2	---	---	0.07	1.50	1.50	0.040	0.030	17.0-20.0	9.00-12.00	2.00-2.50	---
	Grade GX 5 CrNiMo 19 11 3	---	---	0.07	1.50	1.50	0.040	0.030	17.0-20.0	9.00-12.00	3.00-3.50	---
JIS G 5121:2003	Class SCS 14	---	---	0.08	2.00	2.00	0.040	0.040	17.00-20.00	10.00-14.00	2.00-3.00	---
	Class SCS 14A	---	---	0.08	1.50	1.50	0.040	0.040	18.00-21.00	9.00-12.00	2.00-3.00	---
EN 10283:2010	GX5CrNiMoNb19-11-2	---	1.4581	0.07	1.50	1.50	0.040	0.030	18.00-20.00	9.00-12.00	2.00-2.50	(Nb+Ta) 8xC to 1.00; Cu 0.50
ISO 11972:1998	Grade GX 6 CrNiMoNb 19 11 2	---	---	0.08	1.50	1.50	0.040	0.030	17.0-20.0	9.00-12.00	2.00-2.50	Nb 8xC to 1.00
JIS G 5121:2003	Class SCS 22	---	---	0.08	2.00	2.00	0.040	0.040	17.00-20.00	10.00-14.00	2.00-3.00	Nb 10xC to 1.35
ASTM A743/A743M-13ae1	Grade CF3M	J92800	---	0.03	1.50	1.50	0.04	0.04	17.0-21.0	9.0-13.0	2.0-3.0	---
ASTM A744/A744M-13	Grade CF3M	J92800	---	0.03	1.50	1.50	0.04	0.04	17.0-21.0	9.0-13.0	2.0-3.0	---
EN 10283:2010	GX2CrNiMo19-11-2	---	1.4409	0.030	2.00	1.50	0.035	0.025	18.00-20.00	9.00-12.00	2.00-2.50	N 0.20; Cu 0.50
ISO 11972:1998	Grade GX 2 CrNiMo 19 11 2	---	---	0.03	1.50	1.50	0.040	0.030	17.0-20.0	9.00-12.00	2.00-2.50	---
JIS G 5121:2003	Class SCS 16A	---	---	0.03	1.50	1.50	0.040	0.040	17.00-21.00	9.00-13.00	2.00-3.00	---

7.4 Cast Stainless Steels

7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications

7.4.1.2A Chemical Composition of Austenitic Stainless Steels for General and Corrosion Resistant Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A743/A743M-13ae1	Grade CF3MN	J92804	---	0.03	1.50	1.50	0.040	0.040	17.0-22.0	9.0-13.0	2.00-3.00	N 0.10-0.20
EN 10283:2010	GX2CrNiMoN17-13-4	---	1.4446	0.030	1.50	1.00	0.040	0.030	16.50-18.50	12.50-14.50	4.00-4.50	N 0.12-0.22; Cu 0.50
ISO 11972:1998	Grade GX 2 CrNiMoN 19 11 2	---	---	0.03	1.50	1.50	0.040	0.030	17.0-20.0	9.00-12.00	2.00-2.50	N 0.10-0.20
	Grade GX 2 CrNiMoN 19 11 3	---	---	0.03	1.50	1.50	0.040	0.030	17.0-20.0	9.00-12.00	3.00-3.50	N 0.10-0.20
ASTM A743/A743M-13ae1	Grade CG8M	J93000	---	0.08	1.50	1.50	0.04	0.04	18.0-21.0	9.0-13.0	3.0-4.0	---
ASTM A744/A744M-13	Grade CG8M	J93000	---	0.08	1.50	1.50	0.04	0.04	18.0-21.0	9.0-13.0	3.0-4.0	---
EN 10283:2010	GX5CrNiMo19-11-3	---	1.4412	0.07	1.50	1.50	0.040	0.030	18.00-20.00	10.00-13.00	3.00-3.50	---
ASTM A743/A743M-13ae1	Grade CG3M	J92999	---	0.03	1.50	1.50	0.04	0.04	18.0-21.0	9.0-13.0	3.0-4.0	---
ASTM A744/A744M-13	Grade CG3M	J92999	---	0.03	1.50	1.50	0.04	0.04	18.0-21.0	9.0-13.0	3.0-4.0	---
ISO 11972:1998	Grade GX 2 CrNiMo 19 11 3	---	---	0.03	1.50	1.50	0.040	0.030	17.0-20.0	9.00-12.00	3.00-3.50	---
ASTM A743/A743M-13ae1	Grade CH20	J93402	---	0.20	1.50	2.00	0.04	0.04	22.0-26.0	12.0-15.0	---	---
JIS G 5121:2003	Class SCS 17	---	---	0.20	2.00	2.00	0.040	0.040	22.00-26.00	12.00-15.00	---	---
ASTM A743/A743M-13ae1	Grade CN7M	N08007	---	0.07	1.50	1.50	0.04	0.04	19.0-22.0	27.5-30.5	2.0-3.0	Cu 3.0-4.0
ASTM A744/A744M-13	Grade CN7M	N08007	---	0.07	1.50	1.50	0.04	0.04	19.0-22.0	27.5-30.5	2.0-3.0	Cu 3.0-4.0
EN 10283:2010	GX2NiCrMo28-20-2	---	1.4458	0.030	2.00	1.00	0.035	0.025	19.00-22.00	26.00-30.00	2.00-2.50	Cu 2.00; N 0.20
	GX4NiCrCuMo30-20-4	---	1.4527	0.06	1.50	1.50	0.040	0.030	19.00-22.00	27.50-30.50	2.00-3.00	Cu 3.00-4.00
JIS G 5121:2003	Class SCS 23	---	---	0.07	2.00	2.00	0.040	0.040	19.00-22.00	27.50-30.00	2.00-3.00	Cu 3.00-4.00
ASTM A743/A743M-13ae1	Grade CN3M	J94652	---	0.03	2.0	1.0	0.03	0.03	20.0-22.0	23.0-27.0	4.50-5.50	---
EN 10283:2010	GX2NiCrMoN25-20-5	---	1.4416	0.030	1.00	1.00	0.035	0.020	19.00-21.00	24.00-26.00	4.50-5.50	N 0.12-0.20; Cu 0.50
ASTM A743/A743M-13ae1	Grade CN3MN	J94651	---	0.03	2.00	1.00	0.040	0.010	20.0-22.0	23.5-25.5	6.0-7.0	Cu 0.75; N 0.18-0.26
ASTM A744/A744M-13	Grade CN3MN	J94651	---	0.03	2.00	1.00	0.040	0.010	20.0-22.0	23.5-25.5	6.00-7.00	Cu 0.75; N 0.18-0.26
EN 10283:2010	GX2NiCrMoCuN25-20-6	---	1.4588	0.025	2.00	1.00	0.035	0.020	19.00-21.00	24.00-26.00	6.00-7.00	Cu 0.50-1.50; N 0.10-0.25
ASTM A743/A743M-13ae1	Grade CK3MCuN	J93254	---	0.025	1.20	1.00	0.045	0.010	19.5-20.5	17.5-19.5	6.0-7.0	Cu 0.50-1.00; N 0.180-0.240
ASTM A744/A744M-13	Grade CK3MCuN	J93254	---	0.025	1.20	1.00	0.045	0.010	19.5-20.5	17.5-19.5	6.0-7.0	Cu 0.50-1.00; N 0.180-0.240
EN 10283:2010	GX2CrNiMoCuN20-18-6	---	1.4557	0.025	1.20	1.00	0.030	0.010	19.50-20.50	17.50-19.50	6.00-7.00	Cu 0.50-1.00; N 0.18-0.24
EN 10283:2010	GX2CrNiMoCuN25-6-3-3	---	1.4517	0.030	1.50	1.00	0.035	0.025	24.50-26.50	5.00-7.00	2.50-3.50	Cu 2.75-3.50; N 0.12-0.22
GB/T 2100-2002	Grade ZG03Cr26Ni5Cu3Mo3N	---	---	0.03	1.5	1.0	0.035	0.025	25.0-27.0	4.5-6.5	2.5-3.5	Cu 2.4-3.5; N 0.12-0.25
ISO 11972:1998	Grade GX 2 CrNiCuMoN 26 5 3 3	---	---	0.03	1.50	1.00	0.035	0.025	25.0-27.0	4.50-6.50	2.50-3.50	Cu 2.50-3.50; N 0.12-0.25
JIS G 5121:2003	Class SCS 32	---	---	0.03	1.50	1.00	0.035	0.025	25.00-27.00	4.50-6.50	2.50-3.50	Cu 2.50-3.50; N 0.12-0.25
EN 10283:2010	GX2CrNiMoN25-6-3	---	1.4468	0.030	2.00	1.00	0.035	0.025	24.50-26.50	5.50-7.00	2.50-3.50	N 0.12-0.25; Cu 0.50
GB/T 2100-2002	Grade ZG03Cr26Ni5Mo3N	---	---	0.03	1.5	1.0	0.035	0.025	25.0-27.0	4.5-6.5	2.5-3.5	N 0.12-0.25
ISO 11972:1998	Grade GX 2 CrNiMoN 26 5 3	---	---	0.03	1.50	1.00	0.035	0.025	25.0-27.0	4.50-6.50	2.50-3.50	N 0.12-0.25
JIS G 5121:2003	Class SCS 10	---	---	0.03	1.50	1.50	0.040	0.030	21.00-26.00	4.50-8.50	2.50-4.00	N 0.08-0.30
	Class SCS 33	---	---	0.03	1.50	1.00	0.035	0.025	25.00-27.00	4.50-6.50	2.50-3.50	N 0.12-0.25

7.4 Cast Stainless Steels

7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications

7.4.1.2B Mechanical Properties of Austenitic Stainless Steels for General and Corrosion Resistant Applications

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
ASTM A743/A743M-13ae1*	Grade CF20	J92602	---	---	205	30	485	70	30	Q	---
JIS G 5121:2003	Class SCS 12	---	---	---	205	---	480	---	28	ST	183 max HB
ASTM A743/A743M-13ae1*	Grade CF8	J92600	---	---	205	30	485	70	35	Q	---
ASTM A744/A744M-13*	Grade CF8	J92600	---	---	205	30	485	70	35	Q	---
EN 10283:2010	GX5CrNi19-10	---	1.4308	$t \leq 150$	175	---	440	---	30	SA+Q	60 J @ RT
ISO 11972:1998	Grade GX 5 CrNi 19 9	---	---	$t \leq 150$	180	---	440	---	30	ST+Q	60 J @ RT
JIS G 5121:2003	Class SCS 13	---	---	---	185	---	440	---	30	ST	183 max HB
	Class SCS 13A	---	---	---	205	---	480	---	33	ST	183 max HB
ASTM A743/A743M-13ae1*	Grade CF3	J92500	---	---	205	30	485	70	35	AC or Q	---
ASTM A744/A744M-13*	Grade CF3	J92500	---	---	205	30	485	70	35	Q	---
EN 10283:2010	GX2CrNi19-11	---	1.4309	$t \leq 150$	185	---	440	---	30	SA+Q	80 J @ RT
ISO 11972:1998	Grade GX 2 CrNi 18 10	---	---	$t \leq 150$	180	---	440	---	30	ST+Q	80 J @ RT
JIS G 5121:2003	Class SCS 19A	---	---	---	205	---	480	---	33	ST	183 max HB
	Class SCS 19	---	---	---	185	---	390	---	33	ST	183 max HB
ASTM A743/A743M-13ae1*	Grade CF8C	J92710	---	---	205	30	485	70	30	Q	---
ASTM A744/A744M-13*	Grade CF8C	J92710	---	---	205	30	485	70	30	Q	---
EN 10283:2010	GX5CrNiNb19-11	---	1.4552	$t \leq 150$	175	---	440	---	25	SA+Q	40 J @ RT
ISO 11972:1998	Grade GX 6 CrNiNb 19 10	---	---	$t \leq 150$	180	---	440	---	25	ST+Q	40 J @ RT
JIS G 5121:2003	Class SCS 21	---	---	---	205	---	480	---	28	ST	183 max HB
ASTM A743/A743M-13ae1*	Grade CF8M	J92900	---	---	205	30	485	70	30	Q	---
ASTM A744/A744M-13*	Grade CF8M	J92900	---	---	205	30	485	70	30	Q	---
EN 10283:2010	GX5CrNiMo19-11-2	---	1.4408	$t \leq 150$	185	---	440	---	30	SA+Q	60 J @ RT
ISO 11972:1998	Grade GX 5 CrNiMo 19 11 2	---	---	$t \leq 150$	180	---	440	---	30	ST+Q	60 J @ RT
	Grade GX 5 CrNiMo 19 11 3	---	---	$t \leq 150$	180	---	440	---	30	ST+Q	60 J @ RT
JIS G 5121:2003	Class SCS 14	---	---	---	185	---	440	---	28	ST	183 max HB
	Class SCS 14A	---	---	---	205	---	480	---	33	ST	183 max HB
EN 10283:2010	GX5CrNiMoNb19-11-2	---	1.4581	$t \leq 150$	185	---	440	---	25	SA+Q	40 J @ RT
ISO 11972:1998	Grade GX 6 CrNiMoNb 19 11 2	---	---	$t \leq 150$	180	---	440	---	25	ST+Q	40 J @ RT
JIS G 5121:2003	Class SCS 22	---	---	---	205	---	440	---	28	ST	183 max HB
ASTM A743/A743M-13ae1*	Grade CF3M	J92800	---	---	205	30	485	70	30	AC or Q	---
ASTM A744/A744M-13*	Grade CF3M	J92800	---	---	205	30	485	70	30	Q	---
EN 10283:2010	GX2CrNiMo19-11-2	---	1.4409	$t \leq 150$	195	---	440	---	30	SA+Q	80 J @ RT
ISO 11972:1998	Grade GX 2 CrNiMo 19 11 2	---	---	$t \leq 150$	180	---	440	---	30	ST+Q	80 J @ RT
JIS G 5121:2003	Class SCS 16A	---	---	---	205	---	480	---	33	ST	183 max HB

*: See "List of Standards" at the beginning of the chapter.

7.4 Cast Stainless Steels

7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications

7.4.1.2B Mechanical Properties of Austenitic Stainless Steels for General and Corrosion Resistant Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
ASTM A743/A743M-13ae1*	Grade CF3MN	J92804	---	---	255	37	515	75	35	AC or Q	---
EN 10283:2010	GX2CrNiMoN17-13-4	---	1.4446	$t \leq 150$	210	---	440	---	20	SA+Q	50 J @ RT
ISO 11972:1998	Grade GX 2 CrNiMoN 19 11 2	---	---	$t \leq 150$	230	---	510	---	30	ST+Q	80 J @ RT
	Grade GX 2 CrNiMoN 19 11 3	---	---	$t \leq 150$	230	---	510	---	30	ST+Q	80 J @ RT
ASTM A743/A743M-13ae1*	Grade CG8M	J93000	---	---	240	35	520	75	25	Q	---
ASTM A744/A744M-13*	Grade CG8M	J93000	---	---	240	35	520	75	25	Q	---
EN 10283:2010	GX5CrNiMo19-11-3	---	1.4412	$t \leq 150$	205	---	440	---	30	SA+Q	60 J @ RT
ASTM A743/A743M-13ae1*	Grade CG3M	J92999	---	---	240	35	515	75	25	Q	---
ASTM A744/A744M-13*	Grade CG3M	J92999	---	---	240	35	515	75	25	Q	---
ISO 11972:1998	Grade GX 2 CrNiMo 19 11 3	---	---	$t \leq 150$	180	---	440	---	30	ST+Q	80 J @ RT
ASTM A743/A743M-13ae1*	Grade CH20	J93402	---	---	205	30	485	70	30	Q	---
JIS G 5121:2003	Class SCS 17	---	---	---	205	---	480	---	28	ST	183 max. HB
ASTM A743/A743M-13ae1*	Grade CN7M	N08007	---	---	170	25	425	62	35	Q	---
ASTM A744/A744M-13*	Grade CN7M	N08007	---	---	170	25	425	62	35	Q	---
EN 10283:2010	GX2NiCrMo28-20-2	---	1.4458	$t \leq 150$	165	---	430	---	30	SA+Q	60 J @ RT
	GX4NiCrCuMo30-20-4	---	1.4527	$t \leq 150$	170	---	430	---	35	SA+Q	60 J @ RT
JIS G 5121:2003	Class SCS 23	---	---	---	165	---	390	---	30	ST	183 max. HB
ASTM A743/A743M-13ae1*	Grade CN3M	J94652	---	---	170	25	435	63	30	Q	---
EN 10283:2010	GX2NiCrMoN25-20-5	---	1.4416	$t \leq 150$	185	---	450	---	30	SA+Q	60 J @ RT
ASTM A743/A743M-13ae1*	Grade CN3MN	J94651	---	---	260	38	550	80	35	Q	---
ASTM A744/A744M-13*	Grade CN3MN	J94651	---	---	260	38	550	80	35	Q	---
EN 10283:2010	GX2NiCrMoCuN25-20-6	---	1.4588	$t \leq 50$	210	---	480	---	30	SA+Q	60 J @ RT
ASTM A743/A743M-13ae1*	Grade CK3MCuN	J93254	---	---	260	38	550	80	35	Q	---
ASTM A744/A744M-13*	Grade CK3MCuN	J93254	---	---	260	38	550	80	35	Q	---
EN 10283:2010	GX2CrNiMoCuN20-18-6	---	1.4557	$t \leq 50$	260	---	500	---	35	SA+Q	50 J @ RT
EN 10283:2010	GX2CrNiMoCuN25-6-3-3	---	1.4517	$t \leq 150$	480	---	650	---	22	SA+Q	50 J @ RT
GB/T 2100-2002	Grade ZG03Cr26Ni5Cu3Mo3N	---	---	$t \leq 150$	450	---	650	---	18	SA+Q	50 J
ISO 11972:1998	Grade GX 2 CrNiCuMoN 26 5 3 3	---	---	$t \leq 150$	450	---	650	---	18	SA+Q	50 J @ RT
JIS G 5121:2003	Class SCS 32	---	---	---	450	---	650	---	18	ST	50 J @ 20°C
EN 10283:2010	GX2CrNiMoN25-6-3	---	1.4468	$t \leq 150$	480	---	650	---	22	SA+Q	50 J @ RT
GB/T 2100-2002	Grade ZG03Cr26Ni5Mo3N	---	---	$t \leq 150$	450	---	650	---	18	ST+Q	50 J
ISO 11972:1998	Grade GX 2 CrNiMoN 26 5 3	---	---	$t \leq 150$	450	---	650	---	18	SA+Q	50 J @ RT
JIS G 5121:2003	Class SCS 10	---	---	---	390	---	620	---	15	ST	302 max. HB
	Class SCS 33	---	---	---	450	---	650	---	18	ST	50 J @ 20°C

*: See "List of Standards" at the beginning of the chapter.

7.4 Cast Stainless Steels

7.4.2 Cast Stainless Steels for Pressure Purposes

7.4.2.1A Chemical Composition of Martensitic and Ferritic Stainless Steels for Pressure Purposes

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-217/SA-217M	Grade CA15	J91150	---	0.15	1.00	1.50	0.040	0.040	11.5-14.0	1.00	0.50	---
ASME SA-487/SA-487M	Grade CA15, Class A	J91150	---	0.15	1.00	1.50	0.040	0.040	11.5-14.0	1.00	0.50	Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50
	Grade CA15, Class B	J91150	---	0.15	1.00	1.50	0.040	0.040	11.5-14.0	1.00	0.50	Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50
	Grade CA15, Class C	J91150	---	0.15	1.00	1.50	0.040	0.040	11.5-14.0	1.00	0.50	Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50
	Grade CA15, Class D	J91150	---	0.15	1.00	1.50	0.040	0.040	11.5-14.0	1.00	0.50	Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50
ASTM A217/A217M-14	Grade CA15	J91150	---	0.15	1.00	1.50	0.040	0.025	11.5-14.0	1.00	0.50	---
ASTM A487/A487M-14	Grade CA15, Class A	J91150	---	0.15	1.00	1.50	0.035	0.035	11.5-14.0	1.00	0.50	Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50
	Grade CA15, Class B	J91150	---	0.15	1.00	1.50	0.035	0.035	11.5-14.0	1.00	0.50	Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50
	Grade CA15, Class C	J91150	---	0.15	1.00	1.50	0.035	0.035	11.5-14.0	1.00	0.50	Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50
	Grade CA15, Class D	J91150	---	0.15	1.00	1.50	0.035	0.035	11.5-14.0	1.00	0.50	Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50
GB/T 16253-1996	Grade ZG14Cr12Ni1MoG	---	---	0.10-0.17	1.00	0.80	0.035	0.035	11.5-13.5	1.00	0.50	---
ISO 4991:1994	Type C39CH	---	---	0.10-0.17	1.00	0.80	0.035	0.035	11.50-13.50	1.00	0.50	---
EN 10213:2007 C1:2008	GX4CrNi13-4	---	1.4317	0.06	1.00	1.00	0.035	0.025	12.00-13.50	3.50-5.00	0.70	V 0.08; Cu 0.30
	GX3CrNi13-4	---	1.6982	0.05	1.00	1.00	0.035	0.015	12.00-13.50	3.50-5.00	0.70	V 0.08; Cu 0.30
GB/T 16253-1996	Grade ZG08Cr12Ni4Mo1D	---	---	0.08	1.50	1.00	0.030	0.030	11.5-13.5	3.50-5.00	1.00	---
	Grade ZG08Cr12Ni4Mo1G	---	---	0.08	1.50	1.00	0.035	0.035	11.5-13.5	3.50-5.00	1.00	---
ISO 4991:1994	Type C39NiH	---	---	0.08	1.50	1.00	0.035	0.035	11.50-13.50	3.50-5.00	1.00	---
	Type C39NiL	---	---	0.08	1.50	1.00	0.030	0.030	11.50-13.50	3.50-5.00	1.00	---
ASME SA-352/SA-352M	Grade CA6NM	J91540	---	0.06	1.00	1.00	0.04	0.03	11.5-14.0	3.5-4.5	0.4-1.0	---
ASME SA-487/SA-487M	Grade CA6NM, Class A	J91540	---	0.06	1.00	1.00	0.04	0.03	11.5-14.0	3.5-4.5	0.4-1.0	Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50
	Grade CA6NM, Class B	J91540	---	0.06	1.00	1.00	0.04	0.03	11.5-14.0	3.5-4.5	0.4-1.0	Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50
ASTM A352/A352M-06 (2012)	Grade CA6NM	J91540	---	0.06	1.00	1.00	0.04	0.03	11.5-14.0	3.5-4.5	0.4-1.0	---
ASTM A487/A487M-14	Grade CA6NM, Class A	J91540	---	0.06	1.00	1.00	0.035	0.03	11.5-14.0	3.5-4.5	0.4-1.0	Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50
	Grade CA6NM, Class B	J91540	---	0.06	1.00	1.00	0.035	0.03	11.5-14.0	3.5-4.5	0.4-1.0	Cu 0.50; W 0.10; V 0.05; (Cu+W+V) 0.50
ASTM A757/A757M-15	Grade E3N	J91550	---	0.06	1.00	1.00	0.030	0.030	11.5-14.0	3.5-4.5	0.40-1.0	Cu 0.50; W 0.10; (Cu+W+P+S) 0.50

7.4 Cast Stainless Steels

7.4.2 Cast Stainless Steels for Pressure Purposes

7.4.2.1A Chemical Composition of Martensitic and Ferritic Stainless Steels for Pressure Purposes (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10213:2007 C1:2008	GX23CrMoV12-1	---	1.4931	0.20-0.26	0.50-0.80	0.40	0.030	0.020	11.30-12.20	1.00	1.00-1.20	V 0.25-0.35; Cu 0.30; W 0.50
GB/T 16253-1996	Grade ZG23Cr12Mo1NiVG	---	---	0.20-0.26	0.50-0.70	0.20-0.40	0.035	0.035	11.3-12.3	0.70-1.00	1.00-1.20	V 0.25-0.35
ISO 4991:1994	Type C40H	---	---	0.20-0.26	0.50-0.70	0.20-0.40	0.035	0.035	11.30-12.30	0.70-1.00	1.00-1.20	V 0.25-0.35
EN 10213:2007 C1:2008	GX8CrNi12	---	1.4107	0.10	0.50-0.80	0.40	0.030	0.020	11.50-12.50	0.80-1.50	0.50	V 0.08; Cu 0.30
GB/T 16253-1996	Grade ZG08Cr12Ni1MoG	---	---	0.05-0.10	0.40-0.80	0.80	0.035	0.035	11.5-13.0	0.80-1.80	0.20-0.50	---
ISO 4991:1994	Type C39CNiH	---	---	0.05-0.10	0.40-0.80	0.80	0.035	0.035	11.50-13.00	0.80-1.80	0.20-0.50	---

7.4 Cast Stainless Steels

7.4.2 Cast Stainless Steels for Pressure Purposes

7.4.2.1B Mechanical Properties of Martensitic and Ferritic Stainless Steels for Pressure Purposes

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
ASME SA-217/SA-217M	Grade CA15	J91150	---	---	450	65	620-795	90-115	18	N+T	---
ASME SA-487/SA-487M	Grade CA15, Class A	J91150	---	---	760-895	110-130	965-1170	140-170	10	N+T or Q+T	---
	Grade CA15, Class B	J91150	---	---	450	65	620-795	90-115	18	N+T or Q+T	---
	Grade CA15, Class C	J91150	---	---	415	60	620	90	18	N+T or Q+T	235 max HB; 22 max HRC
	Grade CA15, Class D	J91150	---	---	515	75	690	100	17	N+T or Q+T	235 max HB; 22 max HRC
ASTM A217/A217M-14	Grade CA15	J91150	---	---	450	65	620-795	90-115	18	N+T	---
ASTM A487/A487M-14	Grade CA15, Class A	J91150	---	---	760-895	110-130	965-1170	140-170	10	N+T or Q+T	---
	Grade CA15, Class B	J91150	---	---	450	65	620-795	90-115	18	N+T or Q+T	---
	Grade CA15, Class C	J91150	---	---	415	60	620	90	18	N+T or Q+T	235 max HB; 22 max HRC
	Grade CA15, Class D	J91150	---	---	515	75	690	100	17	N+T or Q+T	235 max HB; 22 max HRC
GB/T 16253-1996	Grade ZG14Cr12Ni1MoG	---	---	---	450	---	620-770	---	14	N+T	20 J @ RT
ISO 4991:1994	Type C39CH	---	---	---	450	---	620-770	---	14	N+T	20 J @ RT
EN 10213:2007 C1:2008	GX4CrNi13-4	---	1.4317	$t \leq 300$	550	---	760-960	---	15	Q+T	50 J @ RT
	GX3CrNi13-4	---	1.6982	$t \leq 300$	500	---	700-900	---	15	Q+T	27 J @ -120°C
GB/T 16253-1996	Grade ZG08Cr12Ni4Mo1D	---	---	---	550	---	750-900	---	15	N+T	27 J @ -80°C
	Grade ZG08Cr12Ni4Mo1G	---	---	---	550	---	750-900	---	15	N+T	45 J @ RT
ISO 4991:1994	Type C39NiH	---	---	---	550	---	750-900	---	15	N+T	45 J @ RT
	Type C39NiL	---	---	---	550	---	750-900	---	15	N+T	27 J @ -80°C
ASME SA-352/SA-352M	Grade CA6NM	J91540	---	---	550	80.0	760-930	110.0-135.0	15	N+T	27 J @ -73°C
ASME SA-487/SA-487M	Grade CA6NM, Class A	J91540	---	---	550	80	760-930	110-135	15	N+T or Q+T	---
	Grade CA6NM, Class B	J91540	---	---	515	75	690	100	17	N+T or Q+T	255 max HB; 23 max HRC
ASTM A352/A352M-06 (2012)	Grade CA6NM	J91540	---	---	550	80.0	760-930	110.0-135.0	15	N+T	27 J @ -73°C
ASTM A487/A487M-14	Grade CA6NM, Class A	J91540	---	---	550	80	760-930	110-135	15	N+T or Q+T	---
	Grade CA6NM, Class B	J91540	---	---	515	75	690	100	17	N+T or Q+T	255 max HB; 23 max HRC
ASTM A757/A757M-15	Grade E3N	J91550	---	---	550	80	760	110	15	N+T	L: 27 J @ -73°C
EN 10213:2007 C1:2008	GX23CrMoV12-1	---	1.4931	$t \leq 150$	540	---	740-880	---	15	Q+T	27 J @ RT
GB/T 16253-1996	Grade ZG23Cr12Mo1NiVG	---	---	---	540	---	740-880	---	15	N+T	21 J @ RT
ISO 4991:1994	Type C40H	---	---	---	540	---	740-880	---	15	N+T	21 J @ RT
EN 10213:2007 C1:2008	GX8CrNi12	---	1.4107	$t \leq 300$	355	---	540-690	---	18	Q+T	45 J @ RT
				$t \leq 300$	500	---	600-800	---	16	Q+T	40 J @ RT
GB/T 16253-1996	Grade ZG08Cr12Ni1MoG	---	---	---	360	---	540-690	---	18	N+T	35 J @ RT
ISO 4991:1994	Type C39CNiH	---	---	---	360	---	540-690	---	18	N+T	35 J @ RT

7.4 Cast Stainless Steels

7.4.2 Cast Stainless Steels for Pressure Purposes

7.4.2.2A Chemical Composition of Austenitic Stainless Steels for Pressure Purposes

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-351/SA-351M	Grade CF8	J92600	---	0.08	1.50	2.00	0.040	0.040	18.0-21.0	8.0-11.0	0.50	---
	Grade CF8A	J92600	---	0.08	1.50	2.00	0.040	0.040	18.0-21.0	8.0-11.0	0.50	---
ASTM A351/A351M-14	Grade CF8	J92600	---	0.08	1.50	2.00	0.040	0.040	18.0-21.0	8.0-11.0	0.50	---
	Grade CF8A	J92600	---	0.08	1.50	2.00	0.040	0.040	18.0-21.0	8.0-11.0	0.50	---
EN 10213:2007 C1:2008	GX5CrNi19-10	---	1.4308	0.07	1.50	1.50	0.040	0.030	18.00-20.00	8.00-11.00	---	Cu 0.50
GB/T 16253-1996	Grade ZG07Cr20Ni10	---	---	0.07	2.00	2.00	0.045	0.035	18.0-21.0	8.0-11.0	---	---
ISO 4991:1994	Type C47	---	---	0.07	2.00	2.00	0.045	0.035	18.00-21.00	8.00-11.00	---	---
ASME SA-351/SA-351M	Grade CF3	J92700	---	0.03	1.50	2.00	0.040	0.040	17.0-21.0	8.0-12.0	0.50	---
	Grade CF3A	J92700	---	0.03	1.50	2.00	0.040	0.040	17.0-21.0	8.0-12.0	0.50	---
ASTM A351/A351M-14	Grade CF3	J92700	---	0.03	1.50	2.00	0.040	0.040	17.0-21.0	8.0-12.0	0.50	---
	Grade CF3A	J92700	---	0.03	1.50	2.00	0.040	0.040	17.0-21.0	8.0-12.0	0.50	---
EN 10213:2007 C1:2008	GX2CrNi19-11	---	1.4309	0.030	2.00	1.50	0.035	0.025	18.00-20.00	9.00-12.00	---	N 0.20; Cu 0.50
GB/T 16253-1996	Grade ZG03Cr18Ni10	---	---	0.03	2.00	2.00	0.045	0.035	17.0-19.0	9.0-12.0	---	---
ISO 4991:1994	Type C46	---	---	0.03	2.00	2.00	0.045	0.035	17.00-19.00	9.00-12.00	---	---
ASME SA-351/SA-351M	Grade CF8C	J92710	---	0.08	1.50	2.00	0.040	0.040	18.0-21.0	9.0-12.0	0.50	Cb 8xC to 1.00
ASTM A351/A351M-14	Grade CF8C	J92710	---	0.08	1.50	2.00	0.040	0.040	18.0-21.0	9.0-12.0	0.50	Cb 8xC to 1.00
EN 10213:2007 C1:2008	GX5CrNiNb19-11	---	1.4552	0.07	1.50	1.50	0.040	0.030	18.00-20.00	9.00-12.00	---	Nb 8xC to 1.00; Cu 0.50
GB/T 16253-1996	Grade ZG08Cr20Ni10Nb	---	---	0.08	2.00	2.00	0.045	0.035	18.0-21.0	9.0-12.0	---	Nb 8xC to 1.0
ISO 4991:1994	Type C50	---	---	0.08	2.00	2.00	0.045	0.035	18.00-21.00	9.00-12.00	---	Nb 8xC to 1.0
ASME SA-351/SA-351M	Grade CF8M	J92900	---	0.08	1.50	1.50	0.040	0.040	18.0-21.0	9.0-12.0	2.0-3.0	---
ASTM A351/A351M-14	Grade CF8M	J92900	---	0.08	1.50	1.50	0.040	0.040	18.0-21.0	9.0-12.0	2.0-3.0	---
EN 10213:2007 C1:2008	GX5CrNiMo19-11-2	---	1.4408	0.07	1.50	1.50	0.040	0.030	18.00-20.00	9.00-12.00	2.00-2.50	Cu 0.50
GB/T 16253-1996	Grade ZG07Cr19Ni11Mo2	---	---	0.07	2.00	2.00	0.045	0.035	17.0-21.0	9.0-13.0	2.0-2.5	---
	Grade ZG07Cr19Ni11Mo3	---	---	0.07	2.00	2.00	0.045	0.035	17.0-21.0	9.0-13.0	2.5-3.0	---
ISO 4991:1994	Type C60	---	---	0.07	2.00	2.00	0.045	0.035	17.00-21.00	9.00-13.00	2.00-2.50	---
	Type C61	---	---	0.07	2.00	2.00	0.045	0.035	17.00-21.00	9.00-13.00	2.50-3.00	---
EN 10213:2007 C1:2008	GX5CrNiMoNb19-11-2	---	1.4581	0.07	1.50	1.50	0.040	0.030	18.00-12.00	9.00-12.00	2.00-2.50	Nb 8xC to 1.00; Cu 0.50
GB/T 16253-1996	Grade ZG08Cr19Ni11Mo2Nb	---	---	0.08	2.00	2.00	0.045	0.035	17.0-21.0	9.0-13.0	2.0-2.5	Nb 8xC to 1.0
ISO 4991:1994	Type C60Nb	---	---	0.08	2.00	2.00	0.045	0.035	17.00-21.00	9.00-13.00	2.00-2.50	Nb 8xC to 1.0

7.4 Cast Stainless Steels

7.4.2 Cast Stainless Steels for Pressure Purposes

7.4.2.2A Chemical Composition of Austenitic Stainless Steels for Pressure Purposes (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-351/SA-351M	Grade CF3M	J92800	---	0.03	1.50	1.50	0.040	0.040	17.0-21.0	9.0-13.0	2.0-3.0	---
	Grade CF3MA	J92800	---	0.03	1.50	1.50	0.040	0.040	17.0-21.0	9.0-13.0	2.0-3.0	---
ASTM A351/A351M-14	Grade CF3M	J92800	---	0.03	1.50	1.50	0.040	0.040	17.0-21.0	9.0-13.0	2.0-3.0	---
	Grade CF3MA	J92800	---	0.03	1.50	1.50	0.040	0.040	17.0-21.0	9.0-13.0	2.0-3.0	---
EN 10213:2007 C1:2008	GX2CrNiMo19-11-2	---	1.4409	0.030	2.00	1.50	0.035	0.025	18.00-20.00	9.00-12.00	2.00-2.50	N 0.20; Cu 0.50
GB/T 16253-1996	Grade ZG03Cr19Ni11Mo2	---	---	0.03	2.00	2.00	0.045	0.035	17.0-21.0	9.0-13.0	2.0-2.5	---
	Grade ZG03Cr19Ni11Mo3	---	---	0.03	2.00	2.00	0.045	0.035	17.0-21.0	9.0-13.0	2.5-3.0	---
ISO 4991:1994	Type C57	---	---	0.03	2.00	2.00	0.045	0.035	17.00-21.00	9.00-13.00	2.00-2.50	---
	Type C61LC	---	---	0.03	2.00	2.00	0.045	0.035	17.00-21.00	9.00-13.00	2.50-3.00	---
ASME SA-351/SA-351M	Grade CN7M	N08007	---	0.07	1.50	1.50	0.040	0.040	19.0-22.0	27.5-30.5	2.0-3.0	Cu 3.0-4.0
ASTM A351/A351M-14	Grade CN7M	N08007	---	0.07	1.50	1.50	0.040	0.040	19.0-22.0	27.5-30.5	2.0-3.0	Cu 3.0-4.0
EN 10213:2007 C1:2008	GX2NiCrMo28-20-2	---	1.4458	0.030	2.00	1.00	0.035	0.025	19.00-22.00	26.00-30.00	2.00-2.50	N 0.20; Cu 2.00
GB/T 16253-1996	Grade ZG07Cr20Ni10G	---	---	0.04-0.10	2.00	2.00	0.045	0.035	18.0-21.0	8.0-12.0	---	---
ISO 4991:1994	Type C47H	---	---	0.04-0.10	2.00	2.00	0.045	0.035	18.00-21.00	8.00-12.00	---	---
ASME SA-351/SA-351M	Grade CF10M	J92901	---	0.04-0.10	1.50	1.50	0.040	0.040	18.0-21.0	9.0-12.0	2.0-3.0	---
ASTM A351/A351M-14	Grade CF10M	J92901	---	0.04-0.10	1.50	1.50	0.040	0.040	18.0-21.0	9.0-12.0	2.0-3.0	---
GB/T 16253-1996	Grade ZG07Cr19Ni11Mo2G	---	---	0.04-0.10	2.00	2.00	0.045	0.035	17.0-21.0	9.0-13.0	2.0-2.5	---
ISO 4991:1994	Type C60H	---	---	0.04-0.10	2.00	2.00	0.045	0.035	17.00-21.00	9.00-13.00	2.00-2.50	---
GB/T 16253-1996	Grade ZG07Cr18Ni10D	---	---	0.07	2.00	2.00	0.045	0.035	17.0-20.0	9.0-12.0	---	---
ISO 4991:1994	Type C47L	---	---	0.07	2.00	2.00	0.045	0.035	17.00-20.00	9.00-12.00	---	---

7.4 Cast Stainless Steels

7.4.2 Cast Stainless Steels for Pressure Purposes

7.4.2.2B Mechanical Properties of Austenitic Stainless Steels for Pressure Purposes

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
ASME SA-351/SA-351M	Grade CF8	J92600	---	---	205	30	485	70	35.0	Q	---
	Grade CF8A	J92600	---	---	240	35	530	77	35.0	Q	---
ASTM A351/A351M-14	Grade CF8	J92600	---	---	205	30	485	70	35.0	Q	---
	Grade CF8A	J92600	---	---	240	35	530	77	35.0	Q	---
EN 10213:2007 C1:2008	GX5CrNi19-10	---	1.4308	$t \leq 150$	200	---	440-640	---	30	SA+Q	60 J @ -196°C
GB/T 16253-1996	Grade ZG07Cr20Ni10	---	---	---	210	---	440-640	---	30	ST	---
ISO 4991:1994	Type C47	---	---	---	210	---	440-640	---	30	ST	---
ASME SA-351/SA-351M	Grade CF3	J92700	---	---	205	30	485	70	35.0	Q	---
	Grade CF3A	J92700	---	---	240	35	530	77	35.0	Q	---
ASTM A351/A351M-14	Grade CF3	J92700	---	---	205	30	485	70	35.0	Q	---
	Grade CF3A	J92700	---	---	240	35	530	77	35.0	Q	---
EN 10213:2007 C1:2008	GX2CrNi19-11	---	1.4309	$t \leq 150$	210	---	440-640	---	30	SA+Q	70 J @ -196°C
GB/T 16253-1996	Grade ZG03Cr18Ni10	---	---	---	210	---	440-640	---	30	ST	---
ISO 4991:1994	Type C46	---	---	---	210	---	440-640	---	30	ST	---
ASME SA-351/SA-351M	Grade CF8C	J92710	---	---	205	30	485	70	30.0	Q	---
ASTM A351/A351M-14	Grade CF8C	J92710	---	---	205	30	485	70	30.0	Q	---
EN 10213:2007 C1:2008	GX5CrNiNb19-11	---	1.4552	$t \leq 150$	200	---	440-640	---	25	SA+Q	40 J @ RT
GB/T 16253-1996	Grade ZG08Cr20Ni10Nb	---	---	---	210	---	440-640	---	25	ST	---
ISO 4991:1994	Type C50	---	---	---	210	---	440-640	---	25	ST	---
ASME SA-351/SA-351M	Grade CF8M	J92900	---	---	205	30	485	70	30.0	Q	---
ASTM A351/A351M-14	Grade CF8M	J92900	---	---	205	30	485	70	30.0	Q	---
EN 10213:2007 C1:2008	GX5CrNiMo19-11-2	---	1.4408	$t \leq 150$	210	---	440-640	---	30	SA+Q	60 J @ -196°C
GB/T 16253-1996	Grade ZG07Cr19Ni11Mo2	---	---	---	210	---	440-640	---	30	ST	---
	Grade ZG07Cr19Ni11Mo3	---	---	---	210	---	440-640	---	30	ST	---
ISO 4991:1994	Type C60	---	---	---	210	---	440-640	---	30	ST	---
	Type C61	---	---	---	210	---	440-640	---	30	ST	---
EN 10213:2007 C1:2008	GX5CrNiMoNb19-11-2	---	1.4581	$t \leq 150$	210	---	440-640	---	25	SA+Q	40 J @ RT
GB/T 16253-1996	Grade ZG08Cr19Ni11Mo2Nb	---	---	---	210	---	440-640	---	25	ST	---
ISO 4991:1994	Type C60Nb	---	---	---	210	---	440-640	---	25	ST	---

7.4 Cast Stainless Steels

7.4.2 Cast Stainless Steels for Pressure Purposes

7.4.2.2B Mechanical Properties of Austenitic Stainless Steels for Pressure Purposes (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
ASME SA-351/SA-351M	Grade CF3M	J92800	---	---	205	30	485	70	30.0	Q	---
	Grade CF3MA	J92800	---	---	255	37	550	80	30.0	Q	---
ASTM A351/A351M-14	Grade CF3M	J92800	---	---	205	30	485	70	30.0	Q	---
	Grade CF3MA	J92800	---	---	255	37	550	80	30.0	Q	---
EN 10213:2007 C1:2008	GX2CrNiMo19-11-2	---	1.4409	$t \leq 150$	220	---	440-640	---	30	SA+Q	70 J @ -196°C
GB/T 16253-1996	Grade ZG03Cr19Ni11Mo2	---	---	---	210	---	440-620	---	30	ST	---
	Grade ZG03Cr19Ni11Mo3	---	---	---	210	---	440-640	---	30	ST	---
ISO 4991:1994	Type C57	---	---	---	210	---	440-620	---	30	ST	---
	Type C61LC	---	---	---	210	---	440-640	---	30	ST	---
ASME SA-351/SA-351M	Grade CN7M	N08007	---	---	170	25	425	62	35.0	Q	---
ASTM A351/A351M-14	Grade CN7M	N08007	---	---	170	25	425	62	35.0	Q	---
EN 10213:2007 C1:2008	GX2NiCrMo28-20-2	---	1.4458	$t \leq 150$	190	---	430-630	---	30	SA+Q	60 J @ -196°C
GB/T 16253-1996	Grade ZG07Cr20Ni10G	---	---	---	230	---	470-670	---	30	ST	---
ISO 4991:1994	Type C47H	---	---	---	230	---	470-670	---	30	ST	---
ASME SA-351/SA-351M	Grade CF10M	J92901	---	---	205	30	485	70	30.0	Q	---
ASTM A351/A351M-14	Grade CF10M	J92901	---	---	205	30	485	70	30.0	Q	---
GB/T 16253-1996	Grade ZG07Cr19Ni11Mo2G	---	---	---	230	---	470-670	---	30	ST	---
ISO 4991:1994	Type C60H	---	---	---	230	---	470-670	---	30	ST	---
GB/T 16253-1996	Grade ZG07Cr18Ni10D	---	---	---	210	---	440-640	---	30	ST	45 J @ -195°C
ISO 4991:1994	Type C47L	---	---	---	210	---	440-640	---	30	ST	45 J @ -195°C

7.5 Cast Heat Resistant Steels

7.5A Chemical Composition of Cast Heat Resistant Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
EN 10295:2002	GX40CrSi13	---	1.4729	0.30-0.50	1.00	1.00-2.50	0.040	0.030	12.00-14.00	1.00	0.50	---
ISO 11973:1999	Grade GX40CrSi13	---	---	0.30-0.50	0.50-1.00	1.00-2.5	0.040	0.030	12.0-14.0	1.00	0.5	---
JIS G 5122:2003	Class SCH 3	---	---	0.40	1.00	2.00	0.040	0.040	12.00-15.00	1.00	0.50	---
	Class SCH 1	---	---	0.20-0.40	1.00	1.50-3.00	0.040	0.040	12.00-15.00	1.00	0.50	---
EN 10295:2002	GX40CrSi17	---	1.4740	0.30-0.50	1.00	1.00-2.50	0.040	0.030	16.00-19.00	1.00	0.50	---
ISO 11973:1999	Grade GX40CrSi17	---	---	0.30-0.50	0.50-1.00	1.00-2.5	0.040	0.030	16.0-19.0	1.00	0.5	---
EN 10295:2002	GX40CrSi24	---	1.4745	0.30-0.50	1.00	1.00-2.50	0.040	0.030	23.00-26.00	1.00	0.50	---
ISO 11973:1999	Grade GX40CrSi24	---	---	0.30-0.50	0.50-1.00	1.00-2.5	0.040	0.030	23.0-26.0	1.00	0.5	---
EN 10295:2002	GX40CrSi28	---	1.4776	0.30-0.50	1.00	1.00-2.50	0.040	0.030	27.00-30.00	1.00	0.50	---
ISO 11973:1999	Grade GX40CrSi28	---	---	0.30-0.50	0.50-1.00	1.00-2.5	0.040	0.030	27.0-30.0	1.00	0.5	---
EN 10295:2002	GX130CrSi29	---	1.4777	1.20-1.40	0.50-1.00	1.00-2.50	0.035	0.030	27.00-30.00	1.00	0.50	---
ISO 11973:1999	Grade GX130CrSi29	---	---	1.20-1.40	0.50-1.00	1.00-2.5	0.040	0.030	27.0-30.0	1.00	0.5	---
ASTM A297/A297M-14	Grade HC	J92605	---	0.50	1.00	2.00	0.04	0.04	26.0-30.0	4.00	0.50	---
ASTM A608/A608M-14	Grade HC30	J92613	---	0.25-0.35	0.5-1.0	0.50-2.00	0.04	0.04	26-30	4.0	0.50	---
JIS G 5122:2003	Class SCH 2	---	---	0.40	1.00	2.00	0.040	0.040	25.00-28.00	1.00	0.50	---
ASTM A297/A297M-14	Grade HD	J93005	---	0.50	1.50	2.00	0.04	0.04	26.0-30.0	4.0-7.0	0.50	---
ASTM A608/A608M-14	Grade HD50	J93015	---	0.45-0.55	1.50	0.50-2.00	0.04	0.04	26-30	4-7	0.50	---
EN 10295:2002	GX40CrNiSi27-4	---	1.4823	0.30-0.50	1.50	1.00-2.50	0.040	0.030	25.00-28.00	3.00-6.00	0.50	---
ISO 11973:1999	Grade GX40CrNiSi27-4	---	---	0.30-0.50	1.50	1.00-2.5	0.040	0.030	25.0-28.0	3.00-6.00	0.5	---
JIS G 5122:2003	Class SCH 11	---	---	0.40	1.00	2.00	0.040	0.040	24.00-28.00	4.00-6.00	0.50	---
ASTM A297/A297M-14	Grade HE	J93403	---	0.20-0.50	2.00	2.00	0.04	0.04	26.0-30.0	8.0-11.0	0.50	---
ASTM A608/A608M-14	Grade HE35	J93413	---	0.30-0.40	1.50	0.50-2.00	0.04	0.04	26-30	8-11	0.50	---
JIS G 5122:2003	Class SCH 17	---	---	0.20-0.50	2.00	2.00	0.040	0.040	26.00-30.00	8.00-11.00	0.50	---
ASTM A297/A297M-14	Grade HF	J92603	---	0.20-0.40	2.00	2.00	0.04	0.04	18.0-23.0	8.0-12.0	0.50	---
ASTM A608/A608M-14	Grade HF30	J92803	---	0.25-0.35	1.50	0.50-2.00	0.04	0.04	19-23	9-12	0.50	---
EN 10295:2002	GX25CrNiSi18-9	---	1.4825	0.15-0.35	2.00	0.50-2.50	0.040	0.030	17.00-19.00	8.00-10.00	0.50	---
	GX40CrNiSi22-10	---	1.4826	0.30-0.50	2.00	1.00-2.50	0.040	0.030	21.00-23.00	9.00-11.00	0.50	---
ISO 11973:1999	Grade GX25CrNiSi18-9	---	---	0.15-0.35	2.00	1.00-2.5	0.040	0.030	17.0-19.0	8.00-10.00	0.5	---
	Grade GX40CrNiSi22-10	---	---	0.30-0.50	2.00	1.00-2.5	0.040	0.030	21.0-23.0	9.00-11.00	0.5	---
JIS G 5122:2003	Class SCH 12	---	---	0.20-0.40	2.00	2.00	0.040	0.040	18.00-23.00	8.00-12.00	0.50	---
EN 10295:2002	GX25CrNiSi20-14	---	1.4832	0.15-0.35	2.00	0.50-2.50	0.040	0.030	19.00-21.00	13.00-15.00	0.50	---
ISO 11973:1999	Grade GX25 CrNiSi 20-14	---	---	0.15-0.35	2.00	1.00-2.5	0.040	0.030	19.0-21.0	13.00-15.00	0.5	---

7.5 Cast Heat Resistant Steels

7.5A Chemical Composition of Cast Heat Resistant Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A297/A297M-14	Grade HH	J93503	---	0.20-0.50	2.00	2.00	0.04	0.04	24.0-28.0	11.0-14.0	0.50	---
ASTM A447/A447M-11	Type I	J93303	---	0.20-0.45	2.50	1.75	0.030	0.030	23.00-28.00	10.00-14.00	---	N 0.20
	Type II	J93303	---	0.20-0.45	2.50	1.75	0.030	0.030	23.00-28.00	10.00-14.00	---	N 0.20
ASTM A608/A608M-14	Grade HH30	J93513	---	0.25-0.35	1.50	0.50-2.00	0.04	0.04	24-28	11-14	0.50	---
	Grade HH33	J93633	---	0.28-0.38	1.50	0.50-2.00	0.04	0.04	24-26	12-14	0.50	---
EN 10295:2002	GX40CrNiSi25-12	---	1.4837	0.30-0.50	2.00	1.00-2.50	0.040	0.030	24.00-27.00	11.00-14.00	0.50	---
ISO 11973:1999	Grade GX40CrNiSi25-12	---	---	0.30-0.50	2.00	1.00-2.5	0.040	0.030	24.0-27.0	11.00-14.00	0.5	---
JIS G 5122:2003	Class SCH 13	---	---	0.20-0.50	2.00	2.00	0.040	0.040	24.00-28.00	11.00-14.00	0.50	---
	Class SCH 13A	---	---	0.25-0.50	2.50	1.75	0.040	0.040	23.00-26.00	12.00-14.00	0.50	---
ASTM A297/A297M-14	Grade HI	J94003	---	0.20-0.50	2.00	2.00	0.04	0.04	26.0-30.0	14.0-18.0	0.50	---
ASTM A608/A608M-14	Grade HI35	J94013	---	0.30-0.40	1.50	0.50-2.00	0.04	0.04	26-30	14-18	0.50	---
JIS G 5122:2003	Class SCH 18	---	---	0.20-0.50	2.00	2.00	0.040	0.040	26.00-30.00	14.00-18.00	0.50	---
ASME SA-351/SA-351M	Grade HK30	J94203	---	0.25-0.35	1.50	1.75	0.040	0.040	23.0-27.0	19.0-22.0	0.50	---
ASTM A297/A297M-14	Grade HK	J94224	---	0.20-0.60	2.00	2.00	0.04	0.04	24.0-28.0	18.0-22.0	0.50	---
ASTM A351/A351M-14	Grade HK30	J94203	---	0.25-0.35	1.50	1.75	0.040	0.040	23.0-27.0	19.0-22.0	0.50	---
ASTM A608/A608M-14	Grade HK30	J94203	---	0.25-0.35	1.50	0.50-2.00	0.04	0.04	23-27	19-22	0.50	---
JIS G 5122:2003	Class SCH 21	---	---	0.25-0.35	1.50	1.75	0.040	0.040	23.00-27.00	19.00-22.00	0.50	---
ASME SA-351/SA-351M	Grade HK40	J94204	---	0.35-0.45	1.50	1.75	0.040	0.040	23.0-27.0	19.0-22.0	0.50	---
ASTM A351/A351M-14	Grade HK40	J94204	---	0.35-0.45	1.50	1.75	0.040	0.040	23.0-27.0	19.0-22.0	0.50	---
ASTM A608/A608M-14	Grade HK40	J94204	---	0.35-0.45	1.50	0.50-2.00	0.04	0.04	23-27	19-22	0.50	---
EN 10295:2002	GX40CrNiSi25-20	---	1.4848	0.30-0.50	2.00	1.00-2.50	0.040	0.030	24.00-27.00	19.00-22.00	0.50	---
ISO 11973:1999	Grade GX40CrNiSi25-20	---	---	0.30-0.50	2.00	1.00-2.5	0.040	0.030	24.0-27.0	19.00-22.00	0.5	---
JIS G 5122:2003	Class SCH 22	---	---	0.35-0.45	1.50	1.75	0.040	0.040	23.00-27.00	19.00-22.00	0.50	---
ASTM A297/A297M-14	Grade HL	N08604	---	0.20-0.60	2.00	2.00	0.04	0.04	28.0-32.0	18.0-22.0	0.50	---
ASTM A608/A608M-14	Grade HL30	N08613	---	0.25-0.35	1.50	0.50-2.00	0.04	0.04	28-32	18-22	0.50	---
	Grade HL40	N08614	---	0.35-0.45	1.50	0.50-2.00	0.04	0.04	28-32	18-22	0.50	---
JIS G 5122:2003	Class SCH 23	---	---	0.20-0.60	2.00	2.00	0.040	0.040	28.00-32.00	18.00-22.00	0.50	---

7.5 Cast Heat Resistant Steels

7.5A Chemical Composition of Cast Heat Resistant Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A297/A297M-14	Grade HN	J94213	---	0.20-0.50	2.00	2.00	0.04	0.04	19.0-23.0	23.0-27.0	0.50	---
ASTM A608/A608M-14	Grade HN40	J94214	---	0.35-0.45	1.50	0.50-2.00	0.04	0.04	19-23	23-27	0.50	---
EN 10295:2002	GX35NiCrSi25-21	---	1.4805	0.20-0.50	2.00	1.00-2.00	0.040	0.030	19.00-23.00	23.00-27.00	0.50	---
JIS G 5122:2003	Class SCH 19	---	---	0.20-0.50	2.00	2.00	0.040	0.040	19.00-23.00	23.00-27.00	0.50	---
EN 10295:2002	GX40CrNiSiNb24-24	---	1.4855	0.30-0.50	2.00	1.00-2.50	0.040	0.030	23.00-25.00	23.00-25.00	0.50	Nb 0.80-1.80
ISO 11973:1999	Grade GX40CrNiSiNb24-24	---	---	0.25-0.50	2.00	1.00-2.5	0.040	0.030	23.0-25.0	23.00-25.00	0.5	Nb 1.20-1.80
ASTM A297/A297M-14	Grade HP	N08705	---	0.35-0.75	2.00	2.50	0.04	0.04	24-28	33-37	0.50	---
EN 10295:2002	GX40NiCrSiNb35-26	---	1.4852	0.30-0.50	2.00	1.00-2.50	0.040	0.030	24.00-27.00	33.00-36.00	0.50	Nb 0.80-1.80
	GX40NiCrSi35-26	---	1.4857	0.30-0.50	2.00	1.00-2.50	0.040	0.030	24.00-27.00	33.00-36.00	0.50	---
ISO 11973:1999	Grade GX40NiCrSi35-26	---	---	0.30-0.50	2.00	1.00-2.50	0.040	0.030	24.0-27.0	33.00-36.00	0.50	---
	Grade GX40NiCrSiNb35-26	---	---	0.30-0.50	2.00	1.00-2.50	0.040	0.030	24.0-27.0	33.00-36.00	0.50	Nb 0.80-1.80
JIS G 5122:2003	Class SCH 24	---	---	0.35-0.75	2.00	2.00	0.040	0.040	24.00-28.00	33.00-37.00	0.50	---
ASTM A297/A297M-14	Grade HT	N08605	---	0.35-0.75	2.00	2.50	0.04	0.04	15.0-19.0	33.0-37.0	0.50	---
ASTM A608/A608M-14	Grade HT50	N08050	---	0.40-0.60	1.50	0.50-2.00	0.04	0.04	15-19	33-37	0.50	---
EN 10295:2002	GX40NiCrSi35-17	---	1.4806	0.30-0.50	2.00	1.00-2.50	0.040	0.030	16.00-18.00	34.00-36.00	0.50	---
ISO 11973:1999	Grade GX40NiCrSi35-17	---	---	0.30-0.50	2.00	1.00-2.50	0.040	0.030	16.0-18.0	34.00-36.00	0.50	---
JIS G 5122:2003	Class SCH 15	---	---	0.35-0.70	2.00	2.50	0.040	0.040	15.00-19.00	33.00-37.00	0.50	---
ASME SA-351/SA-351M	Grade HT30	N08030	---	0.25-0.35	2.00	2.50	0.040	0.040	13.0-17.0	33.0-37.0	0.50	---
ASTM A351/A351M-14	Grade HT30	N08030	---	0.25-0.35	2.00	2.50	0.040	0.040	13.0-17.0	33.0-37.0	0.50	---
JIS G 5122:2003	Class SCH 16	---	---	0.20-0.35	2.00	2.50	0.040	0.040	13.00-17.00	33.00-37.00	0.50	---
ASTM A297/A297M-14	Grade HU	N08004	---	0.35-0.75	2.00	2.50	0.04	0.04	17.0-21.0	37.0-41.0	0.50	---
ASTM A608/A608M-14	Grade HU50	N08005	---	0.40-0.60	1.50	0.50-2.00	0.04	0.04	17-21	37-41	0.50	---
EN 10295:2002	GX40NiCrSiNb35-18	---	1.4807	0.30-0.50	2.00	1.00-2.50	0.040	0.030	17.00-20.00	34.00-36.00	0.50	Nb 1.00-1.80
	GX40NiCrSiNb38-19	---	1.4849	0.30-0.50	2.00	1.00-2.50	0.040	0.030	18.00-21.00	36.00-39.00	0.50	Nb 1.20-1.80
	GX40NiCrSi38-19	---	1.4865	0.30-0.50	2.00	1.00-2.50	0.040	0.030	18.00-21.00	36.00-39.00	0.50	---
ISO 11973:1999	Grade GX40NiCrSi38-19	---	---	0.30-0.50	2.00	1.00-2.50	0.040	0.030	18.0-21.0	36.00	0.50	---
	Grade GX40NiCrSiNb38-19	---	---	0.3-0.50	2.00	1.00-2.50	0.040	0.030	18.0-21.0	36.00-39.00	0.50	Nb 1.20-1.80
JIS G 5122:2003	Class SCH 20	---	---	0.35-0.75	2.00	2.50	0.040	0.040	17.00-21.00	37.00-41.00	0.50	---
EN 10295:2002	G-NiCr50Nb	---	2.4680	0.10	0.50	1.00	0.020	0.020	48.00-52.00	---	0.50	Nb 1.00-1.80; N 0.16; Fe 1.00
ISO 11973:1999	Grade GX10NiCrNb50-50	---	---	0.10	0.50	0.50	0.020	0.020	47.0-52.0	---	0.50	Nb 1.40-1.70; N 0.16

7.5 Cast Heat Resistant Steels

7.5A Chemical Composition of Cast Heat Resistant Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A297/A297M-14	Grade HW	N08001	---	0.35-0.75	2.00	2.50	0.04	0.04	10.0-14.0	58.0-62.0	0.50	---
	Grade HX	N06006	---	0.35-0.75	2.00	2.50	0.04	0.04	15.0-19.0	64.0-68.0	0.50	---
ASTM A608/A608M-14	Grade HW50	N08006	---	0.40-0.60	1.50	0.50-2.00	0.04	0.04	10-14	58-62	0.50	---
	Grade HX50	N06050	---	0.40-0.60	1.50	0.50-2.00	0.04	0.04	15-19	64-68	0.50	---
EN 10295:2002	G-NiCr15	---	2.4815	0.35-0.65	2.00	1.00-2.50	0.040	0.030	12.00-18.00	58.00-66.00	1.00	---
ISO 11973:1999	Grade GX50NiCr65-15	---	---	0.35-0.65	1.30	2.00	0.040	0.030	13.0-19.0	64.00-69.00	---	---
EN 10295:2002	G-CoCr28	---	2.4778	0.05-0.25	1.50	0.50-1.50	0.040	0.030	27.00-30.00	4.00	0.50	Co 48.0-52.0; Nb 0.50
ISO 11973:1999	Grade GX30CoCr50-28	---	---	0.50	1.00	1.00	0.040	0.030	25.0-30.0	1.00	0.50	Co 48.00-52.00; Fe 20.0
EN 10295:2002	G-NiCr28W	---	2.4879	0.35-0.55	1.50	1.00-2.00	0.040	0.030	27.00-30.00	47.00-50.00	0.50	W 4.00-6.00
ISO 11973:1999	Grade GX45NiCrWSi48-28-5	---	---	0.35-0.55	1.50	1.00-2.50	0.040	0.030	27.0-30.0	47.00-50.00	---	W 4.00-6.00
EN 10295:2002	GX50NiCrCo20-20-20	---	1.4874	0.35-0.65	2.00	1.00	0.040	0.030	19.00-22.00	18.00-22.00	2.50-3.00	W 2.00-3.00; Co 18.50-22.00; Nb 0.75-1.25
ISO 11973:1999	Grade GX40NiCrCo20-20-20	---	---	0.35-0.60	2.00	1.0	0.040	0.030	19.0-22.0	18.00-22.00	2.50-3.00	W 2.00-3.00; Co 18.00-22.00

7.5 Cast Heat Resistant Steels

7.5B Mechanical Properties of Cast Heat Resistant Steels

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
EN 10295:2002	GX40CrSi13	---	1.4729	---	---	---	---	---	---	A	300 max HB
ISO 11973:1999	Grade GX40CrSi13	---	---	---	---	---	---	---	---	A	300 max HB
JIS G 5122:2003	Class SCH 3	---	---	---	---	---	490	---	---	A	---
	Class SCH 1	---	---	---	---	---	490	---	---	A	---
EN 10295:2002	GX40CrSi17	---	1.4740	---	---	---	---	---	---	A	300 max HB
ISO 11973:1999	Grade GX40CrSi17	---	---	---	---	---	---	---	---	A	300 max HB
EN 10295:2002	GX40CrSi24	---	1.4745	---	---	---	---	---	---	---	---
ISO 11973:1999	Grade GX40CrSi24	---	---	---	---	---	---	---	---	A	300 max HB
EN 10295:2002	GX40CrSi28	---	1.4776	---	---	---	---	---	---	---	---
ISO 11973:1999	Grade GX40CrSi28	---	---	---	---	---	---	---	---	A	320 max HB
EN 10295:2002	GX130CrSi29	---	1.4777	---	---	---	---	---	---	---	---
ISO 11973:1999	Grade GX130CrSi29	---	---	---	---	---	---	---	---	A	400 max HB
ASTM A297/A297M-14*	Grade HC	J92605	---	---	---	---	380	55	---	AC or BA	---
ASTM A608/A608M-14*	Grade HC30	J92613	---	---	---	---	11	1.6	40	---	---
				---	---	---	20.4	2.96	50	---	---
				---	---	---	36	5.3	40	---	---
JIS G 5122:2003	Class SCH 2	---	---	---	---	---	340	---	---	A	---
ASTM A297/A297M-14*	Grade HD	J93005	---	---	240	35	515	75	8	AC or BA	---
ASTM A608/A608M-14*	Grade HD50	J93015	---	---	---	---	6.2	0.91	---	---	---
				---	---	---	17.8	2.58	---	---	---
				---	---	---	51.4	7.45	---	---	---
EN 10295:2002	GX40CrNiSi27-4	---	1.4823	---	250	---	550	---	3	---	---
ISO 11973:1999	Grade GX40CrNiSi27-4	---	---	---	250	---	400	---	3	---	400 max HB
JIS G 5122:2003	Class SCH 11	---	---	---	---	---	590	---	---	AC or BA	---
ASTM A297/A297M-14*	Grade HE	J93403	---	---	275	40	585	85	9	AC or BA	---
JIS G 5122:2003	Class SCH 17	---	---	---	275	---	540	---	5	AC or BA	---
ASTM A297/A297M-14*	Grade HF	J92603	---	---	240	35	485	70	25	AC or BA	---
ASTM A608/A608M-14*	Grade HF30	J92803	---	---	---	---	100	14.5	9.0	---	---
				---	---	---	180	26	7.0	---	---
EN 10295:2002	GX25CrNiSi18-9	---	1.4825	---	230	---	450	---	15	---	---
	GX40CrNiSi22-10	---	1.4826	---	230	---	450	---	8	---	---
ISO 11973:1999	Grade GX25CrNiSi18-9	---	---	---	230	---	450	---	15	---	---
	Grade GX40CrNiSi22-10	---	---	---	230	---	450	---	8	---	---
JIS G 5122:2003	Class SCH 12	---	---	---	235	---	490	---	23	AC or BA	---
EN 10295:2002	GX25CrNiSi20-14	---	1.4832	---	230	---	450	---	10	---	---
ISO 11973:1999	Grade GX25 CrNiSi 20-14	---	---	---	230	---	450	---	10	---	---

*: See "List of Standards" at the beginning of the chapter.

7.5 Cast Heat Resistant Steels

7.5B Mechanical Properties of Cast Heat Resistant Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
ASTM A297/A297M-14*	Grade HH	J93503	---	---	240	35	515	75	10	AC or BA	---
ASTM A447/A447M-11	Type I	J93303	---	---	---	---	550	80	9	---	---
	Type II	J93303	---	---	---	---	550	80	4	---	---
ASTM A608/A608M-14*	Grade HH30	J93513	---	---	---	---	24.2	3.51	16.0	---	---
				---	---	---	52.7	7.65	12.0	---	---
	Grade HH33	J93633	---	---	---	---	28	4	20.0	---	---
				---	---	---	56	8.2	12.0	---	---
				---	---	---	138	20	8.0	---	---
EN 10295:2002	GX40CrNiSi25-12	---	1.4837	---	220	---	450	---	6	---	---
ISO 11973:1999	Grade GX40CrNiSi25-12	---	---	---	220	---	450	---	6	---	---
JIS G 5122:2003	Class SCH 13	---	---	---	235	---	490	---	8	AC or BA	---
	Class SCH 13A	---	---	---	235	---	490	---	8	AC or BA	---
ASTM A297/A297M-14*	Grade HI	J94003	---	---	240	35	485	70	10	AC or BA	---
ASTM A608/A608M-14*	Grade HI35	J94013	---	---	---	---	56	8.2	12.0	---	---
				---	---	---	138	20	8.0	---	---
JIS G 5122:2003	Class SCH 18	---	---	---	235	---	490	---	8	AC or BA	---
ASME SA-351/SA-351M	Grade HK30	J94203	---	---	240	35	450	65	10.0	AC	---
ASTM A297/A297M-14*	Grade HK	J94224	---	---	240	35	450	65	10	AC or BA	---
ASTM A351/A351M-14	Grade HK30	J94203	---	---	240	35	450	65	10.0	AC	---
ASTM A608/A608M-14*	Grade HK30	J94203	---	---	---	---	25	3.6	24.0	---	---
				---	---	---	52	7.5	18.0	---	---
				---	---	---	97	14	9.0	---	---
				---	---	---	180	26	---	---	---
JIS G 5122:2003	Class SCH 21	---	---	---	235	---	440	---	8	AC or BA	---
ASME SA-351/SA-351M	Grade HK40	J94204	---	---	240	35	425	62	10.0	AC	---
ASTM A351/A351M-14	Grade HK40	J94204	---	---	240	35	425	62	10.0	AC	---
ASTM A608/A608M-14*	Grade HK40	J94204	---	---	---	---	29	4.2	22.0	---	---
				---	---	---	61	8.8	15.0	---	---
				---	---	---	114	16.5	6.0	---	---
				---	---	---	200	29	7.0	---	---
EN 10295:2002	GX40CrNiSi25-20	---	1.4848	---	220	---	450	---	8	---	---
ISO 11973:1999	Grade GX40CrNiSi25-20	---	---	---	220	---	450	---	6	---	---
JIS G 5122:2003	Class SCH 22	---	---	---	235	---	440	---	8	AC or BA	---
ASTM A297/A297M-14*	Grade HL	N08604	---	---	240	35	450	65	10	AC or BA	---
JIS G 5122:2003	Class SCH 23	---	---	---	245	---	450	---	8	AC or BA	---

*: See "List of Standards" at the beginning of the chapter.

7.5 Cast Heat Resistant Steels

7.5B Mechanical Properties of Cast Heat Resistant Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Section Thickness, mm	Yield Strength, min.		Tensile Strength, min.		Elongation % min.	Heat Treatment	Other
					MPa	ksi	MPa	ksi			
ASTM A297/A297M-14*	Grade HN	J94213	---	---	---	---	435	63	8	AC or BA	---
EN 10295:2002	GX35NiCrSi25-21	---	1.4805	---	220	---	430	---	8	---	---
JIS G 5122:2003	Class SCH 19	---	---	---	---	---	390	---	5	AC or BA	---
EN 10295:2002	GX40CrNiSiNb24-24	---	1.4855	---	220	---	450	---	4	---	---
ISO 11973:1999	Grade GX40CrNiSiNb24-24	---	---	---	220	---	400	---	4	---	---
ASTM A297/A297M-14*	Grade HP	N08705	---	---	235	34	430	62.5	4.5	AC or BA	---
EN 10295:2002	GX40NiCrSiNb35-26	---	1.4852	---	220	---	440	---	4	---	---
	GX40NiCrSi35-26	---	1.4857	---	220	---	440	---	6	---	---
ISO 11973:1999	Grade GX40NiCrSi35-26	---	---	---	220	---	440	---	6	---	---
	Grade GX40NiCrSiNb35-26	---	---	---	220	---	440	---	4	---	---
JIS G 5122:2003	Class SCH 24	---	---	---	235	---	440	---	5	AC or BA	---
ASTM A297/A297M-14*	Grade HT	N08605	---	---	---	---	450	65	4	AC or BA	---
EN 10295:2002	GX40NiCrSi35-17	---	1.4806	---	220	---	420	---	6	---	---
ISO 11973:1999	Grade GX40NiCrSi35-17	---	---	---	220	---	420	---	6	---	---
JIS G 5122:2003	Class SCH 15	---	---	---	---	---	440	---	4	AC or BA	---
ASME SA-351/SA-351M	Grade HT30	N08030	---	---	195	28	450	65	15.0	AC	---
ASTM A351/A351M-14	Grade HT30	N08030	---	---	195	28	450	65	15.0	AC	---
JIS G 5122:2003	Class SCH 16	---	---	---	195	---	440	---	13	AC or BA	---
ASTM A297/A297M-14*	Grade HU	N08004	---	---	---	---	450	65	4	AC or BA	---
EN 10295:2002	GX40NiCrSiNb35-18	---	1.4807	---	220	---	420	---	4	---	---
	GX40NiCrSiNb38-19	---	1.4849	---	220	---	420	---	4	---	---
	GX40NiCrSi38-19	---	1.4865	---	220	---	420	---	6	---	---
ISO 11973:1999	Grade GX40NiCrSi38-19	---	---	---	220	---	420	---	6	---	---
	Grade GX40NiCrSiNb38-19	---	---	---	220	---	420	---	4	---	---
JIS G 5122:2003	Class SCH 20	---	---	---	---	---	390	---	4	AC or BA	---
EN 10295:2002	G-NiCr50Nb	---	2.4680	---	230	---	540	---	8	---	---
ISO 11973:1999	Grade GX10NiCrNb50-50	---	---	---	230	---	540	---	8	---	---
ASTM A297/A297M-14*	Grade HW	N08001	---	---	---	---	415	60	---	AC or BA	---
	Grade HX	N06006	---	---	---	---	415	60	---	AC or BA	---
EN 10295:2002	G-NiCr15	---	2.4815	---	200	---	400	---	3	---	---
ISO 11973:1999	Grade GX50NiCr65-15	---	---	---	200	---	400	---	3	---	---
EN 10295:2002	G-CoCr28	---	2.4778	---	235	---	490	---	6	---	---
ISO 11973:1999	Grade GX30CoCr50-28	---	---	---	---	---	---	---	---	---	---
EN 10295:2002	G-NiCr28W	---	2.4879	---	240	---	440	---	3	---	---
ISO 11973:1999	Grade GX45NiCrWSi48-28-5	---	---	---	220	---	400	---	3	---	---
EN 10295:2002	GX50NiCrCo20-20-20	---	1.4874	---	320	---	420	---	6	---	---
ISO 11973:1999	Grade GX40NiCrCo20-20-20	---	---	---	320	---	400	---	6	---	---

*: See "List of Standards" at the beginning of the chapter.

Chapter

8

WROUGHT STAINLESS STEELS

Plate, Sheet, Strip**ASME Standards**

ASME SA-240/SA-240M	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASME SA-666	Annealed or Cold-Worked Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar
ASME SA-693	Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

ASTM Standards

ASTM A240/A240M-15a	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A666-15	Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A693-13	Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM B688-96 (2014)	Chromium-Nickel-Molybdenum-Iron (UNS N08366 and UNS N08367) Plate, Sheet, and Strip

DIN Standard

DIN 5512-3:2004	Materials for rail vehicles – Steels – Part 3: Stainless steel flat products; Selected standard

EN Standards

EN 10028-7:2007	Flat products made of steels for pressure purposes – Part 7: Stainless steels
EN 10088-2:2014	Stainless steels – Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes
EN 10095:1999	Heat resisting steels and nickel alloys
EN 10151:2002	Stainless steel strip for springs – Technical delivery conditions
EN 10302:2008	Creep resisting steels, nickel and cobalt alloys

GB Standards

GB 3280-92	Cold Rolled Stainless Steel Sheets and Plates
GB 4237-92	Hot Rolled Stainless Steel Sheets and Plates
GB 4238-92	Heat-Resisting Steel Sheets and Plates
GB 4239-91	Cold Rolled Stainless Steel and Heat Resisting Steel Strips

ISO Standards

ISO 4955:2005	Heat-Resistant Steels
ISO 9328-7:2004	Steel Flat Products for Pressure Purposes – Technical Delivery Conditions – Part 7: Stainless Steels
ISO 16143-1:2004	Stainless Steels for General Purposes – Part 1: Flat Products

JIS Standards

JIS G 4304:2012	Hot-rolled stainless steel plate, sheet and strip
JIS G 4305:2012	Cold-rolled stainless steel plate, sheet and strip
JIS G 4312:2011	Heat-resisting steel plate, sheet and strip

SAE Standard

SAE J405 JUN98	Chemical Compositions of SAE Wrought Stainless Steels

Bars**ASME Standards**

ASME SA-276	Stainless Steel Bars and Shapes
ASME SA-453/SA-453M	High-Temperature Bolting Materials with Expansion Coefficients Comparable to Austenitic Stainless Steels
ASME SA-479/SA-479M	Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
ASME SA-564/SA-564M	Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes

ASTM Standards

ASTM A276/A276M-15	Stainless Steel Bars and Shapes
ASTM A314-13a	Stainless Steel Billets and Bars for Forging
ASTM A453/A453M-12	High-Temperature Bolting, with Expansion Coefficients Comparable to Austenitic Stainless Steels
ASTM A479/A479M-14	Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
ASTM A564/A564M-13	Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A565/A565M-10	Martensitic Stainless Steel Bars for High-Temperature Service
ASTM A582/A582M-12e1	Free-Machining Stainless Steel Bars
ASTM A955/A955M-15	Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement
ASTM A1028-03 (2015)	Stainless Steel Bars for Compressor and Turbine Airfoils
ASTM B691-02 (2013)	Iron-Nickel-Chromium-Molybdenum Alloys (UNS N08366 and UNS N08367) Rod, Bar, and Wire

EN Standards

EN 10088-3:2014	Stainless steels – Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes
EN 10090:1998	Valve steels and alloys for internal combustion engines
EN 10095:1999	Heat resisting steels and nickel alloys
EN 10263-5:2001	Steel rod, bars and wire for cold heading and cold extrusion – Part 5: Technical delivery conditions for stainless steels
EN 10269:2013	Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties
EN 10272:2007	Stainless steel bars for pressure purposes
EN 10294-2:2012	Hollow bars for machining – Technical delivery conditions – Part 2: Stainless steels with specified machinability properties
EN 10302:2008	Creep resisting steels, nickel and cobalt alloys

GB Standards

GB 1220-92	Stainless Steel Bars
GB 1221-92	Heat Resisting Steel Bars
GB 4226-84	Cold Finished Stainless Steel Bars

ISO Standards

ISO 683-15:1992	Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels – Part 15: Valve Steels for Internal Combustion Engines
ISO 4954:1993	Steels for Cold Heading and Cold Extruding
ISO 4955:1994	Heat-Resisting Steels and Alloys
ISO 16143-2:2004	Stainless Steels for General Purposes – Part 2: Semi-Finished Products, Bars, Rods and Sections

JIS Standards

JIS G 4303:2012	Stainless steel bars
JIS G 4311:2011	Heat-resisting steel bars and wire rods
JIS G 4318:1998 A1:2007	Cold finished stainless steel bars

Heat Treatment Terms Applicable to this Chapter

Standard	Heat Treatment Terms
ASME SA-240/SA-240M	See standard; SA: solution annealed; Q+SA: quenched in water and solution annealed
ASME SA-276	A: annealed; HF: hot finished; CF: cold finished; CW: cold worked; H+T: hardened and tempered; H+CW+CF: strain hardened, lightly cold worked and cold finished
ASME SA-453/SA-453M	S+H: solution treated, then hardened
ASME SA-479/SA-479M	A: annealed; N+T: normalized and tempered; T: tempered; Q+T: quenched and tempered; H: strain-hardened
ASME SA-564/SA-564M	SA: solution annealed; PH: precipitation hardened
ASME SA-666	A: annealed
ASME SA-693	PH: precipitation hardened; ST: solution treated; CR: cold rolled; CR+PH: cold rolled and precipitation hardened
ASTM A240/A240M-15a	SA: solution annealed
ASTM A276/A276M-15	A+HF: annealed and hot finished; A+CF: annealed and cold finished; H+T: hardened and tempered; HF: hot finished; CF: cold finished; CW+CF: cold worked and cold finished; H+CF: strain hardened and cold finished
ASTM A314-13a	---
ASTM A453/A453M-12	S+H: solution treated, then hardened
ASTM A479/A479M-14	A: annealed; N+T: normalized and tempered; Q+T: liquid quenched and tempered; SA: solution annealed; H: strain hardened; T: tempered
ASTM A564/A564M-13	SA: solution annealed; PH: precipitation hardened
ASTM A565/A565M-10	A: annealed; HT: heat treated
ASTM A582/A582M-12e1	A: annealed; T: intermediate temper; H: hard temper
ASTM A666-15	A: annealed
ASTM A693-13	PH: precipitation hardened; ST: solution treated; CR: cold rolled; CR+PH: cold rolled and precipitation hardened
ASTM A955/A955M-15	A: annealed; HR: hot rolled; SH: strain hardened
ASTM A1028-03 (2015)	A+Q+G: austenitized, then quenched followed by being aged
ASTM B688-96 (2014)	---
ASTM B691-02 (2013)	CFA: cold-finished-annealed; HFA: hot-finished-annealed
DIN 5512-3:2004	HR: hot rolled; CR: cold rolled
EN 10028-7:2007	A: annealed; SA: solution annealed; Q+T: quenched and tempered;
EN 10088-2:2014	See standard; A: annealed; Q+T: quenched and tempered; SA: solution annealed; PH: precipitation hardened (with specified temperature)
EN 10088-3:2014	A: annealed; A+PH: annealed and precipitation hardened; Q+T: quenched and tempered; SA: solution annealed; CW: cold work hardened; PH: precipitation hardened
EN 10090:1998	Q: quenched; CTC: control cooled
EN 10095:1999	A: annealed; SA: solution annealed
EN 10151:2002	CW: cold worked
EN 10263-5:2001	CD+A: cold drawn and soft annealed; A: soft annealed; CD+SA: cold drawn and solution annealed; SA: solution annealed
EN 10269:2013	Q+T: quenched and tempered; A: soft annealed; CW: cold work hardened; SA: solution annealed
EN 10272:2007	SA: solution annealed
EN 10294-2:2012	SA: solution annealed
EN 10302:2008	Q+T: quenched and tempered; SA: solution annealed; PH: precipitation hardened; A: annealed
GB 1220-92	A: annealed; ST: solution treated; Q+T: quenched and tempered
GB 1221-92	A: annealed; ST: solution treated; Q+T: quenched and tempered
GB 3280-92	A: annealed; ST: solution treated; Q+T: quenched and tempered; WH: work hardened
GB 4226-84	---
GB 4237-92	A: annealed; ST: solution treated
GB 4238-92	See standard; A: annealed; ST: solution treated
GB 4239-91	A: annealed; ST: solution treated; Q+T: quenched and tempered; WH: work hardened

Heat Treatment Terms Applicable to this Chapter (continued)

Standard	Heat Treatment Terms
ISO 683-15:1992	CTC: controlled cooled; Q: quenched
ISO 4954:1993	See standard; CW: cold worked; A: annealed; Q: quenched; CD: cold drawn
ISO 4955:2005	A: annealed; SA: solution annealed
ISO 9328-7:2004	A: annealed; Q+T: quenched and tempered; SA: solution annealed
ISO 16143-1:2004	A: annealed; Q+T: quenched and tempered; SA: solution annealed; PH: precipitation-hardened
JIS G 4303:2012	ST: solution treated; A: annealed; Q+T: quenched and tempered; PH: precipitation hardened at specified temperature
JIS G 4304:2012	ST: solution treated; A: annealed; Q+T: quenched and tempered; PH: precipitation hardening treatment at specified temperature
JIS G 4305:2012	ST: solution treated; A: annealed; Q+T: quenched and tempered T: temper rolled for hardening; PH: precipitation hardening treatment at specified temperature
JIS G 4311:2011	See standard; A: annealed; Q+T: quenched and tempered; ST: solution treated
JIS G 4312:2011	See standard; A: annealed; ST: solution treated
JIS G 4318:1998 A1:2007	---
SAE J405 JUN98	---

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.1A Chemical Composition of Martensitic Stainless Steels

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A240/A240M-15a	Type 403	S40300	---	0.15	1.00	0.50	0.040	0.030	11.5-13.0	0.60	---	---
GB 3280-92	Grade 1Cr12	---	---	0.15	1.00	0.50	0.035	0.030	11.50-13.00	0.60	---	---
GB 4237-92	Grade 1Cr12	---	---	0.15	1.00	0.50	0.035	0.030	11.50-13.00	0.60	---	---
GB 4238-92	Grade 1Cr12	---	---	0.15	1.00	0.50	0.035	0.030	11.50-13.00	0.60	---	Cu 0.30
GB 4239-91	Grade 1Cr12	---	---	0.15	1.00	0.50	0.035	0.030	11.50-13.00	0.60	---	---
JIS G 4304:2012	Symbol SUS403	---	---	0.15	1.00	0.50	0.040	0.030	11.50-13.00	0.60	---	---
JIS G 4305:2012	Symbol SUS403	---	---	0.15	1.00	0.50	0.040	0.030	11.50-13.00	0.60	---	---
EN 10088-2:2014	X12Cr13	---	1.4006	0.08-0.15	1.50	1.00	0.040	0.015	11.5-13.5	0.75	---	---
GB 3280-92	Grade 1Cr13	---	---	0.15	1.00	1.00	0.035	0.030	11.50-13.50	0.60	---	---
GB 4237-92	Grade 1Cr13	---	---	0.15	1.00	1.00	0.035	0.030	11.50-13.50	0.60	---	---
GB 4238-92	Grade 1Cr13	---	---	0.15	1.00	1.00	0.035	0.030	11.50-13.50	0.60	---	Cu 0.30
GB 4239-91	Grade 1Cr13	---	---	0.15	1.00	1.00	0.035	0.030	11.50-13.50	0.60	---	---
ISO 16143-1:2004	X12Cr13	---	---	0.08-0.15	1.50	1.00	0.040	0.030	11.5-13.5	0.75	---	---
JIS G 4304:2012	Symbol SUS410	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.60	---	---
JIS G 4305:2012	Symbol SUS410	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.60	---	---
SAE J405 JUN98	Type 410	S41000	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.75	---	---
GB 3280-92	Grade 00Cr12	---	---	0.030	1.00	1.00	0.035	0.030	11.00-13.50	0.60	---	---
GB 4237-92	Grade 00Cr12	---	---	0.030	1.00	0.75	0.035	0.030	11.00-13.50	0.60	---	---
GB 4238-92	Grade 00Cr12	---	---	0.03	1.00	1.00	0.035	0.030	11.00-13.00	0.60	---	---
GB 4239-91	Grade 00Cr12	---	---	0.030	1.00	1.00	0.035	0.030	11.00-13.50	0.60	---	---
JIS G 4304:2012	Symbol SUS410L	---	---	0.030	1.00	1.00	0.040	0.030	11.00-13.50	0.60	---	---
JIS G 4305:2012	Symbol SUS410L	---	---	0.030	1.00	1.00	0.040	0.030	11.00-13.50	0.60	---	---
ASME SA-240/SA-240M	Type 410S	S41008	---	0.08	1.00	1.00	0.040	0.030	11.5-13.5	0.60	---	---
ASTM A240/A240M-15a	Type 410S	S41008	---	0.08	1.00	1.00	0.040	0.030	11.5-13.5	0.60	---	---
EN 10088-2:2014	X6Cr13	---	1.4000	0.08	1.00	1.00	0.040	0.015	12.0-14.0	---	---	---
GB 3280-92	Grade 0Cr13	---	---	0.08	1.00	1.00	0.035	0.030	11.50-13.50	0.60	---	---
GB 4237-92	Grade 0Cr13	---	---	0.08	1.00	1.00	0.035	0.030	11.50-13.50	0.60	---	---
GB 4239-91	Grade 0Cr13	---	---	0.08	1.00	1.00	0.035	0.030	11.50-13.50	0.60	---	---
JIS G 4304:2012	Symbol SUS410S	---	---	0.08	1.00	1.00	0.040	0.030	11.50-13.50	0.60	---	---
JIS G 4305:2012	Symbol SUS410S	---	---	0.08	1.00	1.00	0.040	0.030	11.50-13.50	0.60	---	---
SAE J405 JUN98	Type 410S	S41008	---	0.08	1.00	1.00	0.040	0.030	11.50-13.50	0.60	---	---
ISO 4955:2005	X6Cr13	---	---	0.08	1.00	1.00	0.040	0.030	12.0-14.0	1.00	---	---

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.1A Chemical Composition of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A240/A240M-15a	Type 420	S42000	---	0.15 min.	1.00	1.00	0.040	0.030	12.0-14.0	0.75	0.50	---
EN 10088-2:2014	X20Cr13	---	1.4021	0.16-0.25	1.50	1.00	0.040	0.015	12.0-14.0	---	---	---
GB 3280-92	Grade 2Cr13	---	---	0.16-0.25	1.00	1.00	0.035	0.030	12.00-14.00	0.60	---	---
GB 4237-92	Grade 2Cr13	---	---	0.16-0.25	1.00	1.00	0.035	0.030	12.00-14.00	0.60	---	---
GB 4239-91	Grade 2Cr13	---	---	0.16-0.25	1.00	1.00	0.035	0.030	12.00-14.00	0.60	---	---
ISO 16143-1:2004	X20Cr13	---	---	0.16-0.25	1.50	1.00	0.040	0.030	12.0-14.0	---	---	---
JIS G 4304:2012	Symbol SUS420J1	---	---	0.16-0.25	1.00	1.00	0.040	0.030	12.00-14.00	0.60	---	---
JIS G 4305:2012	Symbol SUS420J1	---	---	0.16-0.25	1.00	1.00	0.040	0.030	12.00-14.00	0.60	---	---
EN 10088-2:2014	X30Cr13	---	1.4028	0.26-0.35	1.50	1.00	0.040	0.015	12.0-14.0	---	---	---
GB 3280-92	Grade 3Cr13	---	---	0.26-0.35	1.00	1.00	0.035	0.030	12.00-14.00	0.60	---	---
GB 4237-92	Grade 3Cr13	---	---	0.26-0.35	1.00	1.00	0.035	0.030	12.00-14.00	0.60	---	---
GB 4239-91	Grade 3Cr13	---	---	0.26-0.40	1.00	1.00	0.035	0.030	12.00-14.00	0.60	---	---
ISO 16143-1:2004	X30Cr13	---	---	0.26-0.35	1.50	1.00	0.040	0.030	12.0-14.0	---	---	---
JIS G 4304:2012	Symbol SUS420J2	---	---	0.26-0.40	1.00	1.00	0.040	0.030	12.00-14.00	0.60	---	---
JIS G 4305:2012	Symbol SUS420J2	---	---	0.26-0.40	1.00	1.00	0.040	0.030	12.00-14.00	0.60	---	---
ASME SA-240/SA-240M	---	S41500	---	0.05	0.50-1.00	0.60	0.030	0.030	11.5-14.0	3.5-5.5	0.50-1.00	---
ASTM A240/A240M-15a	---	S41500	---	0.05	0.50-1.00	0.60	0.030	0.030	11.5-14.0	3.5-5.5	0.50-1.00	---
EN 10028-7:2007	X3CrNiMo13-4	---	1.4313	0.05	1.50	0.70	0.040	0.015	12.0-14.0	3.5-4.5	0.30-0.70	N 0.020 min.
ISO 9328-7:2004	Grade X3CrNiMo13-4	---	---	0.05	0.50-1.00	0.70	0.040	0.015	12.0-14.0	3.5-4.5	0.30-1.00	---
SAE J405 JUN98	---	S41500	---	0.05	0.5-1.0	0.60	0.030	0.030	11.5-14.0	3.5-5.5	0.5-1.0	---
EN 10088-2:2014	X39Cr13	---	1.4031	0.36-0.42	1.00	1.00	0.040	0.015	12.5-14.5	---	---	---
GB 3280-92	Grade 4Cr13	---	---	0.36-0.45	0.80	0.80	0.035	0.030	12.00-14.00	0.60	---	---
GB 4237-92	Grade 4Cr13	---	---	0.36-0.45	0.80	0.80	0.035	0.030	12.00-14.00	0.60	---	---
ISO 16143-1:2004	X39Cr13	---	---	0.36-0.42	1.00	1.00	0.040	0.030	12.5-14.5	---	---	---
EN 10028-7:2007	X4CrNiMo16-5-1	---	1.4418	0.06	1.50	0.70	0.040	0.015	15.0-17.0	4.0-6.0	0.80-1.50	N 0.020 min.
EN 10088-2:2014	X4CrNiMo16-5-1	---	1.4418	0.06	1.50	0.70	0.040	0.015	15.0-17.0	4.0-6.0	0.80-1.50	N 0.020 min.
ISO 9328-7:2004	Grade X4CrNiMo16-5-1	---	---	0.06	1.50	0.70	0.040	0.015	15.0-17.0	4.0-6.0	0.80-1.50	N 0.020 min.
GB 3280-92	Grade 7Cr17	---	---	0.60-0.75	1.00	1.00	0.035	0.030	16.00-18.00	0.60	0.75	---
GB 4237-92	Grade 7Cr17	---	---	0.60-0.75	1.00	1.00	0.035	0.030	16.00-18.00	0.60	0.75	---
GB 4239-91	Grade 7Cr17	---	---	0.60-0.75	1.00	1.00	0.035	0.030	16.00-18.00	0.60	0.75	---
JIS G 4304:2012	Symbol SUS440A	---	---	0.60-0.75	1.00	1.00	0.040	0.030	16.00-18.00	0.60	0.75	---
JIS G 4305:2012	Symbol SUS440A	---	---	0.60-0.75	1.00	1.00	0.040	0.030	16.00-18.00	0.60	0.75	---

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.1B Mechanical Properties of Martensitic Stainless Steels

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A240/A240M-15a	Type 403	S40300	---	$t \leq 1.27$	$t \leq 0.050$	205	30	485	70	20	---	217 max. HBW; 96 max. HRBW
				$t > 1.27$	$t > 0.050$	205	30	485	70	25	---	217 max. HBW; 96 max. HRBW
GB 3280-92	Grade 1Cr12	---	---	---	---	205	---	440	---	20	A	200 max. HB; 93 max. HRB
GB 4237-92	Grade 1Cr12	---	---	---	---	205	---	440	---	20	A	200 max. HB; 93 max. HRB
GB 4238-92	Grade 1Cr12	---	---	---	---	205	---	440	---	20	A	200 max. HB; 93 max. HRB
GB 4239-91	Grade 1Cr12	---	---	---	---	205	---	440	---	20	A	93 max. HRB
JIS G 4304:2012	Symbol SUS403	---	---	---	---	205	---	440	---	20	A	201 max. HBW; 93 max. HRBW; 210 max. HV
JIS G 4305:2012	Symbol SUS403	---	---	---	---	205	---	440	---	20	A	201 max. HBW; 93 max. HRBW; 210 max. HV
EN 10088-2:2014	X12Cr13	---	1.4006	$t \leq 8$	---	---	---	600 max.	---	20 L, 20 T	A	200 max. HBW; 90 max. HRB
				$t \leq 13.5$	---	---	---	600 max.	---	20 L, 20 T	A	200 max. HBW; 90 max. HRB
				$t \leq 75$	---	450	---	650-850	---	12 L, 12 T	Q+T	BA J @ RT
				$t \leq 75$	---	400	---	550-750	---	15 L, 15 T	Q+T	BA J @ RT
GB 3280-92	Grade 1Cr13	---	---	---	---	205	---	440	---	20	A	183 max. HB; 88 max. HRB
GB 4237-92	Grade 1Cr13	---	---	---	---	225	---	440	---	20	A	200 max. HB; 93 max. HRB
GB 4238-92	Grade 1Cr13	---	---	---	---	205	---	440	---	20	A	200 max. HB; 93 max. HRB
GB 4239-91	Grade 1Cr13	---	---	---	---	205	---	440	---	20	A	93 max. HRB
ISO 16143-1:2004	X12Cr13	---	---	$t \leq 8$	---	---	---	440-600	---	20	A	---
				$t \leq 13.5$	---	---	---	440-600	---	20	A	---
				$t \leq 75$	---	400	---	550-750	---	15	Q+T	---
				$t \leq 75$	---	450	---	650-850	---	12	Q+T	---
JIS G 4304:2012	Symbol SUS410	---	---	---	---	205	---	440	---	20	A	201 max. HBW; 93 max. HRBW; 210 max. HV
JIS G 4305:2012	Symbol SUS410	---	---	---	---	205	---	440	---	20	A	201 max. HBW; 93 max. HRBW; 210 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 3280-92	Grade 00Cr12	---	---	---	---	190	---	365	---	22	A	183 max. HB; 88 max. HRB
GB 4237-92	Grade 00Cr12	---	---	---	---	196	---	370	---	22	A	183 max. HB; 88 max. HRB
GB 4238-92	Grade 00Cr12	---	---	---	---	195	---	365	---	22	A	183 max. HB; 88 max. HRB
GB 4239-91	Grade 00Cr12	---	---	---	---	195	---	365	---	22	A	88 max. HRB
JIS G 4304:2012	Symbol SUS410L	---	---	---	---	195	---	360	---	22	A	183 max. HBW; 88 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS410L	---	---	---	---	195	---	360	---	22	A	183 max. HBW; 88 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	Type 410S	S41008	---	$t \leq 1.27$	$t \leq 0.050$	205	30	415	60	20	see standard	183 max. HB; 89 max. HRB
				$t > 1.27$	$t > 0.050$	205	30	415	60	22	see standard	183 max. HB; 89 max. HRB
ASTM A240/A240M-15a	Type 410S	S41008	---	$t \leq 1.27$	$t \leq 0.050$	205	30	415	60	20	---	183 max. HBW; 89 max. HRBW
				$t > 1.27$	$t > 0.050$	205	30	415	60	22	---	183 max. HBW; 89 max. HRBW
EN 10088-2:2014	X6Cr13	---	1.4000	$t \leq 8$	---	240	---	400-600	---	19 L, 19 T	A	---
				$t \leq 13.5$	---	220	---	400-600	---	19 L, 19 T	A	---
				$t \leq 25$	---	220	---	400-600	---	19 L, 19 T	A	---
GB 3280-92	Grade 0Cr13	---	---	---	---	205	---	440	---	20	A	200 max. HB; 93 max. HRB
GB 4237-92	Grade 0Cr13	---	---	---	---	205	---	410	---	20	A	183 max. HB; 88 max. HRB
GB 4239-91	Grade 0Cr13	---	---	---	---	205	---	410	---	20	A	88 max. HRB
JIS G 4304:2012	Symbol SUS410S	---	---	---	---	205	---	410	---	20	A	183 max. HBW; 88 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS410S	---	---	---	---	205	---	410	---	20	A	183 max. HBW; 88 max. HRBW; 200 max. HV
ISO 4955:2005	X6Cr13	---	---	$0.5 \leq t < 3$	---	230	---	400-630	---	18 L, 18 T	A	197 max. HB
				$3 \leq t \leq 12$	---	230	---	400-630	---	20 L, 18 T	A	197 max. HB
				$5 \leq t \leq 15$	---	230	---	400-630	---	20	A	197 max. HB
				$5 \leq t \leq 25$	---	230	---	400-630	---	20	A	197 max. HB
				$1.5 \leq t \leq 25$	---	230	---	400-630	---	20	A	197 max. HB

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A240/A240M-15a	Type 420	S42000	---	---	---	---	---	690 max.	100 max.	15	---	217 max. HBW; 96 max. HRBW
EN 10088-2:2014	X20Cr13	---	1.4021	$t \leq 3$	---	---	---	---	---	---	Q+T	44-50 HRC; 440-530 HV
				$t \leq 8$	---	---	---	700 max.	---	15 L, 15 T	A	225 max. HBW; 95 max. HRB
				$t \leq 13.5$	---	---	---	700 max.	---	15 L, 15 T	A	225 max. HBW; 95 max. HRB
				$t \leq 75$	---	550	---	750-950	---	10 L, 10 T	Q+T	BA J @ RT
				$t \leq 75$	---	450	---	650-850	---	12 L, 12 T	Q+T	BA J @ RT
GB 3280-92	Grade 2Cr13	---	---	---	---	225	---	520	---	18	A	223 max. HB; 97 max. HRB
GB 4237-92	Grade 2Cr13	---	---	---	---	225	---	520	---	18	A	223 max. HB; 97 max. HRB
GB 4239-91	Grade 2Cr13	---	---	---	---	225	---	520	---	18	A	97 max. HRB
ISO 16143-1:2004	X20Cr13	---	---	$t \leq 3$	---	---	---	---	---	---	Q+T	---
				$t \leq 8$	---	---	---	520-700	---	15	A	---
				$t \leq 13.5$	---	---	---	520-700	---	15	A	---
				$t \leq 75$	---	450	---	650-850	---	12	Q+T	---
				$t \leq 75$	---	550	---	750-950	---	10	Q+T	---
JIS G 4304:2012	Symbol SUS420J1	---	---	---	---	225	---	520	---	18	A	223 max. HBW; 97 max. HRBW; 234 max. HV
JIS G 4305:2012	Symbol SUS420J1	---	---	---	---	225	---	520	---	18	A	223 max. HBW; 97 max. HRBW; 234 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-2:2014	X30Cr13	---	1.4028	t ≤ 3	---	---	---	---	---	---	Q+T	45-51 HRC; 450-550 HV
				t ≤ 8	---	---	---	740 max.	---	15 L, 15 T	A	235 max. HBW; 97 max. HRB
				t ≤ 13.5	---	---	---	740 max.	---	15 L, 15 T	A	235 max. HBW; 97 max. HRB
				t ≤ 75	---	600	---	800-1000	---	10 L, 10 T	Q+T	---
GB 3280-92	Grade 3Cr13	---	---	---	---	225	---	540	---	18	A	235 max. HB; 99 max. HRB
				---	---	---	---	---	---	---	Q+T	---
GB 4237-92	Grade 3Cr13	---	---	---	---	225	---	540	---	18	A	235 max. HB; 99 max. HRB
GB 4239-91	Grade 3Cr13	---	---	---	---	225	---	540	---	18	A	99 max. HRB
				---	---	---	---	---	---	---	Q+T	---
ISO 16143-1:2004	X30Cr13	---	---	t ≤ 3	---	---	---	---	---	---	Q+T	---
				t ≤ 8	---	---	---	540-740	---	15	A	---
				t ≤ 13.5	---	---	---	540-740	---	15	A	---
				t ≤ 75	---	600	---	800-1000	---	10	Q+T	---
JIS G 4304:2012	Symbol SUS420J2	---	---	---	---	---	---	---	---	---	Q+T	40 min. HRC
				---	---	225	---	540	---	18	A	235 max. HBW; 99 max. HRBW; 247 max. HV
JIS G 4305:2012	Symbol SUS420J2	---	---	---	---	225	---	540	---	18	A	235 max. HBW; 99 max. HRBW; 247 max. HV
				---	---	---	---	---	---	---	Q+T	40 min. HRC
ASME SA-240/SA-240M	---	S41500	---	---	---	620	90	795	115	15	see standard	302 max. HB; 32 max. HRC
ASTM A240/A240M-15a	---	S41500	---	---	---	620	90	795	115	15	---	302 max. HBW; 32 max. HRC
EN 10028-7:2007	X3CrNiMo13-4	---	1.4313	t ≤ 75	---	650	---	780-980	---	14 L, 14 T	Q+T	see standard for impact data
ISO 9328-7:2004	Grade X3CrNiMo13-4	---	---	t ≤ 75	---	650	---	780-980	---	14 L, 14 T	Q+T	see standard for impact data

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-2:2014	X39Cr13	---	1.4031	$t \leq 3$	---	---	---	---	---	---	Q+T	47-53 HRC; 480-580 HV
				$t \leq 8$	---	---	---	760 max.	---	12 L, 12 T	A	240 max. HBW; 98 max. HRB
				$t \leq 13.5$	---	---	---	760 max.	---	12 L, 12 T	A	240 max. HBW; 98 max. HRB
GB 3280-92	Grade 4Cr13	---	---	---	---	225	---	590	---	15	A	---
				---	---	---	---	---	---	---	Q+T	---
GB 4237-92	Grade 4Cr13	---	---	---	---	---	---	590	---	15 max.	A	---
ISO 16143-1:2004	X39Cr13	---	---	$t \leq 3$	---	---	---	---	---	---	Q+T	---
				$t \leq 8$	---	---	---	760 max.	---	12	A	---
				$t \leq 13.5$	---	---	---	760 max.	---	12	A	---
EN 10028-7:2007	X4CrNiMo16-5-1	---	1.4418	$t \leq 75$	---	680	---	840-980	---	14 L, 14 T	Q+T	see standard for impact data
EN 10088-2:2014	X4CrNiMo16-5-1	---	1.4418	$t \leq 75$	---	660	---	840-1100	---	14 L, 14 T	Q+T	55 J @ RT
ISO 9328-7:2004	Grade X4CrNiMo16-5-1	---	---	$t \leq 75$	---	680	---	840-980	---	14 L, 14 T	Q+T	see standard for impact data
GB 3280-92	Grade 7Cr17	---	---	---	---	245	---	590	---	15	A	255 max. HB
				---	---	---	---	---	---	---	Q+T	---
GB 4237-92	Grade 7Cr17	---	---	---	---	245	---	590	---	15	A	255 max. HB
GB 4239-91	Grade 7Cr17	---	---	---	---	245	---	590	---	15	A	---
				---	---	---	---	---	---	---	Q+T	---
JIS G 4304:2012	Symbol SUS440A	---	---	---	---	---	---	---	---	---	Q+T	40 min. HRC
				---	---	245	---	590	---	15	A	255 max. HBW; 25 max. HRC; 269 max. HV
JIS G 4305:2012	Symbol SUS440A	---	---	---	---	245	---	590	---	15	A	255 max. HBW; 25 max. HRC; 269 max. HV
				---	---	---	---	---	---	---	Q+T	40 min. HRC

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.2A Chemical Composition of Ferritic Stainless Steels

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 405	S40500	---	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.60	---	Al 0.10-0.30
ASTM A240/A240M-15a	Type 405	S40500	---	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.60	---	Al 0.10-0.30
EN 10088-2:2014	X6CrAl13	---	1.4002	0.08	1.00	1.00	0.040	0.015	12.0-14.0	---	---	Al 0.10-0.30
GB 3280-92	Grade 0Cr13Al	---	---	0.08	1.00	1.00	0.035	0.030	11.50-14.50	0.60	---	Al 0.10-0.30
GB 4237-92	Grade 0Cr13Al	---	---	0.08	1.00	1.00	0.035	0.030	11.50-14.50	0.60	---	Al 0.10-0.30
GB 4238-92	Grade 0Cr13Al	---	---	0.08	1.00	1.00	0.035	0.030	11.50-14.50	0.60	---	Al 0.10-0.30
GB 4239-91	Grade 0Cr13Al	---	---	0.08	1.00	1.00	0.035	0.030	11.50-14.50	0.60	---	Al 0.10-0.30
JIS G 4304:2012	Symbol SUS405	---	---	0.08	1.00	1.00	0.040	0.030	11.50-14.50	0.60	---	Al 0.10-0.30
JIS G 4305:2012	Symbol SUS405	---	---	0.08	1.00	1.00	0.040	0.030	11.50-14.50	0.60	---	Al 0.10-0.30
SAE J405 JUN98	Type 405	S40500	---	0.08	1.00	1.00	0.040	0.030	11.50-14.50	0.60	---	Al 0.10-0.30
ASME SA-240/SA-240M	---	S40977	---	0.030	1.50	1.00	0.040	0.015	10.5-12.5	0.30-1.00	---	N 0.030
		S41050	---	0.04	1.00	1.00	0.045	0.030	10.5-12.5	0.60-1.10	---	N 0.10
ASTM A240/A240M-15a	---	S40977	---	0.030	1.50	1.00	0.040	0.015	10.5-12.5	0.30-1.00	---	N 0.030
		S41050	---	0.04	1.00	1.00	0.045	0.030	10.5-12.5	0.60-1.10	---	N 0.10
EN 10028-7:2007	X2CrNi12	---	1.4003	0.030	1.50	1.00	0.040	0.015	10.5-12.5	0.30-1.00	---	N 0.030
EN 10088-2:2014	X2CrNi12	---	1.4003	0.030	1.50	1.00	0.040	0.015	10.5-12.5	0.30-1.00	---	N 0.030
JIS G 4312:2011	Symbol SUH409L	---	---	0.030	1.00	1.00	0.040	0.030	10.50-11.75	0.60	---	Ti 6xC to 0.75
ISO 16143-1:2004	X2CrNi12	---	---	0.030	1.50	1.00	0.040	0.015	10.5-12.5	0.30-1.10	---	N 0.030
ISO 9328-7:2004	Grade X2CrNi12	---	---	0.030	1.50	1.00	0.040	0.015	10.5-12.5	0.30-1.10	---	N 0.030
SAE J405 JUN98	---	S41050	---	0.040	1.00	1.00	0.045	0.030	10.50-12.50	0.60-1.10	---	N 0.10
ASME SA-240/SA-240M	---	S40945	---	0.030	1.00	1.00	0.040	0.030	10.5-11.7	0.50	---	Ti 0.05-0.20; Cb 0.18-0.40; N 0.030
		S40975	---	0.030	1.00	1.00	0.040	0.030	10.5-11.7	0.50-1.00	---	N 0.030; Ti 6x(C+N) to 0.75
ASTM A240/A240M-15a	---	S40945	---	0.030	1.00	1.00	0.040	0.030	10.5-11.7	0.50	---	Ti 0.05-0.20; Cb 0.18-0.40; N 0.030
		S40975	---	0.030	1.00	1.00	0.040	0.030	10.5-11.7	0.50-1.00	---	N 0.030; Ti 6x(C+N) to 0.75
EN 10088-2:2014	X2CrTi12	---	1.4512	0.030	1.00	1.00	0.040	0.015	10.5-12.5	---	---	Ti 6x(C+N) to 0.65
ISO 16143-1:2004	X2CrTi12	---	---	0.030	1.00	1.00	0.040	0.030	10.5-12.5	0.50	---	Ti 6x(C+N) to 0.65
ISO 4955:2005	X2CrTi12	---	---	0.03	1.00	1.00	0.040	0.015	10.5-12.5	---	---	Ti 6x(C+N) to 0.65
SAE J405 JUN98	---	S40945	---	0.030	1.00	1.00	0.040	0.030	10.50-11.75	0.50	---	Ti 0.05-0.20; Cb 0.18-0.40; N 0.030
EN 10028-7:2007	X6CrNiTi12	---	1.4516	0.08	1.50	0.70	0.040	0.015	10.5-12.5	0.50-1.50	---	Ti 0.05-0.35
EN 10088-2:2014	X6CrNiTi12	---	1.4516	0.08	1.50	0.70	0.040	0.015	10.5-12.5	0.50-1.50	---	Ti 0.05-0.35
ISO 9328-7:2004	Grade X6CrNiTi12	---	---	0.08	1.00	1.00	0.040	0.015	10.5-12.5	0.50-1.50	---	Ti 0.05-0.35
JIS G 4312:2011	Symbol SUH409	---	---	0.08	1.00	1.00	0.040	0.030	10.50-11.75	0.60	---	Ti 6xC to 0.75
ASME SA-240/SA-240M	---	S42035	---	0.08	1.00	1.00	0.045	0.030	13.5-15.5	1.0-2.5	0.2-1.2	Ti 0.30-0.50
ASTM A240/A240M-15a	---	S42035	---	0.08	1.00	1.00	0.045	0.030	13.5-15.5	1.0-2.5	0.2-1.2	Ti 0.30-0.50
DIN 5512-3:2004	X5CrNiMoTi15-2	---	1.4589	0.08	1.0	1.0	0.045	0.03	13.5-15.5	1.0-2.5	0.2-1.2	Ti 0.3-0.5
EN 10088-2:2014	X5CrNiMoTi15-2	---	1.4589	0.08	1.00	1.00	0.040	0.015	13.5-15.5	1.00-2.50	0.20-1.20	Ti 0.30-0.50

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.2A Chemical Composition of Ferritic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 429	S42900	---	0.12	1.00	1.00	0.040	0.030	14.0-16.0	---	---	---
ASTM A240/A240M-15a	Type 429	S42900	---	0.12	1.00	1.00	0.040	0.030	14.0-16.0	---	---	---
GB 3280-92	Grade 1Cr15	---	---	0.12	1.00	1.00	0.035	0.030	14.00-16.00	0.60	---	---
GB 4237-92	Grade 1Cr15	---	---	0.12	1.00	1.00	0.035	0.030	14.00-16.00	0.60	---	---
GB 4239-91	Grade 1Cr15	---	---	0.12	1.00	1.00	0.035	0.030	14.00-16.00	0.60	---	---
JIS G 4304:2012	Symbol SUS429	---	---	0.12	1.00	1.00	0.040	0.030	14.00-16.00	0.60	---	---
JIS G 4305:2012	Symbol SUS429	---	---	0.12	1.00	1.00	0.040	0.030	14.00-16.00	0.60	---	---
SAE J405 JUN98	Type 429	S42900	---	0.12	1.00	1.00	0.040	0.030	14.00-16.00	---	---	---
ASME SA-240/SA-240M	Type 430	S43000	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	0.75	---	---
ASTM A240/A240M-15a	Type 430	S43000	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	0.75	---	---
EN 10088-2:2014	X6Cr17	---	1.4016	0.08	1.00	1.00	0.040	0.015	16.0-18.0	---	---	---
GB 3280-92	Grade 1Cr17	---	---	0.12	1.00	0.75	0.035	0.030	16.00-18.00	0.60	---	---
GB 4237-92	Grade 1Cr17	---	---	0.12	1.00	0.75	0.035	0.030	16.00-18.00	0.60	---	---
GB 4238-92	Grade 1Cr17	---	---	0.12	1.00	0.75	0.035	0.030	16.00-18.00	0.60	---	---
GB 4239-91	Grade 1Cr17	---	---	0.12	1.00	0.75	0.035	0.030	16.00-18.00	0.60	---	---
ISO 16143-1:2004	X6Cr17	---	---	0.08	1.00	1.00	0.040	0.030	16.0-18.0	---	---	---
JIS G 4304:2012	Symbol SUS430	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	0.60	---	---
JIS G 4305:2012	Symbol SUS430	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	0.60	---	---
SAE J405 JUN98	Type 430	S43000	---	0.12	1.00	1.00	0.040	0.030	16.00-18.00	0.75	---	---
EN 10028-7:2007	X3CrTi17	---	1.4510	0.05	1.00	1.00	0.040	0.015	16.0-18.0	---	---	Ti [4x(C+N)+0.15] to 0.80
	X2CrTi17	---	1.4520	0.025	0.50	0.50	0.040	0.015	16.0-18.0	---	---	Ti 0.30-0.60; N 0.015
EN 10088-2:2014	X3CrTi17	---	1.4510	0.05	1.00	1.00	0.040	0.015	16.0-18.0	---	---	Ti [4x(C+N)+0.15] to 0.80
	X3CrNb17	---	1.4511	0.05	1.00	1.00	0.040	0.015	16.0-18.0	---	---	Nb 12xC to 1.00
	X2CrTi17	---	1.4520	0.025	0.50	0.50	0.040	0.015	16.0-18.0	---	---	Ti [4x(C+N)+0.15] to 0.80; N 0.015
GB 3280-92	Grade 00Cr17	---	---	0.030	1.00	0.75	0.035	0.030	16.00-19.00	0.60	---	Ti 0.10-1.00; Nb 0.10-1.00
GB 4239-91	Grade 00Cr17	---	---	0.030	1.00	0.75	0.035	0.030	16.00-19.00	0.60	---	Ti 0.10-1.00; Nb 0.10-1.00
ISO 16143-1:2004	X3CrTi17	---	---	0.05	1.00	1.00	0.040	0.030	16.0-19.0	---	---	Ti [4x(C+N)+0.20] to 0.75
	X3CrNb17	---	---	0.05	1.00	1.00	0.040	0.015	16.0-18.0	---	---	Nb 12xC to 1.00
ISO 4955:2005	X3CrTi17	---	---	0.05	1.00	1.00	0.040	0.015	16.0-18.0	---	---	Ti [4x(C+N)+0.15] to 0.80
ISO 9328-7:2004	Grade X2CrTi17	---	---	0.025	0.50	0.50	0.040	0.015	16.0-18.0	---	---	Ti 0.30-0.60; N 0.015
	Grade X3CrTi17	---	---	0.05	1.00	1.00	0.040	0.015	16.0-19.0	---	---	Ti [4x(C+N)+0.15] to 0.75
JIS G 4304:2012	Symbol SUS430LX	---	---	0.030	1.00	0.75	0.040	0.030	16.00-19.00	0.60	---	Ti 0.10-1.00; Nb 0.10-1.00
JIS G 4305:2012	Symbol SUS430LX	---	---	0.030	1.00	0.75	0.040	0.030	16.00-19.00	0.60	---	Ti 0.10-1.00; Nb 0.10-1.00

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.2A Chemical Composition of Ferritic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 434	S43400	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	0.75-1.25	---
ASTM A240/A240M-15a	Type 434	S43400	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	0.75-1.25	---
EN 10088-2:2014	X6CrMo17-1	---	1.4113	0.08	1.00	1.00	0.040	0.015	16.0-18.0	---	0.90-1.40	---
GB 3280-92	Grade 1Cr17Mo	---	---	0.12	1.00	1.00	0.035	0.030	16.00-18.00	0.60	0.75-1.25	---
GB 4237-92	Grade 1Cr17Mo	---	---	0.12	1.00	1.00	0.035	0.030	16.00-18.00	0.60	0.75-1.25	---
GB 4239-91	Grade 1Cr17Mo	---	---	0.12	1.00	1.00	0.035	0.030	16.00-18.00	0.60	0.75-1.25	---
JIS G 4304:2012	Symbol SUS434	---	---	0.12	1.00	1.00	0.040	0.030	16.00-18.00	0.60	0.75-1.25	---
JIS G 4305:2012	Symbol SUS434	---	---	0.12	1.00	1.00	0.040	0.030	16.00-18.00	0.60	0.75-1.25	---
SAE J405 JUN98	---	S43400	---	0.12	1.00	1.00	0.040	0.030	16.00-18.00	---	0.75-1.25	---
ASME SA-240/SA-240M	Type 436	S43600	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	0.75-1.25	Cb 5xC to 0.80
ASTM A240/A240M-15a	Type 436	S43600	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	0.75-1.25	Cb 5xC to 0.80
EN 10088-2:2014	X6CrMoNb17-1	---	1.4526	0.08	1.00	1.00	0.040	0.015	16.0-18.0	---	0.80-1.40	Nb [7x(C+N)+0.10] to 1.00; N 0.040
SAE J405 JUN98	---	S43600	---	0.12	1.00	1.00	0.040	0.030	16.00-18.00	---	0.75-1.25	Cb 5xC to 0.80
ASME SA-240/SA-240M	Type 439	S43035	---	0.030	1.00	1.00	0.040	0.030	17.0-19.0	0.50	---	Ti [0.20+4(C+N)] to 1.10; Al 0.15; N 0.030
	---	S43932	---	0.030	1.00	1.00	0.040	0.030	17.0-19.0	0.50	---	(Ti+Cb) [0.20+4(C+N)] to 0.75; Al 0.15; N 0.030
ASTM A240/A240M-15a	Type 439	S43035	---	0.030	1.00	1.00	0.040	0.030	17.0-19.0	0.50	---	Ti [0.20+4(C+N)] to 1.10; Al 0.15; N 0.030
	---	S43932	---	0.030	1.00	1.00	0.040	0.030	17.0-19.0	0.50	---	(Ti+Cb) [0.20+4(C+N)] to 0.75; Al 0.15; N 0.030
SAE J405 JUN98	---	S43932	---	0.030	1.00	1.00	0.040	0.030	17.0-19.0	0.50	---	(Ti+Cb) [0.20+4x(C+N)] to 0.75; Al 0.15; N 0.030
ASME SA-240/SA-240M	---	S43940	---	0.030	1.00	1.00	0.040	0.015	17.5-18.5	---	---	Cb [0.30+(3xC)] min.; Ti 0.10-0.60
ASTM A240/A240M-15a	---	S43940	---	0.030	1.00	1.00	0.040	0.015	17.5-18.5	---	---	Cb [0.30+(3xC)] min.; Ti 0.10-0.60
EN 10028-7:2007	X2CrTiNb18	---	1.4509	0.030	1.00	1.00	0.040	0.015	17.5-18.5	---	---	Nb [3xC+0.30] to 1.00; Ti 0.10-0.60
EN 10088-2:2014	X2CrTiNb18	---	1.4509	0.030	1.00	1.00	0.040	0.015	17.5-18.5	---	---	Nb [3xC+0.30] to 1.00; Ti 0.10-0.60
ISO 9328-7:2004	Grade X2CrTiNb18	---	---	0.030	1.00	1.00	0.040	0.015	17.5-18.5	---	---	Nb [3xC+0.30] to 1.00; Ti 0.10-0.60
ISO 4955:2005	X2CrTiNb18	---	---	0.03	1.00	1.00	0.040	0.015	17.5-18.5	---	---	Nb [3xC+0.30] to 1.00; Ti 0.10-0.60

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.2A Chemical Composition of Ferritic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 444	S44400	---	0.025	1.00	1.00	0.040	0.030	17.5-19.5	1.00	1.75-2.50	(Ti+Cb) [0.20+4x(C+N)] to 0.80; N 0.035
ASTM A240/A240M-15a	Type 444	S44400	---	0.025	1.00	1.00	0.040	0.030	17.5-19.5	1.00	1.75-2.50	(Ti+Cb) [0.20+4x(C+N)] to 0.80; N 0.035
EN 10028-7:2007	X2CrMoTi18-2	---	1.4521	0.025	1.00	1.00	0.040	0.015	17.0-20.0	---	1.80-2.50	Ti [4x(C+N)+0.15] to 0.80; N 0.030
EN 10088-2:2014	X2CrMoTi18-2	---	1.4521	0.025	1.00	1.00	0.040	0.015	17.0-20.0	---	1.80-2.50	Ti [4x(C+N)+0.15] to 0.80; N 0.030
GB 3280-92	Grade 00Cr18Mo2	---	---	0.025	1.00	1.00	0.035	0.030	17.00-20.00	0.60	1.75-2.50	Ti 8x(C+N) to 0.80; Nb 8x(C+N) to 0.80; Zr 8x(C+N) to 0.80; (Ti+Nb+Zr) 8x(C+N) to 0.80; N 0.025
GB 4237-92	Grade 00Cr18Mo2	---	---	0.025	1.00	1.00	0.035	0.030	17.00-20.00	0.60	1.75-2.50	Ti 8x(C+N) to 0.80; Nb 8x(C+N) to 0.80; Zr 8x(C+N) to 0.80; (Ti+Nb+Zr) 8x(C+N) to 0.80; N 0.025
GB 4239-91	Grade 00Cr18Mo2	---	---	0.025	1.00	1.00	0.035	0.030	17.00-20.00	0.60	1.75-2.50	Ti 8x(C+N) to 0.80; Nb 8x(C+N) to 0.80; Zr 8x(C+N) to 0.80; (Ti+Nb+Zr) 8x(C+N) to 0.80; N 0.025
ISO 9328-7:2004	Grade X2CrMoTi18-2	---	---	0.025	1.00	1.00	0.040	0.015	17.0-20.0	---	1.80-2.50	Ti [4x(C+N)+0.15] to 0.80; N 0.030
JIS G 4304:2012	Symbol SUS444	---	---	0.025	1.00	1.00	0.040	0.030	17.00-20.00	0.60	1.75-2.50	Ti, Nb, Zr or their combination 8x(C + N) to 0.80; N 0.025
JIS G 4305:2012	Symbol SUS444	---	---	0.025	1.00	1.00	0.040	0.030	17.00-20.00	0.60	1.75-2.50	Ti, Nb, Zr or their combination 8x(C + N) to 0.80; N 0.025
SAE J405 JUN98	Type 444	S44400	---	0.025	1.00	1.00	0.040	0.030	17.5-19.5	1.00	1.75-2.50	(Ti+Cb) [0.20 +4x(C+N)] to 0.80; N 0.035
GB 4238-92	Grade 1Cr19Al3	---	---	0.10	1.00	1.50	0.035	0.030	17.00-21.00	0.60	---	Al 2.00-4.00
JIS G 4312:2011	Symbol SUH21	---	---	0.10	1.00	1.50	0.040	0.030	17.00-21.00	0.60	---	Al 2.00-4.00
ASTM A240/A240M-15a	Type 446	S44600	---	0.20	1.50	1.00	0.040	0.030	23.0-27.0	0.75	---	N 0.25
GB 4238-92	Grade 2Cr25N	---	---	0.20	1.50	1.00	0.035	0.030	23.00-27.00	0.60	---	Cu 0.30; N 0.25
ISO 4955:2005	X15CrN26	---	---	0.20	1.00	1.00	0.040	0.030	24.0-28.0	1.00	---	N 0.15-0.25
JIS G 4312:2011	Symbol SUH446	---	---	0.20	1.50	1.00	0.040	0.030	23.00-27.00	0.60	---	N 0.25
ASME SA-240/SA-240M	Type XM-27	S44627	---	0.010	0.40	0.40	0.020	0.020	25.0-27.5	0.50	0.75-1.50	(Ni+Cu) 0.50; Cu 0.20; Cb 0.05-0.20; N 0.015
ASTM A240/A240M-15a	Type XM-27	S44627	---	0.010	0.40	0.40	0.020	0.020	25.0-27.5	0.50	0.75-1.50	(Ni+Cu) 0.50; Cu 0.20; Cb 0.05-0.20; N 0.015
GB 3280-92	Grade 00Cr27Mo	---	---	0.010	0.40	0.40	0.030	0.020	25.00-27.50	0.50	0.75-1.50	(Ni+Cu) 0.50 max.; Cu 0.20; N 0.015
GB 4237-92	Grade 00Cr27Mo	---	---	0.010	0.40	0.40	0.030	0.020	25.00-27.00	0.50	0.75-1.50	(Ni+Cu) 0.50 max.; Cu 0.20; N 0.015
GB 4239-91	Grade 00Cr27Mo	---	---	0.010	0.40	0.40	0.030	0.020	25.00-27.50	0.50	0.75-1.50	(Ni+Cu) 0.50 max.; Cu 0.20; N 0.015
JIS G 4304:2012	Symbol SUSXM27	---	---	0.010	0.40	0.40	0.030	0.020	25.00-27.50	0.50	0.75-1.50	(Ni+Cu) 0.50 max.; Cu 0.20; N 0.015
JIS G 4305:2012	Symbol SUSXM27	---	---	0.010	0.40	0.40	0.030	0.020	25.00-27.50	0.50	0.75-1.50	(Ni+Cu) 0.50 max.; Cu 0.20; N 0.015
SAE J405 JUN98	Type SM-27	S44627	---	0.010	0.40	0.40	0.020	0.020	25.00-27.50	0.50	0.75-1.50	(Ni+Cu) 0.50; Cu 0.20; Cb 0.05-0.20; N 0.015

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.2A Chemical Composition of Ferritic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB 3280-92	Grade 00Cr30Mo2	---	---	0.010	0.40	0.40	0.030	0.020	28.50-32.00	0.50	1.50-2.50	(Ni+Cu) 0.50 max.; Cu 0.20; N 0.015
GB 4237-92	Grade 00Cr30Mo2	---	---	0.010	0.40	0.40	0.030	0.020	28.00-32.00	0.50	1.50-2.50	(Ni+Cu) 0.50 max.; Cu 0.20; N 0.015
GB 4239-91	Grade 00Cr30Mo2	---	---	0.010	0.40	0.40	0.030	0.020	28.50-32.00	0.50	1.50-2.50	(Ni+Cu) 0.50 max.; Cu 0.20; N 0.015
JIS G 4304:2012	Symbol SUS447J1	---	---	0.010	0.40	0.40	0.030	0.020	28.50-32.00	0.50	1.50-2.50	(Ni+Cu) 0.50 max.; Cu 0.20; N 0.015
JIS G 4305:2012	Symbol SUS447J1	---	---	0.010	0.40	0.40	0.030	0.020	28.50-32.00	0.50	1.50-2.50	(Ni+Cu) 0.50 max.; Cu 0.20; N 0.015
ASME SA-240/SA-240M	---	S44735	---	0.030	1.00	1.00	0.040	0.030	28.0-30.0	1.00	3.6-4.2	(Ti+Cb) 6x(C+N) min.; (Ti+Cb) 0.20 to 1.00; N 0.045
ASTM A240/A240M-15a	---	S44735	---	0.030	1.00	1.00	0.040	0.030	28.0-30.0	1.00	3.6-4.2	(Ti+Cb) 6x(C+N) min.; (Ti+Cb) 0.20 to 1.00; N 0.045
EN 10088-2:2014	X2CrMoTi29-4	---	1.4592	0.025	1.00	1.00	0.030	0.010	28.0-30.0	---	3.5-4.5	Ti [4x(C+N)+0.15] to 0.80; N 0.045
SAE J405 JUN98	---	S44735	---	0.030	1.00	1.00	0.040	0.030	28.00-30.00	1.00	3.60-4.20	(Ti+Cb) 0.20 to 1.00; (Ti+Cb) [6x(C+N)] min.; N 0.045

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.2B Mechanical Properties of Ferritic Stainless Steels

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 405	S40500	---	---	---	170	25	415	60	20	see standard	179 max. HB; 88 max. HRB
ASTM A240/A240M-15a	Type 405	S40500	---	---	---	170	25	415	60	20	---	179 max. HBW; 88 max. HRBW
EN 10088-2:2014	X6CrAl13	---	1.4002	t ≤ 8	---	230	---	400-600	---	17 L, 17 T	A	---
				t ≤ 13.5	---	210	---	400-600	---	17 L, 17 T	A	---
				t ≤ 25	---	210	---	400-600	---	17 L, 17 T	A	---
GB 3280-92	Grade 0Cr13Al	---	---	---	---	175	---	410	---	20	A	183 max. HB; 88 max. HRB
GB 4237-92	Grade 0Cr13Al	---	---	---	---	177	---	410	---	20	A	183 max. HB; 88 max. HRB
GB 4238-92	Grade 0Cr13Al	---	---	---	---	175	---	410	---	20	A	183 max. HB; 88 max. HRB
GB 4239-91	Grade 0Cr13Al	---	---	---	---	175	---	410	---	20	A	88 max. HRB
JIS G 4304:2012	Symbol SUS405	---	---	---	---	175	---	410	---	20	A	183 max. HBW; 88 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS405	---	---	---	---	175	---	410	---	20	A	183 max. HBW; 88 max. HRBW; 200 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.2B Mechanical Properties of Ferritic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	---	S40977	---	---	---	280	41	450	65	18	see standard	180 max. HB; 88 max. HRB
		S41050	---	---	---	205	30	415	60	22	see standard	183 max. HB; 89 max. HRB
ASTM A240/A240M-15a	---	S40977	---	---	---	280	41	450	65	18	---	180 max. HBW; 88 max. HRBW
		S41050	---	---	---	205	30	415	60	22	---	183 max. HBW; 89 max. HRBW
EN 10028-7:2007	X2CrNi12	---	1.4003	$t \leq 8$	---	280	---	450-650	---	20 L, 20 T	A	T: 50 J @ RT
				$t \leq 13.5$	---	280	---	450-650	---	20 L, 20 T	A	T: 50 J @ RT
				$t \leq 25$	---	250	---	450-650	---	18 L, 18 T	A	T: 50 J @ RT
EN 10088-2:2014	X2CrNi12	---	1.4003	$t \leq 8$	---	280	---	450-650	---	20 L, 20 T	A	---
				$t \leq 13.5$	---	280	---	450-650	---	20 L, 20 T	A	---
				$t \leq 25$	---	250	---	450-650	---	18 L, 18 T	A	---
JIS G 4312:2011	Symbol SUH409L	---	---	---	---	175	---	360	---	25	A	162 max. HBW; 80 max. HRBW; 175 max. HV
ISO 16143-1:2004	X2CrNi12	---	---	$t \leq 6$	---	320	---	450	---	20 L, 20 T	A	---
				$t \leq 12$	---	300	---	450	---	20 L, 20 T	A	---
				$t \leq 25$	---	280	---	430	---	20 L, 20 T	A	---
ISO 9328-7:2004	Grade X2CrNi12	---	---	$t \leq 6$	---	280	---	450-650	---	20 L, 20 T	A	T: 50 J @ 20°C
				$t \leq 12$	---	280	---	450-650	---	20 L, 20 T	A	T: 50 J @ 20°C
				$t \leq 25$	---	250	---	450-650	---	18 L, 18 T	A	T: 50 J @ 20°C
ASME SA-240/SA-240M	---	S40945	---	---	---	205	30	380	55	22	see standard	80 max. HRB
		S40975	---	---	---	275	40	415	60	20	see standard	197 max. HB; 92 max. HRB
ASTM A240/A240M-15a	---	S40945	---	---	---	205	30	380	55	22	---	80 max. HRBW
		S40975	---	---	---	275	40	415	60	20	---	197 max. HBW; 92 max. HRBW
EN 10088-2:2014	X2CrTi12	---	1.4512	$t \leq 8$	---	210	---	380-560	---	25 L, 25 T	A	---
				$t \leq 13.5$	---	210	---	380-560	---	25 L, 25 T	A	---
ISO 16143-1:2004	X2CrTi12	---	---	$t \leq 6$	---	220	---	380	---	25 L, 25 T	A	---
				$t \leq 6$	---	175	---	360	---	25 L, 25 T	A	---
				$t \leq 12$	---	200	---	380	---	25 L, 25 T	A	---
				$t \leq 12$	---	175	---	360	---	25 L, 25 T	A	---
ISO 4955:2005	X2CrTi12	---	---	$0.5 \leq t < 3$	---	210	---	390-590	---	25 L, 25 T	A	---
				$3 \leq t \leq 12$	---	210	---	390-590	---	25 L, 25 T	A	---
				$5 \leq t \leq 15$	---	210	---	390-590	---	---	A	---
				$5 \leq t \leq 25$	---	210	---	390-590	---	---	A	---
				$1.5 \leq t \leq 25$	---	210	---	390-590	---	---	A	---

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.2B Mechanical Properties of Ferritic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10028-7:2007	X6CrNiTi12	---	1.4516	$t \leq 8$	---	280	---	450-650	---	23 L, 23 T	A	T: 50 J @ RT
				$t \leq 13.5$	---	280	---	450-650	---	23 L, 23 T	A	T: 50 J @ RT
				$t \leq 25$	---	250	---	450-650	---	20 L, 20 T	A	T: 50 J @ RT
EN 10088-2:2014	X6CrNiTi12	---	1.4516	$t \leq 8$	---	280	---	450-650	---	23 L, 23 T	A	---
				$t \leq 13.5$	---	280	---	450-650	---	23 L, 23 T	A	---
				$t \leq 25$	---	250	---	450-650	---	20 L, 20 T	A	---
ISO 9328-7:2004	Grade X6CrNiTi12	---	---	$t \leq 6$	---	280	---	450-650	---	23 L, 23 T	A	T: 50 J @ 20°C
				$t \leq 12$	---	280	---	450-650	---	23 L, 23 T	A	T: 50 J @ 20°C
				$t \leq 25$	---	250	---	450-650	---	20 L, 20 T	A	T: 50 J @ 20°C
JIS G 4312:2011	Symbol SUH409	---	---	---	---	175	---	360	---	22	A	162 max. HBW; 80 max. HRBW; 175 max. HV
ASME SA-240/SA-240M	---	S42035	---	---	---	380	55	550	80	16	see standard	180 max. HB; 88 max. HRB
ASTM A240/A240M-15a	---	S42035	---	---	---	380	55	550	80	16	---	180 max. HBW; 88 max. HRBW
DIN 5512-3:2004	X5CrNiMoTi15-2		1.4589	---	---	380	---	550-750	---	16 T	HR	---
				$t < 3$	---	420	---	550-750	---	14 T	CR	---
				$t \geq 3$	---	420	---	550-750	---	16 T	CR	---
EN 10088-2:2014	X5CrNiMoTi15-2	---	1.4589	$t \leq 8$	---	400	---	550-750	---	16 L, 16 T	A	---
				$t \leq 13.5$	---	360	---	550-750	---	14 L, 14 T	A	---
ASME SA-240/SA-240M	Type 429	S42900	---	$t \leq 1.27$	$t \leq 0.050$	205	30	450	65	20	see standard	183 max. HB; 89 max. HRB
				$t > 1.27$	$t > 0.050$	205	30	450	65	22	see standard	183 max. HB; 89 max. HRB
ASTM A240/A240M-15a	Type 429	S42900	---	$t \leq 1.27$	$t \leq 0.050$	205	30	450	65	20	---	183 max. HBW; 89 max. HRBW
				$t > 1.27$	$t > 0.050$	205	30	450	65	22	---	183 max. HBW; 89 max. HRBW
GB 3280-92	Grade 1Cr15	---	---	---	---	205	---	450	---	22	A	183 max. HB; 88 max. HRB
GB 4237-92	Grade 1Cr15	---	---	---	---	205	---	450	---	22	A	183 max. HB; 88 max. HRB
GB 4239-91	Grade 1Cr15	---	---	---	---	205	---	450	---	22	A	88 max. HRB
JIS G 4304:2012	Symbol SUS429	---	---	---	---	205	---	450	---	22	A	183 max. HBW; 88 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS429	---	---	---	---	205	---	450	---	22	A	183 max. HBW; 88 max. HRBW; 200 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.2B Mechanical Properties of Ferritic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 430	S43000	---	$t \leq 1.27$	$t \leq 0.050$	205	30	450	65	20	see standard	183 max. HB; 89 max. HRB
				$t > 1.27$	$t > 0.050$	205	30	450	65	22	see standard	183 max. HB; 89 max. HRB
ASTM A240/A240M-15a	Type 430	S43000	---	$t \leq 1.27$	$t \leq 0.050$	205	30	450	65	20	---	183 max. HBW; 89 max. HRBW
				$t > 1.27$	$t > 0.050$	205	30	450	65	22	---	183 max. HBW; 89 max. HRBW
EN 10088-2:2014	X6Cr17	---	1.4016	$t \leq 8$	---	260	---	430-600	---	20 L, 20 T	A	---
				$t \leq 13.5$	---	240	---	430-600	---	18 L, 18 T	A	---
				$t \leq 25$	---	240	---	430-630	---	20 L, 20 T	A	---
GB 3280-92	Grade 1Cr17	---	---	---	---	205	---	450	---	22	A	183 max. HB; 88 max. HRB
GB 4237-92	Grade 1Cr17	---	---	---	---	205	---	450	---	22	A	183 max. HB; 88 max. HRB
GB 4238-92	Grade 1Cr17	---	---	---	---	205	---	450	---	22	A	183 max. HB; 88 max. HRB
GB 4239-91	Grade 1Cr17	---	---	---	---	205	---	450	---	22	A	88 max. HRB
ISO 16143-1:2004	X6Cr17	---	---	$t \leq 6$	---	250	---	450	---	20 L, 20 T	A	---
				$t \leq 6$	---	205	---	450	---	20 L, 20 T	A	---
				$t \leq 12$	---	230	---	450	---	20 L, 20 T	A	---
				$t \leq 12$	---	205	---	450	---	20 L, 20 T	A	---
				$t \leq 25$	---	230	---	430	---	20 L, 20 T	A	---
JIS G 4304:2012	Symbol SUS430	---	---	---	---	205	---	420	---	22	A	183 max. HBW; 88 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS430	---	---	---	---	205	---	420	---	22	A	183 max. HBW; 88 max. HRBW; 200 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.2B Mechanical Properties of Ferritic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10028-7:2007	X3CrTi17	---	1.4510	$t \leq 4$	---	230	---	420-600	---	23 L, 23 T	A	---
	X2CrTi17	---	1.4520	$t \leq 4$	---	180	---	380-530	---	24 L, 24 T	A	---
EN 10088-2:2014	X3CrTi17	---	1.4510	$t \leq 8$	---	230	---	420-600	---	23 L, 23 T	A	---
				$t \leq 13.5$	---	230	---	420-600	---	23 L, 23 T	A	---
	X3CrNb17	---	1.4511	$t \leq 8$	---	230	---	420-600	---	23 L, 23 T	A	---
	X2CrTi17	---	1.4520	$t \leq 8$	---	180	---	380-530	---	24 L, 24 T	A	---
GB 3280-92	Grade 00Cr17	---	---	---	---	175	---	365	---	22	A	183 max. HB; 88 max. HRB
GB 4239-91	Grade 00Cr17	---	---	---	---	175	---	365	---	22	A	88 max. HRB
ISO 16143-1:2004	X3CrTi17	---	---	$t \leq 6$	---	240	---	420	---	23 L, 23 T	A	---
				$t \leq 6$	---	175	---	360	---	23 L, 23 T	A	---
				$t \leq 12$	---	220	---	420	---	23 L, 23 T	A	---
				$t \leq 12$	---	175	---	360	---	23 L, 23 T	A	---
	X3CrNb17	---	---	$t \leq 6$	---	230	---	420	---	23 L, 23 T	A	---
ISO 4955:2005	X3CrTi17	---	---	$0.5 \leq t \leq 12$	---	230	---	---	---	23 L, 23 T	A	---
				$5 \leq t \leq 15$	---	230	---	---	---	---	A	---
				$1.5 \leq t \leq 25$	---	230	---	---	---	---	A	---
				$5 \leq t \leq 25$	---	230	---	---	---	---	A	---
ISO 9328-7:2004	Grade X2CrTi17	---	---	$t \leq 2.5$	---	180	---	380-530	---	24 L, 24 T	A	---
	Grade X3CrTi17	---	---	$t \leq 3$	---	230	---	420-600	---	23 L, 23 T	A	---
JIS G 4304:2012	Symbol SUS430LX	---	---	---	---	175	---	360	---	22	A	183 max. HBW; 88 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS430LX	---	---	---	---	175	---	360	---	22	A	183 max. HBW; 88 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	Type 434	S43400	---	---	---	240	35	450	65	22	see standard	89 max. HRB
ASTM A240/A240M-15a	Type 434	S43400	---	---	---	240	35	450	65	22	---	89 max. HRBW
EN 10088-2:2014	X6CrMo17-1	---	1.4113	$t \leq 8$	---	260	---	450-630	---	18 L, 18 T	A	---
				$t \leq 13.5$	---	260	---	450-630	---	18 L, 18 T	A	---
GB 3280-92	Grade 1Cr17Mo	---	---	---	---	205	---	450	---	22	A	183 max. HB; 88 max. HRB
GB 4237-92	Grade 1Cr17Mo	---	---	---	---	205	---	450	---	22	A	183 max. HB; 88 max. HRB
GB 4239-91	Grade 1Cr17Mo	---	---	---	---	205	---	450	---	22	A	88 max. HRB
JIS G 4304:2012	Symbol SUS434	---	---	---	---	205	---	450	---	22	A	183 max. HBW; 88 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS434	---	---	---	---	205	---	450	---	22	A	183 max. HBW; 88 max. HRBW; 200 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.2B Mechanical Properties of Ferritic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 436	S43600	---	---	---	240	35	450	65	22	see standard	89 max. HRB
ASTM A240/A240M-15a	Type 436	S43600	---	---	---	240	35	450	65	22	---	89 max. HRBW
EN 10088-2:2014	X6CrMoNb17-1	---	1.4526	$t \leq 8$	---	280	---	480-560	---	25 L, 25 T	A	---
ASME SA-240/SA-240M	Type 439	S43035	---	---	---	205	30	415	60	22	see standard	183 max. HB; 89 max. HRB
	---	S43932	---	---	---	205	30	415	60	22	see standard	183 max. HB; 89 max. HRB
ASTM A240/A240M-15a	Type 439	S43035	---	---	---	205	30	415	60	22	---	183 max. HBW; 89 max. HRBW
	---	S43932	---	---	---	205	30	415	60	22	---	183 max. HBW; 89 max. HRBW
ASME SA-240/SA-240M	---	S43940	---	---	---	250	36	430	62	18	see standard	180 max. HB; 88 max. HRB
ASTM A240/A240M-15a	---	S43940	---	---	---	250	36	430	62	18	---	180 max. HBW; 88 max. HRBW
EN 10028-7:2007	X2CrTiNb18	---	1.4509	$t \leq 4$	---	230	---	430-630	---	18 L, 18 T	A	---
EN 10088-2:2014	X2CrTiNb18	---	1.4509	$t \leq 8$	---	230	---	430-630	---	18 L, 18 T	A	---
ISO 9328-7:2004	Grade X2CrTiNb18	---	---	$t \leq 2.5$	---	230	---	430-630	---	18 L, 18 T	A	---
ISO 4955:2005	X2CrTiNb18	---	---	$0.5 \leq t \leq 12$	---	230	---	---	---	18 L, 18 T	A	---
				$5 \leq t \leq 15$	---	230	---	---	---	18	A	---
				$1.5 \leq t \leq 25$	---	230	---	---	---	18	A	---
				$5 \leq t \leq 25$	---	230	---	---	---	18	A	---

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.2B Mechanical Properties of Ferritic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 444	S44400	---	---	---	275	40	415	60	20	see standard	217 max. HB; 96 max. HRB
ASTM A240/A240M-15a	Type 444	S44400	---	---	---	275	40	415	60	20	---	217 max. HBW; 96 max. HRBW
EN 10028-7:2007	X2CrMoTi18-2	---	1.4521	$t \leq 4$	---	300	---	420-640	---	20 L, 20 T	A	---
EN 10088-2:2014	X2CrMoTi18-2	---	1.4521	$t \leq 8$	---	300	---	420-640	---	20 L, 20 T	A	---
				$t \leq 12$	---	280	---	420-620	---	20 L, 20 T	A	---
				$t \leq 13.5$	---	280	---	400-600	---	20 L, 20 T	A	---
GB 3280-92	Grade 00Cr18Mo2	---	---	---	---	245	---	410	---	20	A	217 max. HB; 96 max. HRB
GB 4237-92	Grade 00Cr18Mo2	---	---	---	---	245	---	410	---	20	A	217 max. HB; 96 max. HRB
GB 4239-91	Grade 00Cr18Mo2	---	---	---	---	245	---	410	---	20	A	96 max. HRB
ISO 9328-7:2004	Grade X2CrMoTi18-2	---	---	$t \leq 2.5$	---	300	---	420-640	---	20 L, 20 T	A	---
JIS G 4304:2012	Symbol SUS444	---	---	---	---	245	---	410	---	20	A	217 max. HBW; 96 max. HRBW; 230 max. HV
JIS G 4305:2012	Symbol SUS444	---	---	---	---	245	---	410	---	20	A	217 max. HBW; 96 max. HRBW; 230 max. HV
GB 4238-92	Grade 1Cr19Al3	---	---	---	---	245	---	440	---	15	A	210 max. HB; 95 max. HRB
JIS G 4312:2011	Symbol SUH21	---	---	---	---	245	---	440	---	15	A	210 max. HBW; 95 max. HRBW; 220 max. HV
ASTM A240/A240M-15a	Type 446	S44600	---	---	---	275	40	515	65	20	---	217 max. HBW; 96 max. HRBW
GB 4238-92	Grade 2Cr25N	---	---	---	---	275	---	510	---	20	A	201 max. HB; 95 max. HRB
ISO 4955:2005	X15CrN26	---	---	$0.5 \leq t < 3$	---	280	---	500-700	---	13 L, 13 T	A	212 max. HB
				$3 \leq t \leq 12$	---	280	---	500-700	---	15 L, 15 T	A	212 max. HB
				$5 \leq t \leq 15$	---	280	---	500-700	---	15	A	212 max. HB
				$5 \leq t \leq 25$	---	280	---	500-700	---	15	A	212 max. HB
				$1.5 \leq t \leq 25$	---	280	---	500-700	---	15	A	212 max. HB
JIS G 4312:2011	Symbol SUH446	---	---	---	---	275	---	510	---	20	A	201 max. HBW; 95 max. HRBW; 210 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.2B Mechanical Properties of Ferritic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type XM-27	S44627	---	---	---	275	40	450	65	22	see standard	187 max. HB; 90 max. HRB
ASTM A240/A240M-15a	Type XM-27	S44627	---	---	---	275	40	450	65	22	---	187 max. HBW; 90 max. HRBW
GB 3280-92	Grade 00Cr27Mo	---	---	---	---	245	---	410	---	22	A	190 max. HB; 90 max. HRB
GB 4237-92	Grade 00Cr27Mo	---	---	---	---	245	---	410	---	22	A	190 max. HB; 90 max. HRB
GB 4239-91	Grade 00Cr27Mo	---	---	---	---	245	---	410	---	22	A	90 max. HRB
JIS G 4304:2012	Symbol SUSXM27	---	---	---	---	245	---	410	---	22	A	192 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUSXM27	---	---	---	---	245	---	410	---	22	A	192 max. HBW; 90 max. HRBW; 200 max. HV
GB 3280-92	Grade 00Cr30Mo2	---	---	---	---	295	---	450	---	22	A	209 max. HB; 95 max. HRB
GB 4237-92	Grade 00Cr30Mo2	---	---	---	---	295	---	450	---	22	A	209 max. HB; 95 max. HRB
GB 4239-91	Grade 00Cr30Mo2	---	---	---	---	295	---	450	---	22	A	95 max. HRB
JIS G 4304:2012	Symbol SUS447J1	---	---	---	---	295	---	450	---	22	A	207 max. HBW; 95 max. HRBW; 220 max. HV
JIS G 4305:2012	Symbol SUS447J1	---	---	---	---	295	---	450	---	22	A	207 max. HBW; 95 max. HRBW; 220 max. HV
ASME SA-240/SA-240M	---	S44735	---	---	---	415	60	550	80	18	see standard	255 max. HB; 25 max. HRC
ASTM A240/A240M-15a	---	S44735	---	---	---	415	60	550	80	18	---	255 max. HBW; 25 max. HRC
EN 10088-2:2014	X2CrMoTi29-4	---	1.4592	t ≤ 8	---	430	---	550-700	---	20 L, 20 T	A	---

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 201-1	S20100	---	0.15	5.50-7.50	1.00	0.060	0.030	16.0-18.0	3.5-5.5	---	N 0.25
	Type 201-2	S20100	---	0.15	5.50-7.50	1.00	0.060	0.030	16.0-18.0	3.5-5.5	---	N 0.25
ASME SA-666	Type 201-1	S20100	---	0.15	5.5-7.5	0.75	0.060	0.030	16.0-18.0	3.5-5.5	---	N 0.25
	Type 201-2	S20100	---	0.15	5.5-7.5	0.75	0.060	0.030	16.0-18.0	3.5-5.5	---	N 0.25
ASTM A240/A240M-15a	Type 201-1	S20100	---	0.15	5.50-7.50	1.00	0.060	0.030	16.0-18.0	3.5-5.5	---	N 0.25
	Type 201-2	S20100	---	0.15	5.50-7.50	1.00	0.060	0.030	16.0-18.0	3.5-5.5	---	N 0.25
ASTM A666-15	Type 201-1	S20100	---	0.15	5.5-7.5	0.75	0.060	0.030	16.0-18.0	3.5-5.5	---	N 0.25
	Type 201-2	S20100	---	0.15	5.5-7.5	0.75	0.060	0.030	16.0-18.0	3.5-5.5	---	N 0.25
EN 10088-2:2014	X12CrMnNiN17-7-5	---	1.4372	0.15	5.5-7.5	1.00	0.045	0.015	16.0-18.0	3.5-5.5	---	N 0.05-0.25
GB 3280-92	Grade 1Cr17Mn6Ni5N	---	---	0.15	5.50-7.50	1.00	0.060	0.030	16.00-18.00	3.50-5.50	---	N 0.25
GB 4237-92	Grade 1Cr17Mn6Ni5N	---	---	0.15	5.50-7.50	1.00	0.060	0.030	16.00-18.00	3.50-5.50	---	N 0.25
GB 4239-91	Grade 1Cr17Mn6Ni5N	---	---	0.15	5.50-7.50	1.00	0.060	0.030	16.00-18.00	3.50-5.50	---	N 0.25
ISO 16143-1:2004	X12CrMnNiN17-7-5	---	---	0.15	5.5-7.5	1.00	0.045	0.030	16.0-18.0	3.5-5.5	---	N 0.05-0.25
SAE J405 JUN98	Type 201	S20100	---	0.15	5.50-7.50	1.00	0.060	0.030	16.00-18.00	3.50-5.50	---	N 0.25
ASME SA-240/SA-240M	Type 201L	S20103	---	0.03	5.50-7.50	0.75	0.045	0.030	16.0-18.0	3.5-5.5	---	N 0.25
ASME SA-666	Type 201L	S20103	---	0.03	5.5-7.5	0.75	0.045	0.030	16.0-18.0	3.5-5.5	---	N 0.25
ASTM A240/A240M-15a	Type 201L	S20103	---	0.03	5.50-7.50	0.75	0.045	0.030	16.0-18.0	3.5-5.5	---	N 0.25
ASTM A666-15	Type 201L	S20103	---	0.03	5.5-7.5	0.75	0.045	0.030	16.0-18.0	3.5-5.5	---	N 0.25
EN 10088-2:2014	X2CrMnNiN17-7-5	---	1.4371	0.030	6.0-8.0	1.00	0.045	0.015	16.0-17.5	3.5-5.5	---	N 0.15-0.25; Cu 1.00
SAE J405 JUN98	---	S20103	---	0.03	5.50-7.50	0.75	0.045	0.030	16.00-18.00	3.50-5.50	---	N 0.25
ASME SA-240/SA-240M	Type 201LN	S20153	---	0.03	6.40-7.50	0.75	0.045	0.015	16.0-17.5	4.0-5.0	---	Cu 1.00; N 0.10-0.25
ASME SA-666	Type 201LN	S20153	---	0.03	6.4-7.5	0.75	0.045	0.015	16.0-17.5	4.0-5.0	---	Cu 1.00; N 0.10-0.25
ASTM A240/A240M-15a	Type 201LN	S20153	---	0.03	6.40-7.50	0.75	0.045	0.015	16.0-17.5	4.0-5.0	---	Cu 1.00; N 0.10-0.25
ASTM A666-15	Type 201LN	S20153	---	0.03	6.4-7.5	0.75	0.045	0.015	16.0-17.5	4.0-5.0	---	Cu 1.00; N 0.10-0.25
SAE J405 JUN98	---	S20153	---	0.03	6.40-7.50	0.75	0.045	0.015	16.00-17.50	4.00-5.00	---	Cu 1.00; N 0.10-0.25
ASME SA-240/SA-240M	Type 202	S20200	---	0.15	7.50-10.00	1.00	0.060	0.030	17.0-19.0	4.0-6.0	---	N 0.25
ASME SA-666	Type 202	S20200	---	0.15	7.5-10.0	0.75	0.060	0.030	17.0-19.0	4.0-6.0	---	N 0.25
ASTM A240/A240M-15a	Type 202	S20200	---	0.15	7.50-10.00	1.00	0.060	0.030	17.0-19.0	4.0-6.0	---	N 0.25
ASTM A666-15	Type 202	S20200	---	0.15	7.5-10.0	0.75	0.060	0.030	17.0-19.0	4.0-6.0	---	N 0.25
EN 10088-2:2014	X12CrMnNiN18-9-5	---	1.4373	0.15	7.5-10.5	1.00	0.045	0.015	17.0-19.0	4.0-6.0	---	N 0.05-0.25
GB 3280-92	Grade 1Cr18Mn8Ni5N	---	---	0.15	7.50-10.00	1.00	0.060	0.030	17.00-19.00	4.00-6.00	---	N 0.25
GB 4237-92	Grade 1Cr18Mn8Ni5N	---	---	0.15	7.50-10.00	1.00	0.060	0.030	17.00-19.00	4.00-6.00	---	N 0.25
GB 4239-91	Grade 1Cr18Mn8Ni5N	---	---	0.15	7.50-10.00	1.00	0.060	0.030	17.00-19.00	4.00-6.00	---	N 0.25
SAE J405 JUN98	Type 202	S20200	---	0.15	7.50-10.0	1.00	0.060	0.030	17.00-19.00	4.00-6.00	---	N 0.25

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 301	S30100	---	0.15	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.10
ASME SA-666	Type 301	S30100	---	0.15	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.10
ASTM A240/A240M-15a	Type 301	S30100	---	0.15	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.10
ASTM A666-15	Type 301	S30100	---	0.15	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.10
EN 10088-2:2014	X10CrNi18-8	---	1.4310	0.05-0.15	2.00	2.00	0.045	0.015	16.0-19.0	6.0-9.5	0.80	N 0.10
	X5CrNi17-7	---	1.4319	0.07	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.10
GB 3280-92	Grade 1Cr17Ni7	---	---	0.15-0.25	2.00	1.00	0.035	0.030	16.00-18.00	6.00-8.00	---	---
	Grade 1Cr17Ni8	---	---	0.03-0.12	2.00	1.00	0.035	0.030	16.00-18.00	7.00-9.00	---	---
GB 4239-91	Grade 1Cr17Ni7	---	---	0.15	2.00	1.00	0.035	0.030	16.00-18.00	6.00-8.00	---	---
	Grade 1Cr17Ni8	---	---	0.08-0.12	2.00	1.00	0.035	0.030	16.00-18.00	7.00-9.00	---	---
ISO 16143-1:2004	X10CrNi18-8	---	---	0.05-0.15	2.00	2.00	0.045	0.030	16.0-19.0	6.0-9.5	0.80	N 0.11
JIS G 4304:2012	Symbol SUS301	---	---	0.15	2.00	1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	---
	Symbol SUS301J1	---	---	0.08-0.12	2.00	1.00	0.045	0.030	16.00-18.00	7.00-9.00	---	---
JIS G 4305:2012	Symbol SUS301	---	---	0.15	2.00	1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	---
	Symbol SUS301J1	---	---	0.08-0.12	2.00	1.00	0.045	0.030	16.00-18.00	7.00-9.00	---	---
SAE J405 JUN98	Type 301	S30100	---	0.15	2.00	1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	N 0.10
ASME SA-240/SA-240M	Type 301L	S30103	---	0.03	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.20
ASME SA-666	Type 301L	S30103	---	0.03	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.20
ASTM A240/A240M-15a	Type 301L	S30103	---	0.03	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.20
ASTM A666-15	Type 301L	S30103	---	0.03	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.20
JIS G 4304:2012	Symbol SUS301L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	N 0.20
JIS G 4305:2012	Symbol SUS301L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	N 0.20
ASME SA-240/SA-240M	Type 301LN	S30153	---	0.03	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.07-0.20
ASME SA-666	Type 301LN	S30153	---	0.03	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.07-0.20
ASTM A240/A240M-15a	Type 301LN	S30153	---	0.03	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.07-0.20
ASTM A666-15	Type 301LN	S30153	---	0.03	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.07-0.20
EN 10028-7:2007	X2CrNi18-7	---	1.4318	0.030	2.00	1.00	0.045	0.015	16.5-18.5	6.0-8.0	---	N 0.10-0.20
EN 10088-2:2014	X2CrNi18-7	---	1.4318	0.030	2.00	1.00	0.045	0.015	16.5-18.5	6.0-8.0	---	N 0.10-0.20
ISO 9328-7:2004	Grade X2CrNi18-7	---	---	0.030	2.00	1.00	0.045	0.015	16.5-18.5	6.0-8.0	---	N 0.10-0.20
ASME SA-240/SA-240M	Type 302	S30200	---	0.15	2.00	0.75	0.045	0.030	17.0-19.0	8.0-10.0	---	N 0.10
ASME SA-666	Type 302	S30200	---	0.15	2.00	0.75	0.045	0.030	17.0-19.0	8.0-10.0	---	---
ASTM A240/A240M-15a	Type 302	S30200	---	0.15	2.00	0.75	0.045	0.030	17.0-19.0	8.0-10.0	---	N 0.10
ASTM A666-15	Type 302	S30200	---	0.15	2.00	0.75	0.045	0.030	17.0-19.0	8.0-10.0	---	---
JIS G 4304:2012	Symbol SUS303	---	---	0.15	2.00	1.00	0.20	0.15	17.00-19.00	8.00-10.00	0.60	---
SAE J405 JUN98	Type 302	S30200	---	0.15	2.00	0.75	0.045	0.030	17.00-19.00	8.00-10.00	---	N 0.10

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB 3280-92	Grade 1Cr18Ni9Si3	---	---	0.15	2.00	2.00-3.00	0.035	0.030	17.00-19.00	8.00-10.00	---	---
GB 4237-92	Grade 1Cr18Ni9Si3	---	---	0.15	2.00	2.00-3.00	0.035	0.030	17.00-19.00	8.00-10.00	---	---
GB 4238-92	Grade 1Cr18Ni9Si3	---	---	0.15	2.00	2.00-3.00	0.035	0.030	17.00-19.00	8.00-10.00	---	---
GB 4239-91	Grade 1Cr18Ni9Si3	---	---	0.15	2.00	2.00-3.00	0.035	0.030	17.00-19.00	8.00-10.00	---	---
JIS G 4304:2012	Symbol SUS302B	---	---	0.15	2.00	2.00-3.00	0.045	0.030	17.00-19.00	8.00-10.00	---	---
JIS G 4305:2012	Symbol SUS302B	---	---	0.15	2.00	2.00-3.00	0.045	0.030	17.00-19.00	8.00-10.00	---	---
ASME SA-240/SA-240M	Type 304	S30400	---	0.07	2.00	0.75	0.045	0.030	17.5-19.5	8.0-10.5	---	N 0.10
ASME SA-666	Type 304	S30400	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10
ASTM A240/A240M-15a	Type 304	S30400	---	0.07	2.00	0.75	0.045	0.030	17.5-19.5	8.0-10.5	---	N 0.10
ASTM A666-15	Type 304	S30400	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10
EN 10028-7:2007	X5CrNi18-10	---	1.4301	0.07	2.00	1.00	0.045	0.015	17.5-19.5	8.0-10.5	---	N 0.10
EN 10088-2:2014	X5CrNi18-10	---	1.4301	0.07	2.00	1.00	0.045	0.015	17.5-19.5	8.0-10.5	---	N 0.10
GB 3280-92	Grade 0Cr18Ni9	---	---	0.07	2.00	1.00	0.035	0.030	17.00-19.00	8.00-11.00	---	---
GB 4237-92	Grade 0Cr18Ni9	---	---	0.07	2.00	1.00	0.035	0.030	17.00-19.00	8.00-11.00	---	---
GB 4238-92	Grade 0Cr18Ni9	---	---	0.07	2.00	1.00	0.035	0.030	17.00-19.00	8.00-11.00	---	---
GB 4239-91	Grade 0Cr18Ni9	---	---	0.07	2.00	1.00	0.035	0.030	17.00-19.00	8.00-11.00	---	---
ISO 16143-1:2004	X5CrNi18-9	---	---	0.07	2.00	1.00	0.045	0.030	17.5-19.5	8.0-10.5	---	N 0.11
ISO 9328-7:2004	Grade X5CrNi18-9	---	---	0.07	2.00	1.00	0.045	0.015	17.5-19.5	8.0-10.5	---	N 0.11
JIS G 4304:2012	Symbol SUS304	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
JIS G 4305:2012	Symbol SUS304	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
SAE J405 JUN98	Type 304	S30400	---	0.08	2.00	0.75	0.045	0.030	18.00-20.00	8.00-10.50	---	N 0.10
ISO 16143-1:2004	X6CrNiCu17-8-2	---	---	0.08	3.00	1.70	0.045	0.030	15.0-18.0	6.0-9.0	---	Cu 1.00-3.00
JIS G 4304:2012	Symbol SUS304J1	---	---	0.08	3.00	1.70	0.045	0.030	15.00-18.00	6.00-9.00	---	Cu 1.00-3.00
JIS G 4305:2012	Symbol SUS304J1	---	---	0.08	3.00	1.70	0.045	0.030	15.00-18.00	6.00-9.00	---	Cu 1.00-3.00

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 304L	S30403	---	0.030	2.00	0.75	0.045	0.030	17.5-19.5	8.0-12.0	---	N 0.10
ASME SA-666	Type 304L	S30403	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10
ASTM A240/A240M-15a	Type 304L	S30403	---	0.030	2.00	0.75	0.045	0.030	17.5-19.5	8.0-12.0	---	N 0.10
ASTM A666-15	Type 304L	S30403	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10
EN 10028-7:2007	X2CrNi19-11	---	1.4306	0.030	2.00	1.00	0.045	0.015	18.0-20.0	10.0-12.0	---	N 0.10
	X2CrNi18-9	---	1.4307	0.030	2.00	1.00	0.045	0.015	17.5-19.5	8.0-10.5	---	N 0.10
EN 10088-2:2014	X2CrNi19-11	---	1.4306	0.030	2.00	1.00	0.045	0.015	18.0-20.0	10.0-12.0	---	N 0.10
	X2CrNi18-9	---	1.4307	0.030	2.00	1.00	0.045	0.015	17.5-19.5	8.0-10.5	---	N 0.10
GB 3280-92	Grade 00Cr19Ni10	---	---	0.030	2.00	1.00	0.035	0.030	18.00-20.00	8.00-12.00	---	---
	Grade 00Cr19Ni13Mo3	---	---	0.030	2.50	1.00	0.035	0.030	18.00-20.00	11.00-15.00	---	---
GB 4237-92	Grade 00Cr19Ni10	---	---	0.030	2.00	1.00	0.035	0.030	18.00-20.00	8.00-12.00	---	---
GB 4239-91	Grade 00Cr19Ni10	---	---	0.030	2.00	1.00	0.035	0.030	18.00-20.00	8.00-12.00	---	---
ISO 16143-1:2004	X2CrNi18-9	---	---	0.030	2.00	1.00	0.045	0.030	17.5-19.5	8.0-10.0	---	N 0.11
	X2CrNi19-11	---	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	10.0-12.0	---	N 0.11
ISO 9328-7:2004	Grade X2CrNi18-9	---	---	0.030	2.00	1.00	0.045	0.015	17.5-19.5	8.0-10.0	---	N 0.11
	Grade X2CrNi19-11	---	---	0.030	2.00	1.00	0.045	0.015	18.0-20.0	10.0-12.0	---	N 0.11
JIS G 4304:2012	Symbol SUS304L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	9.00-13.00	---	---
JIS G 4305:2012	Symbol SUS304L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	9.00-13.00	---	---
SAE J405 JUN98	Type 304L	S30403	---	0.030	2.00	0.75	0.045	0.030	18.00-20.00	8.00-12.00	---	N 0.10
ASME SA-240/SA-240M	Type 304H	S30409	---	0.04-0.10	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	---
ASTM A240/A240M-15a	Type 304H	S30409	---	0.04-0.10	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	---
EN 10028-7:2007	X6CrNi18-10	---	1.4948	0.04-0.08	2.00	1.00	0.035	0.015	17.0-19.0	8.0-11.0	---	N 0.10
ISO 9328-7:2004	Grade X6CrNi18-10	---	---	0.04-0.08	2.00	1.00	0.035	0.015	17.0-19.0	8.0-11.0	---	N 0.11
ISO 4955:2005	X7CrNi18-9	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	8.0-11.0	---	---
SAE J405 JUN98	Type 304H	S30409	---	0.04-0.10	2.00	0.75	0.045	0.030	18.00-20.00	8.00-10.50	---	---
ASME SA-240/SA-240M	Type 304N	S30451	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10-0.16
ASME SA-666	Type 304N	S30451	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10-0.16
ASTM A240/A240M-15a	Type 304N	S30451	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10-0.16
ASTM A666-15	Type 304N	S30451	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10-0.16
EN 10028-7:2007	X5CrNiN19-9	---	1.4315	0.06	2.00	1.00	0.045	0.015	18.0-20.0	8.0-11.0	---	N 0.12-0.22
EN 10088-2:2014	X5CrNiN19-9	---	1.4315	0.06	2.00	1.00	0.045	0.015	18.0-20.0	8.0-11.0	---	N 0.12-0.22
GB 3280-92	Grade 0Cr19Ni9N	---	---	0.08	2.50	1.00	0.035	0.030	18.00-20.00	7.00-10.50	---	N 0.10-0.25
GB 4237-92	Grade 0Cr19Ni9N	---	---	0.08	2.50	1.00	0.035	0.030	18.00-20.00	7.00-10.50	---	N 0.10-0.25
GB 4239-91	Grade 0Cr19Ni9N	---	---	0.08	2.50	1.00	0.035	0.030	18.00-20.00	7.00-10.50	---	N 0.10-0.25
ISO 9328-7:2004	Grade X5CrNiN18-8	---	---	0.07	2.50	1.00	0.045	0.015	18.0-20.0	8.0-11.0	---	N 0.10-0.16
JIS G 4304:2012	Symbol SUS304N1	---	---	0.08	2.50	1.00	0.045	0.030	18.00-20.00	7.00-10.50	---	N 0.10-0.25
JIS G 4305:2012	Symbol SUS304N1	---	---	0.08	2.50	1.00	0.045	0.030	18.00-20.00	7.00-10.50	---	N 0.10-0.25
SAE J405 JUN98	Type 304N	S30451	---	0.08	2.00	0.75	0.045	0.030	18.00-20.00	8.00-10.50	---	N 0.10-0.16

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
GB 3280-92	Grade 0Cr19Ni10NbN	---	---	0.08	2.50	1.00	0.035	0.030	18.00-20.00	7.50-10.50	---	Nb 0.15; N 0.15-0.30
GB 4237-92	Grade 0Cr19Ni10NbN	---	---	0.08	2.50	1.00	0.035	0.030	18.00-20.00	7.50-10.50	---	Nb 0.15; N 0.15-0.30
GB 4239-91	Grade 0Cr19Ni10NbN	---	---	0.08	2.50	1.00	0.035	0.030	18.00-20.00	7.50-10.50	---	Nb 0.15; N 0.15-0.30
JIS G 4304:2012	Symbol SUS304N2	---	---	0.08	2.50	1.00	0.045	0.030	18.00-20.00	7.50-10.50	---	Nb 0.15; N 0.15-0.30
	Symbol SUS304N2-X	---	---	0.08	2.50	1.00	0.045	0.030	18.00-20.00	7.50-10.50	---	Nb 0.15; N 0.15-0.30
JIS G 4305:2012	Symbol SUS304N2	---	---	0.08	2.50	1.00	0.045	0.030	18.00-20.00	7.50-10.50	---	Nb 0.15; N 0.15-0.30
ASME SA-240/SA-240M	Type 304LN	S30453	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10-0.16
ASME SA-666	Type 304LN	S30453	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10-0.16
ASTM A240/A240M-15a	Type 304LN	S30453	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10-0.16
ASTM A666-15	Type 304LN	S30453	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10-0.16
EN 10028-7:2007	X2CrNiN18-10	---	1.4311	0.030	2.00	1.00	0.045	0.015	17.5-19.5	8.5-11.5	---	N 0.12-0.22
EN 10088-2:2014	X2CrNiN18-10	---	1.4311	0.030	2.00	1.00	0.045	0.015	17.5-19.5	8.5-11.5	---	N 0.12-0.22
GB 3280-92	Grade 00Cr18Ni10N	---	---	0.030	2.00	1.00	0.035	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
GB 4237-92	Grade 00Cr18Ni10N	---	---	0.030	2.00	1.00	0.035	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
GB 4239-91	Grade 00Cr18Ni10N	---	---	0.030	2.00	1.00	0.035	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
ISO 16143-1:2004	X2CrNiN18-9	---	---	0.030	2.00	1.00	0.045	0.030	17.5-19.5	8.0-10.0	---	N 0.12-0.22
ISO 9328-7:2004	Grade X2CrNiN18-10	---	---	0.030	2.00	1.00	0.045	0.015	17.5-19.5	8.0-11.5	---	N 0.12-0.22
JIS G 4304:2012	Symbol SUS304LN	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
JIS G 4305:2012	Symbol SUS304LN	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
SAE J405 JUN98	Type 304LN	S30453	---	0.030	2.00	0.75	0.045	0.030	18.00-20.00	8.00-12.00	---	N 0.10-0.16
ASME SA-240/SA-240M	Type 305	S30500	---	0.12	2.00	0.75	0.045	0.030	17.0-19.0	10.5-13.0	---	---
ASTM A240/A240M-15a	Type 305	S30500	---	0.12	2.00	0.75	0.045	0.030	17.0-19.0	10.5-13.0	---	---
EN 10088-2:2014	X4CrNi18-12	---	1.4303	0.06	2.00	1.00	0.045	0.015	17.0-19.0	11.0-13.0	---	N 0.10
GB 3280-92	Grade 1Cr18Ni12	---	---	0.12	2.00	1.00	0.035	0.030	17.00-19.00	10.50-13.00	---	---
GB 4237-92	Grade 1Cr18Ni12	---	---	0.12	2.00	1.00	0.035	0.030	17.00-19.00	10.50-13.00	---	---
GB 4239-91	Grade 1Cr18Ni12	---	---	0.12	2.00	1.00	0.035	0.030	17.00-19.00	10.50-13.00	---	---
JIS G 4304:2012	Symbol SUS305	---	---	0.12	2.00	1.00	0.045	0.030	17.00-19.00	10.50-13.00	---	---
JIS G 4305:2012	Symbol SUS305	---	---	0.12	2.00	1.00	0.045	0.030	17.00-19.00	10.50-13.00	---	---
SAE J405 JUN98	Type 305	S30500	---	0.12	2.00	0.75	0.045	0.030	17.00-19.00	10.50-13.00	---	---
ASME SA-240/SA-240M	---	S30600	---	0.018	2.00	3.7-4.3	0.020	0.020	17.0-18.5	14.0-15.5	0.20	Cu 0.50
ASTM A240/A240M-15a	---	S30600	---	0.018	2.00	3.7-4.3	0.020	0.020	17.0-18.5	14.0-15.5	0.20	Cu 0.50
EN 10088-2:2014	X1CrNiSi18-15-4	---	1.4361	0.015	2.00	3.7-4.5	0.025	0.010	16.5-18.5	14.0-16.0	0.20	N 0.10
SAE J405 JUN98	---	S30600	---	0.018	2.00	3.7-4.3	0.020	0.020	17.0-18.5	14.0-15.5	0.20	Cu 0.50
GB 4238-92	Grade 2Cr23Ni13	---	---	0.20	2.00	1.00	0.035	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 4312:2011	Symbol SUH309	---	---	0.20	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 309S	S30908	---	0.08	2.00	0.75	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASTM A240/A240M-15a	Type 309S	S30908	---	0.08	2.00	0.75	0.045	0.030	22.0-24.0	12.0-15.0	---	---
EN 10095:1999	X12CrNi23-13	---	1.4833	0.15	2.00	1.00	0.045	0.015	22.00-24.00	12.00-14.00	---	N 0.11
GB 3280-92	Grade 0Cr23Ni13	---	---	0.08	2.00	1.50	0.035	0.030	22.00-24.00	12.00-15.00	---	---
GB 4237-92	Grade 0Cr23Ni13	---	---	0.08	2.00	1.00	0.035	0.030	22.00-24.00	12.00-15.00	---	---
GB 4238-92	Grade 0Cr23Ni13	---	---	0.08	2.00	1.00	0.035	0.030	22.00-24.00	12.00-15.00	---	---
GB 4239-91	Grade 0Cr23Ni13	---	---	0.08	2.00	1.00	0.035	0.030	22.00-24.00	12.00-15.00	---	---
ISO 4955:2005	X12CrNi23-13	---	---	0.15	2.00	1.00	0.045	0.015	22.0-24.0	12.0-14.0	---	N 0.11
JIS G 4304:2012	Symbol SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 4305:2012	Symbol SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
SAE J405 JUN98	Type 309S	S30908	---	0.08	2.00	0.75	0.045	0.030	22.00-24.00	12.00-15.00	---	---
ASME SA-240/SA-240M	Type 309H	S30909	---	0.04-0.10	2.00	0.75	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASTM A240/A240M-15a	Type 309H	S30909	---	0.04-0.10	2.00	0.75	0.045	0.030	22.0-24.0	12.0-15.0	---	---
EN 10028-7:2007	X6CrNi23-13	---	1.4950	0.04-0.08	2.00	0.70	0.035	0.015	22.0-24.0	12.0-15.0	---	N 0.10
ISO 9328-7:2004	Grade X6CrNi23-13	---	---	0.04-0.08	2.00	0.70	0.035	0.015	22.0-24.0	12.0-15.0	---	N 0.11
SAE J405 JUN98	Type 309H	S30909	---	0.04-0.10	2.00	0.75	0.045	0.030	22.00-24.00	12.00-15.00	---	---
GB 4238-92	Grade 1Cr25Ni20Si2	---	---	0.20	1.50	1.50-2.50	0.035	0.030	24.00-27.00	18.00-21.00	---	---
	Grade 2Cr25Ni20	---	---	0.25	2.00	1.50	0.035	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 4312:2011	Symbol SUH310	---	---	0.25	2.00	1.50	0.040	0.030	24.00-26.00	19.00-22.00	---	---
EN 10095:1999	X15CrNiSi25-21	---	1.4841	0.20	2.00	1.50-2.50	0.045	0.015	24.00-26.00	19.00-22.00	---	N 0.11
ASME SA-240/SA-240M	Type 310S	S31008	---	0.08	2.00	1.50	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A240/A240M-15a	Type 310S	S31008	---	0.08	2.00	1.50	0.045	0.030	24.0-26.0	19.0-22.0	---	---
EN 10095:1999	X8CrNi25-21	---	1.4845	0.10	2.00	1.50	0.045	0.015	24.00-26.00	19.00-22.00	---	N 0.11
GB 3280-92	Grade 0Cr25Ni20	---	---	0.08	2.00	1.00	0.035	0.030	24.00-26.00	19.00-22.00	---	---
GB 4237-92	Grade 0Cr25Ni20	---	---	0.08	2.00	1.00	0.035	0.030	24.00-26.00	19.00-22.00	---	---
GB 4238-92	Grade 0Cr25Ni20	---	---	0.08	2.00	1.00	0.035	0.030	24.00-26.00	19.00-22.00	---	---
GB 4239-91	Grade 0Cr25Ni20	---	---	0.08	2.00	1.50	0.035	0.030	24.00-26.00	19.00-22.00	---	---
ISO 4955:2005	X8CrNi25-21	---	---	0.10	2.00	1.50	0.045	0.015	24.0-26.0	19.0-22.0	---	N 0.11
JIS G 4304:2012	Symbol SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 4305:2012	Symbol SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
SAE J405 JUN98	Type 310S	S31008	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
ASME SA-240/SA-240M	Type 310H	S31009	---	0.04-0.10	2.00	0.75	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A240/A240M-15a	Type 310H	S31009	---	0.04-0.10	2.00	0.75	0.045	0.030	24.0-26.0	19.0-22.0	---	---
EN 10028-7:2007	X6CrNi25-20	---	1.4951	0.04-0.08	2.00	0.70	0.035	0.015	24.0-26.0	19.0-22.0	---	N 0.10
ISO 9328-7:2004	Grade X6CrNi25-20	---	---	0.04-0.08	2.00	0.70	0.035	0.015	24.0-26.0	19.0-22.0	---	N 0.11
SAE J405 JUN98	Type 310H	S31009	---	0.04-0.10	2.00	0.75	0.045	0.030	24.00-26.00	19.00-22.00	---	---

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 310 MoLN	S31050	---	0.020	2.00	0.50	0.030	0.010	24.0-26.0	20.5-23.5	1.60-2.60	N 0.09-0.15
ASTM A240/A240M-15a	Type 310 MoLN	S31050	---	0.020	2.00	0.50	0.030	0.010	24.0-26.0	20.5-23.5	1.60-2.60	N 0.09-0.15
EN 10028-7:2007	X1CrNiMoN25-22-2	---	1.4466	0.020	2.00	0.70	0.025	0.010	24.0-26.0	21.0-23.0	2.00-2.50	N 0.10-0.16
EN 10088-2:2014	X1CrNiMoN25-22-2	---	1.4466	0.020	2.00	0.70	0.025	0.010	24.0-26.0	21.0-23.0	2.00-2.50	N 0.10-0.16
ISO 16143-1:2004	X1CrNiMoN25-22-2	---	---	0.020	2.00	0.70	0.025	0.010	24.0-26.0	21.0-23.0	2.00-2.50	N 0.10-0.16
ISO 9328-7:2004	Grade X1CrNiMoN25-22-2	---	---	0.020	2.00	0.70	0.025	0.010	24.0-26.0	21.0-23.0	2.00-2.50	N 0.10-0.16
SAE J405 JUN98	Type 310 MoLN	S31050	---	0.030	2.00	0.50	0.030	0.010	24.00-26.00	21.00-23.00	2.00-3.00	N 0.10-0.16
ASME SA-240/SA-240M	---	S31254	---	0.020	1.00	0.80	0.030	0.010	19.5-20.5	17.5-18.5	6.0-6.5	Cu 0.50-1.00; N 0.18-0.22
ASTM A240/A240M-15a	---	S31254	---	0.020	1.00	0.80	0.030	0.010	19.5-20.5	17.5-18.5	6.0-6.5	Cu 0.50-1.00; N 0.18-0.25
EN 10028-7:2007	X1CrNiMoCuN20-18-7	---	1.4547	0.020	1.00	0.70	0.030	0.010	19.5-20.5	17.5-18.5	6.0-7.0	Cu 0.50-1.00; N 0.18-0.25
EN 10088-2:2014	X1CrNiMoCuN20-18-7	---	1.4547	0.020	1.00	0.70	0.030	0.010	19.5-20.5	17.5-18.5	6.0-7.0	Cu 0.50-1.00; N 0.18-0.25
ISO 9328-7:2004	Grade X1CrNiMoCuN20-18-7	---	---	0.020	1.00	0.70	0.030	0.010	19.5-20.5	17.5-18.5	6.0-7.0	Cu 0.50-1.00; N 0.18-0.25
JIS G 4304:2012	Symbol SUS312L	---	---	0.020	1.00	0.80	0.030	0.015	19.00-21.00	17.50-19.50	6.00-7.00	Cu 0.50-1.00; N 0.16-0.25
JIS G 4305:2012	Symbol SUS312L	---	---	0.020	1.00	0.80	0.030	0.015	19.00-21.00	17.50-19.50	6.00-7.00	Cu 0.50-1.00; N 0.16-0.25
SAE J405 JUN98	---	S31254	---	0.020	1.00	0.80	0.030	0.010	19.50-20.50	17.50-18.50	6.00-6.50	Cu 0.50-1.00; N 0.18-0.22
ASME SA-240/SA-240M	Type 316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASME SA-666	Type 316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A240/A240M-15a	Type 316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASTM A666-15	Type 316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
EN 10028-7:2007	X5CrNiMo17-12-2	---	1.4401	0.07	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-2.50	N 0.10
	X3CrNiMo17-13-3	---	1.4436	0.05	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.0	2.50-3.00	N 0.10
EN 10088-2:2014	X5CrNiMo17-12-2	---	1.4401	0.07	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-2.50	N 0.10
	X3CrNiMo17-13-3	---	1.4436	0.05	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.0	2.50-3.00	N 0.10
GB 3280-92	Grade 0Cr17Ni12Mo2	---	---	0.08	2.00	1.00	0.035	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
GB 4237-92	Grade 0Cr17Ni12Mo2	---	---	0.08	2.00	1.00	0.035	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
GB 4238-92	Grade 0Cr17Ni12Mo2	---	---	0.08	2.00	1.00	0.035	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
GB 4239-91	Grade 0Cr17Ni12Mo2	---	---	0.08	2.00	1.00	0.035	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
ISO 16143-1:2004	X5CrNiMo17-12-2	---	---	0.07	2.00	1.00	0.045	0.030	16.5-18.5	10.0-13.0	2.00-3.00	N 0.11
	X3CrNiMo17-12-3	---	---	0.05	2.00	1.00	0.045	0.030	16.5-18.5	10.5-13.0	2.50-3.00	N 0.11
ISO 9328-7:2004	Grade X3CrNiMo17-12-3	---	---	0.05	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.0	2.50-3.00	N 0.11
	Grade X5CrNiMo17-12-2	---	---	0.07	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-3.00	N 0.11
JIS G 4304:2012	Symbol SUS316	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 4305:2012	Symbol SUS316	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
SAE J405 JUN98	Type 316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 316L	S31603	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASME SA-666	Type 316L	S31603	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A240/A240M-15a	Type 316L	S31603	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASTM A666-15	Type 316L	S31603	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
EN 10028-7:2007	X2CrNiMo17-12-2	---	1.4404	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-2.50	N 0.10
	X2CrNiMo17-12-3	---	1.4432	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.0	2.50-3.00	N 0.10
	X2CrNiMo18-14-3	---	1.4435	0.030	2.00	1.00	0.045	0.015	17.0-19.0	12.5-15.0	2.50-3.00	N 0.10
EN 10088-2:2014	X2CrNiMo17-12-2	---	1.4404	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-2.50	N 0.10
	X2CrNiMo17-12-3	---	1.4432	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.0	2.50-3.00	N 0.10
	X2CrNiMo18-14-3	---	1.4435	0.030	2.00	1.00	0.045	0.015	17.0-19.0	12.5-15.0	2.50-3.00	N 0.10
GB 3280-92	Grade 00Cr17Ni14Mo2	---	---	0.030	2.00	1.00	0.035	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
GB 4237-92	Grade 00Cr17Ni14Mo2	---	---	0.030	2.00	1.00	0.035	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
GB 4239-91	Grade 00Cr17Ni14Mo2	---	---	0.030	2.00	1.00	0.035	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
ISO 16143-1:2004	X2CrNiMo17-12-2	---	---	0.030	2.00	1.00	0.045	0.030	16.5-18.5	10.0-13.0	2.00-3.00	N 0.11
	X2CrNiMo17-12-3	---	---	0.030	2.00	1.00	0.045	0.030	16.5-18.5	10.5-13.0	2.50-3.00	N 0.11
	X2CrNiMo18-14-3	---	---	0.030	2.00	1.00	0.045	0.015	17.0-19.0	12.5-15.0	2.50-3.00	N 0.11
ISO 9328-7:2004	Grade X2CrNiMo17-12-2	---	---	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-3.00	N 0.11
	Grade X2CrNiMo17-12-3	---	---	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.0	2.50-3.00	N 0.11
	Grade X2CrNiMo18-14-3	---	---	0.030	2.00	1.00	0.045	0.015	17.0-19.0	12.5-15.0	2.50-3.00	N 0.11
JIS G 4304:2012	Symbol SUS316L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
JIS G 4305:2012	Symbol SUS316L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
SAE J405 JUN98	Type 316L	S31603	---	0.030	2.00	0.75	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10
GB 4237-92	Grade 00Cr18Ni12Mo2Cu2	---	---	0.030	2.00	1.00	0.035	0.030	17.00-19.00	12.00-16.00	1.20-2.75	Cu 1.00-2.50
GB 4239-91	Grade 00Cr18Ni14Mo2Cu2	---	---	0.030	2.00	1.00	0.035	0.030	17.00-19.00	12.00-16.00	1.20-2.75	Cu 1.00-2.50
JIS G 4304:2012	Symbol SUS316J1L	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	12.00-16.00	1.20-2.75	Cu 1.00-2.50
JIS G 4305:2012	Symbol SUS316J1L	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	12.00-16.00	1.20-2.75	Cu 1.00-2.50
GB 3280-92	Grade 0Cr18Ni12Mo2Cu2	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	10.00-14.00	1.20-2.75	Cu 1.00-2.50
GB 4237-92	Grade 0Cr18Ni12Mo2Cu2	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	10.00-14.00	1.20-2.75	Cu 1.00-2.50
GB 4239-91	Grade 0Cr18Ni12Mo2Cu2	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	10.00-14.00	1.20-2.75	Cu 1.00-2.50
JIS G 4304:2012	Symbol SUS316J1	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	10.00-14.00	1.20-2.75	Cu 1.00-2.50
JIS G 4305:2012	Symbol SUS316J1	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	10.00-14.00	1.20-2.75	Cu 1.00-2.50

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 316Ti	S31635	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	Ti 5x(C+N) to 0.70; N 0.10
ASTM A240/A240M-15a	Type 316Ti	S31635	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	Ti 5x(C+N) to 0.70; N 0.10
EN 10028-7:2007	X6CrNiMoTi17-12-2	---	1.4571	0.08	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.5	2.00-2.50	Ti [5xC] to 0.70
EN 10088-2:2014	X6CrNiMoTi17-12-2	---	1.4571	0.08	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.5	2.00-2.50	Ti 5xC to 0.70
GB 3280-92	Grade 0Cr18Ni12Mo2Ti	---	---	0.08	2.00	1.00	0.035	0.030	16.00-19.00	11.00-14.00	1.80-2.50	Ti 5xC to 0.70
GB 4237-92	Grade 0Cr18Ni12Mo2Ti	---	---	0.08	2.00	1.00	0.035	0.030	16.00-19.00	11.00-14.00	1.80-2.50	Ti 5xC to 0.07
ISO 16143-1:2004	X6CrNiMoTi17-12-2	---	---	0.08	2.00	1.00	0.045	0.030	16.5-18.5	10.5-13.5	2.00-2.50	Ti 5xC to 0.70
ISO 9328-7:2004	Grade X6CrNiMoTi17-12-2	---	---	0.08	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.5	2.00-2.50	Ti 5xC to 0.70
JIS G 4304:2012	Symbol SUS316Ti	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti 5xC min
JIS G 4305:2012	Symbol SUS316Ti	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti 5xC min
SAE J405 JUN98	Type 316Ti	S31635	---	0.08	2.00	0.75	0.045	0.030	16.00-18.00	10.00-14.00	2.0-3.0	Ti [5x(C+N)] to 0.70; N 0.10
ASME SA-240/SA-240M	Type 316Cb	S31640	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	Cb 10xC to 1.10; N 0.10
ASTM A240/A240M-15a	Type 316Cb	S31640	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	Cb 10xC to 1.10 ; N 0.10
EN 10028-7:2007	X6CrNiMoNb17-12-2	---	1.4580	0.08	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.5	2.00-2.50	Nb 10xC to 1.00
EN 10088-2:2014	X6CrNiMoNb17-12-2	---	1.4580	0.08	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.5	2.00-2.50	Nb 10xC to 1.00
ISO 9328-7:2004	Grade X6CrNiMoNb17-12-2	---	---	0.08	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.5	2.00-2.50	Nb 10xC to 1.00
SAE J405 JUN98	Type 316Cb	S31640	---	0.08	2.00	0.75	0.045	0.030	16.00-18.00	10.00-14.00	2.0-3.0	Cb 10xC to 1.10; N 0.10
ASME SA-240/SA-240M	Type 316N	S31651	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
ASME SA-666	Type 316N	S31651	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
ASTM A240/A240M-15a	Type 316N	S31651	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
ASTM A666-15	Type 316N	S31651	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
GB 3280-92	Grade 0Cr17Ni12Mo2N	---	---	0.08	2.00	1.00	0.035	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10-0.22
GB 4237-92	Grade 0Cr17Ni12Mo2N	---	---	0.08	2.00	1.00	0.035	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10-0.22
GB 4239-91	Grade 0Cr17Ni12Mo2N	---	---	0.08	2.00	1.00	0.035	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10-0.22
JIS G 4304:2012	Symbol SUS316N	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10-0.22
JIS G 4305:2012	Symbol SUS316N	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10-0.22
SAE J405 JUN98	Type 316N	S31651	---	0.08	2.00	0.75	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10-0.16

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 316LN	S31653	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
ASTM A240/A240M-15a	Type 316LN	S31653	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
EN 10028-7:2007	X2CrNiMoN17-11-2	---	1.4406	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.0-12.5	2.00-2.50	N 0.12-0.22
	X2CrNiMoN17-13-3	---	1.4429	0.030	2.00	1.00	0.045	0.015	16.5-18.5	11.0-14.0	2.50-3.00	N 0.12-0.22
EN 10088-2:2014	X2CrNiMoN17-11-2	---	1.4406	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.0-12.5	2.00-2.50	N 0.12-0.22
	X2CrNiMoN17-13-3	---	1.4429	0.030	2.00	1.00	0.045	0.015	16.5-18.5	11.0-14.0	2.50-3.00	N 0.12-0.22
GB 3280-92	Grade 00Cr17Ni13Mo2N	---	---	0.030	2.00	1.00	0.035	0.030	16.50-18.50	10.50-14.50	2.00-3.00	N 0.12-0.22
GB 4237-92	Grade 00Cr17Ni13Mo2N	---	---	0.030	2.00	1.00	0.035	0.030	16.50-18.50	10.50-14.50	2.00-3.00	N 0.12-0.22
GB 4239-91	Grade 00Cr17Ni13Mo2N	---	---	0.030	2.00	1.00	0.035	0.030	16.50-18.50	10.50-14.50	2.00-3.00	N 0.12-0.22
ISO 16143-1:2004	X2CrNiMoN17-12-3	---	---	0.030	2.00	1.00	0.045	0.030	16.5-18.5	10.5-13.0	2.50-3.00	N 0.12-0.22
ISO 9328-7:2004	Grade X2CrNiMoN17-11-2	---	---	0.030	2.00	1.00	0.045	0.015	16.5-18.5	10.0-12.5	2.00-3.00	N 0.12-0.22
	Grade X2CrNiMoN17-13-3	---	---	0.030	2.00	1.00	0.045	0.015	16.5-18.5	11.0-13.0	2.50-3.00	N 0.12-0.22
JIS G 4304:2012	Symbol SUS316LN	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.50-14.50	2.00-3.00	N 0.12-0.22
JIS G 4305:2012	Symbol SUS316LN	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.50-14.50	2.00-3.00	N 0.12-0.22
SAE J405 JUN98	Type 316LN	S31653	---	0.030	2.00	0.75	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10-0.16
ASME SA-240/SA-240M	Type 317	S31700	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	N 0.10
ASTM A240/A240M-15a	Type 317	S31700	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	N 0.10
GB 3280-92	Grade 0Cr19Ni13Mo3	---	---	0.08	2.00	1.00	0.035	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
GB 4237-92	Grade 0Cr19Ni13Mo3	---	---	0.08	2.00	1.00	0.035	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
GB 4238-92	Grade 0Cr19Ni13Mo3	---	---	0.08	2.00	1.00	0.035	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
GB 4239-91	Grade 0Cr19Ni13Mo3	---	---	0.08	2.00	1.00	0.035	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 4304:2012	Symbol SUS317	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 4305:2012	Symbol SUS317	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
SAE J405 JUN98	Type 317	S31700	---	0.08	2.00	0.75	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	N 0.10
GB 3280-92	Grade 0Cr18Ni16Mo5	---	---	0.040	2.00	1.00	0.035	0.030	16.00-19.00	15.00-17.00	4.00-6.00	---
GB 4237-92	Grade 0Cr18Ni16Mo5	---	---	0.040	2.50	1.00	0.035	0.030	16.00-19.00	15.00-17.00	4.00-6.00	---
GB 4239-91	Grade 0Cr18Ni16Mo5	---	---	0.040	2.50	1.00	0.035	0.030	16.00-19.00	15.00-17.00	4.00-6.00	---
JIS G 4304:2012	Symbol SUS317J1	---	---	0.040	2.50	1.00	0.045	0.030	16.00-19.00	15.00-17.00	4.00-6.00	---
JIS G 4305:2012	Symbol SUS317J1	---	---	0.040	2.50	1.00	0.045	0.030	16.00-19.00	15.00-17.00	4.00-6.00	---
ASME SA-240/SA-240M	Type 317L	S31703	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	N 0.10
ASTM A240/A240M-15a	Type 317L	S31703	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	N 0.10
EN 10028-7:2007	X2CrNiMo18-15-4	---	1.4438	0.030	2.00	1.00	0.045	0.015	17.5-19.5	13.0-16.0	3.0-4.0	N 0.10
EN 10088-2:2014	X2CrNiMo18-15-4	---	1.4438	0.030	2.00	1.00	0.045	0.015	17.5-19.5	13.0-16.0	3.0-4.0	N 0.10
GB 4237-92	Grade 00Cr19Ni13Mo3	---	---	0.030	2.00	1.00	0.035	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
GB 4239-91	Grade 00Cr19Ni13Mo3	---	---	0.030	2.00	1.00	0.035	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
ISO 9328-7:2004	Grade X2CrNiMo18-15-4	---	---	0.030	2.00	1.00	0.045	0.015	17.5-19.5	13.0-16.0	3.00-4.0	N 0.11
JIS G 4304:2012	Symbol SUS317L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 4305:2012	Symbol SUS317L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
SAE J405 JUN98	Type 317L	S31703	---	0.030	2.00	0.75	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	N 0.10

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 317LMN	S31726	---	0.030	2.00	0.75	0.045	0.030	17.0-20.0	13.5-17.5	4.0-5.0	N 0.10-0.20
ASTM A240/A240M-15a	Type 317LMN	S31726	---	0.030	2.00	0.75	0.045	0.030	17.0-20.0	13.5-17.5	4.0-5.0	N 0.10-0.20
EN 10028-7:2007	X2CrNiMoN17-13-5	---	1.4439	0.030	2.00	1.00	0.045	0.015	16.5-18.5	12.5-14.5	4.0-5.0	N 0.12-0.22
EN 10088-2:2014	X2CrNiMoN17-13-5	---	1.4439	0.030	2.00	1.00	0.045	0.015	16.5-18.5	12.5-14.5	4.0-5.0	N 0.12-0.22
ISO 9328-7:2004	Grade X2CrNiMoN17-13-5	---	---	0.030	2.00	1.00	0.045	0.015	16.5-18.5	12.5-14.5	4.0-5.0	N 0.12-0.22
SAE J405 JUN98	---	S31726	---	0.030	2.00	0.75	0.045	0.030	17.00-20.00	13.50-17.50	4.0-5.0	N 0.10-0.20
ASME SA-240/SA-240M	Type 317LN	S31753	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	N 0.10-0.22
ASTM A240/A240M-15a	Type 317LN	S31753	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	N 0.10-0.22
EN 10028-7:2007	X2CrNiMoN18-12-4	---	1.4434	0.030	2.00	1.00	0.045	0.015	16.5-19.5	10.5-14.0	3.0-4.0	N 0.10-0.20
EN 10088-2:2014	X2CrNiMoN18-12-4	---	1.4434	0.030	2.00	1.00	0.045	0.015	16.5-19.5	10.5-14.0	3.0-4.0	N 0.10-0.20
ISO 9328-7:2004	Grade X2CrNiMoN18-12-4	---	---	0.030	2.00	1.00	0.045	0.015	16.5-19.5	10.5-14.0	3.00-4.0	N 0.10-0.20
JIS G 4304:2012	Symbol SUS317LN	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	N 0.10-0.22
JIS G 4305:2012	Symbol SUS317LN	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	N 0.10-0.22
SAE J405 JUN98	Type 317LN	S31753	---	0.030	2.00	0.75	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	N 0.10-0.22
ASME SA-240/SA-240M	Type 321	S32100	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5x(C+N) to 0.70; N 0.10
ASTM A240/A240M-15a	Type 321	S32100	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5x(C+N) to 0.70 ; N 0.10
EN 10028-7:2007	X6CrNiTi18-10	---	1.4541	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70
EN 10088-2:2014	X6CrNiTi18-10	---	1.4541	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70
GB 3280-92	Grade 0Cr18Ni10Ti	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-12.00	---	Ti 5xC min.
GB 4237-92	Grade 0Cr18Ni10Ti	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-12.00	---	Ti 5xC min.
GB 4238-92	Grade 0Cr18Ni10Ti	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-12.00	---	Ti 5xC min.
GB 4239-91	Grade 0Cr18Ni10Ti	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-12.00	---	Ti 5xC min.
ISO 16143-1:2004	X6CrNiTi18-10	---	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70
ISO 9328-7:2004	Grade X6CrNiTi18-10	---	---	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70
JIS G 4304:2012	Symbol SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5xC min.
JIS G 4305:2012	Symbol SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5xC min.
SAE J405 JUN98	Type 321	S32100	---	0.08	2.00	0.75	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5x(C+N) to 0.70; N 0.10
ASME SA-240/SA-240M	Type 321H	S32109	---	0.04-0.10	2.00	0.75	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 4x(C+N) to 0.70
ASTM A240/A240M-15a	Type 321H	S32109	---	0.04-0.10	2.00	0.75	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 4x(C+N) to 0.70
GB 3280-92	Grade 1Cr18Ni9	---	---	0.15	2.00	1.00	0.035	0.030	17.00-19.00	8.00-10.00	---	Ti 5x(C-0.02) to 0.80
GB 4237-92	Grade 1Cr18Ni9	---	---	0.15	2.00	1.00	0.035	0.030	17.00-19.00	8.00-10.00	---	Ti 5x(C-0.02) to 0.80
GB 4239-91	Grade 1Cr18Ni9	---	---	0.15	2.00	1.00	0.035	0.030	17.00-19.00	8.00-10.00	---	Ti 5x(C-0.02) to 0.80
ISO 4955:2005	X7CrNiTi18-10	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.80
SAE J405 JUN98	Type 321H	S32109	---	0.04-0.10	2.00	0.75	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 4x(C+N) to 0.70
EN 10095:1999	X12NiCrSi35-16	---	1.4864	0.15	2.00	1.00-2.00	0.045	0.015	15.00-17.00	33.00-37.00	---	N 0.11
GB 4238-92	Grade 1Cr16Ni35	---	---	0.15	2.00	1.50	0.035	0.030	14.00-17.00	33.00-37.00	---	---
JIS G 4312:2011	Symbol SUH330	---	---	0.15	2.00	1.50	0.040	0.030	14.00-17.00	33.00-37.00	---	---

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10088-2:2014	X2CrMoTi17-1	---	1.4513	0.025	1.00	1.00	0.040	0.015	16.0-18.0	---	0.80-1.40	Ti [4x(C+N)+0.15] to 0.80; N 0.020
GB 3280-92	Grade 00Cr17Mo	---	---	0.025	1.00	1.00	0.035	0.030	16.00-19.00	0.60	0.75-1.25	Ti 8x(C+N) to 0.80; Nb 8x(C+N) to 0.80; Zr 8x(C+N) to 0.80; (Ti+Nb+Zr) 8x(C+N) to 0.80; N 0.025
GB 4237-92	Grade 00Cr17Mo	---	---	0.025	1.00	1.00	0.035	0.030	16.00-19.00	0.60	0.75-1.25	Ti 8x(C+N) to 0.80; Nb 8x(C+N) to 0.80; Zr 8x(C+N) to 0.80; (Ti+Nb+Zr) 8x(C+N) to 0.80; N 0.025
GB 4239-91	Grade 00Cr17Mo	---	---	0.025	1.00	1.00	0.035	0.030	16.00-19.00	0.60	0.75-1.25	Ti 8x(C+N) to 0.80; Nb 8x(C+N) to 0.80; Zr 8x(C+N) to 0.80; (Ti+Nb+Zr) 8x(C+N) to 0.80; N 0.025
JIS G 4304:2012	Symbol SUS436L	---	---	0.025	1.00	1.00	0.040	0.030	16.00-19.00	0.60	0.75-1.50	Ti, Nb, Zr or their combination 8x(C + N) to 0.80; N 0.025
JIS G 4305:2012	Symbol SUS436L	---	---	0.025	1.00	1.00	0.040	0.030	16.00-19.00	0.60	0.75-1.50	Ti, Nb, Zr or their combination 8x(C + N) to 0.80; N 0.025
ASME SA-240/SA-240M	Type 347	S34700	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 10xC to 1.00
ASTM A240/A240M-15a	Type 347	S34700	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 10xC to 1.00
EN 10028-7:2007	X6CrNiNb18-10	---	1.4550	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Nb 10xC to 1.00
EN 10088-2:2014	X6CrNiNb18-10	---	1.4550	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Nb 10xC to 1.00
GB 3280-92	Grade 0Cr18Ni11Nb	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min.
GB 4237-92	Grade 0Cr18Ni11Nb	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min.
GB 4238-92	Grade 0Cr18Ni11Nb	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min.
GB 4239-91	Grade 0Cr18Ni11Nb	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min.
ISO 16143-1:2004	X6CrNiNb18-10	---	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Nb 10xC to 1.00
ISO 9328-7:2004	Grade X6CrNiNb18-10	---	---	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Nb 10xC to 1.00
JIS G 4304:2012	Symbol SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min.
JIS G 4305:2012	Symbol SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min.
SAE J405 JUN98	Type 347	S34700	---	0.08	2.00	0.75	0.045	0.030	17.00-19.00	9.00-13.00	---	Cb 10xC to 1.00
EN 10088-2:2014	X11CrNiMnN19-8-6	---	1.4369	0.07-0.15	5.0-7.5	0.50-1.00	0.030	0.015	17.5-19.5	6.5-8.5	---	N 0.20-0.30
EN 10151:2002	X11CrNiMnN19-8-6	---	1.4369	0.07-0.15	5.0-7.5	0.50-1.00	0.030	0.015	17.5-19.5	6.5-8.5	---	N 0.20-0.30
ISO 16143-1:2004	X11CrNiMnN19-8-6	---	---	0.07-0.15	5.0-7.5	0.50-1.00	0.030	0.015	17.5-19.5	6.5-8.5	---	N 0.20-0.30
EN 10028-7:2007	X6CrNiTiB18-10	---	1.4941	0.04-0.08	2.00	1.00	0.035	0.015	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70; B 0.0015-0.0050
EN 10302:2008	X6CrNiTiB18-10	---	1.4941	0.04-0.08	2.00	1.00	0.035	0.015	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.80; B 0.0015-0.0050
ISO 9328-7:2004	Grade X6CrNiTiB18-10	---	---	0.04-0.08	2.00	1.00	0.035	0.015	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70; B 0.0015-0.0050
GB 3280-92	Grade 0Cr18Ni13Si4	---	---	0.08	2.00	3.00-5.00	0.035	0.030	15.00-20.00	11.50-15.00	---	---
GB 4237-92	Grade 0Cr18Ni13Si4	---	---	0.08	2.00	3.00-5.00	0.035	0.030	15.00-20.00	11.50-15.00	---	---
GB 4238-92	Grade 0Cr18Ni13Si4	---	---	0.08	2.00	3.00-5.00	0.035	0.030	15.00-20.00	11.50-15.00	---	---
GB 4239-91	Grade 0Cr18Ni13Si4	---	---	0.08	2.00	3.00-5.00	0.035	0.030	15.00-20.00	11.50-15.00	---	---
JIS G 4304:2012	Symbol SUSXM15J1	---	---	0.08	2.00	3.00-5.00	0.045	0.030	15.00-20.00	11.50-15.00	---	---
JIS G 4305:2012	Symbol SUSXM15J1	---	---	0.08	2.00	3.00-5.00	0.045	0.030	15.00-20.00	11.50-15.00	---	---

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10088-2:2014	X8CrMnCuN17-8-3	---	1.4597	0.10	6.5-9.0	2.00	0.040	0.030	15.0-18.0	3.00	1.00	Cu 2.00-3.5; N 0.10-0.30
ISO 16143-1:2004	X8CrMnCuN17-8-3	---	---	0.10	6.5-8.5	2.00	0.040	0.030	16.0-18.0	2.00	1.00	Cu 2.00-3.5; N 0.15-0.30
ASME SA-240/SA-240M	---	S31060	---	0.05-0.10	1.00	0.50	0.040	0.030	22.0-24.0	10.0-12.5	---	B 0.001-0.01; N 0.18-0.25; (Ce+La) 0.025-0.070
ASTM A240/A240M-15a	---	S31060	---	0.05-0.10	1.00	0.50	0.040	0.030	22.0-24.0	10.0-12.5	---	B 0.001-0.010; N 0.18-0.25; (Ce+La) 0.025-0.070
EN 10302:2008	X8CrNiNb16-13	---	1.4961	0.04-0.10	1.50	0.30-0.60	0.035	0.015	15.0-17.0	12.0-14.0	---	Nb 10xC to 1.20
	X6CrNiMoTiB17-13	---	1.4983	0.04-0.08	2.00	0.75	0.035	0.015	16.0-18.0	12.0-14.0	2.00-2.50	B 0.0015-0.0060; Ti 5xC to 0.80
EN 10028-7:2007	X1CrNi25-21	---	1.4335	0.020	2.00	0.25	0.025	0.010	24.0-26.0	20.0-22.0	0.20	N 0.10
EN 10088-2:2014	X1CrNi25-21	---	1.4335	0.020	2.00	0.25	0.025	0.010	24.0-26.0	20.0-22.0	0.20	N 0.10
ISO 16143-1:2004	X1CrNi25-21	---	---	0.02	2.00	0.25	0.025	0.010	24.0-26.0	20.0-22.0	0.20	N 0.11
ISO 9328-7:2004	Grade X1CrNi25-21	---	---	0.020	2.00	0.25	0.025	0.010	24.0-26.0	20.0-22.0	0.20	N 0.11
ASME SA-240/SA-240M	---	S34565	---	0.030	5.00-7.00	1.00	0.030	0.010	23.0-25.0	16.0-18.0	4.0-5.0	Cb 0.10; N 0.40-0.60
ASTM A240/A240M-15a	---	S34565	---	0.030	5.00-7.00	1.00	0.030	0.010	23.0-25.0	16.0-18.0	4.0-5.0	Cb 0.10; N 0.40-0.60
EN 10088-2:2014	X2CrNiMnMoN25-18-6-5	---	1.4565	0.030	5.0-7.0	1.00	0.030	0.015	24.0-26.0	16.0-19.0	4.0-5.0	Nb 0.15; N 0.30-0.60
ISO 16143-1:2004	X2CrNiMnMoN25-18-6-5	---	---	0.030	5.0-7.0	1.00	0.030	0.010	24.0-26.0	16.0-19.0	4.0-5.0	Nb 0.15; N 0.30-0.60
SAE J405 JUN98	---	S34565	---	0.030	5.00-7.00	1.00	0.030	0.010	23.00-25.00	16.00-18.00	4.00-5.00	Cb 0.10; N 0.40-0.60
ASME SA-240/SA-240M	---	S31266	---	0.030	2.00-4.00	1.00	0.035	0.020	23.0-25.0	21.0-24.0	5.2-6.2	Cu 1.00-2.50; W 1.50-2.50; N 0.35-0.60
ASTM A240/A240M-15a	---	S31266	---	0.030	2.00-4.00	1.00	0.035	0.020	23.0-25.0	21.0-24.0	5.2-6.2	Cu 1.00-2.50; W 1.50-2.50; N 0.35-0.60
EN 10088-2:2014	X1CrNiMoCuNW24-22-6	---	1.4659	0.020	2.00-4.0	0.70	0.030	0.010	23.0-25.0	21.0-23.0	5.5-6.5	Cu 1.00-2.00; W 1.50-2.50; N 0.35-0.50
SAE J405 JUN98	---	S31266	---	0.030	2.00-4.00	1.00	0.035	0.020	23.00-25.00	21.00-24.00	5.00-7.00	Cu 0.50-3.00; W 1.00-3.00; N 0.35-0.60
ASME SA-240/SA-240M	---	S32654	---	0.020	2.00-4.00	0.50	0.030	0.005	24.0-25.0	21.0-23.0	7.0-8.0	Cu 0.30-0.60; N 0.45-0.55
ASTM A240/A240M-15a	---	S32654	---	0.020	2.00-4.00	0.50	0.030	0.005	24.0-25.0	21.0-23.0	7.0-8.0	Cu 0.30-0.60; N 0.45-0.55
EN 10088-2:2014	X1CrNiMoCuN24-22-8	---	1.4652	0.020	2.00-4.0	0.50	0.030	0.005	23.0-25.0	21.0-23.0	7.0-8.0	Cu 0.30-0.60; N 0.45-0.55
ISO 16143-1:2004	X1CrNiMoCuN24-22-8	---	---	0.020	2.0-4.0	0.50	0.030	0.005	23.0-25.0	21.0-23.0	7.0-8.0	Cu 0.30-0.60; N 0.45-0.55
SAE J405 JUN98	---	S32654	---	0.020	2.00-4.00	0.50	0.030	0.005	24.00-25.00	21.00-23.00	7.00-8.00	Cu 0.30-0.60; N 0.45-0.55
EN 10095:1999	X8CrNiTi18-10	---	1.4878	0.10	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Ti 5xC to 0.80
GB 3280-92	Grade 1Cr18Ni9Ti	---	---	0.12	2.00	1.00	0.035	0.030	17.00-19.00	8.00-11.00	---	Ti 5x(C-0.02) to 0.80
GB 4237-92	Grade 1Cr18Ni9Ti	---	---	0.12	2.00	1.00	0.035	0.030	17.00-19.00	8.00-11.00	---	Ti 5x(C-0.02) to 0.80
GB 4238-92	Grade 1Cr18Ni9Ti	---	---	0.12	2.00	1.00	0.035	0.030	17.00-19.00	8.00-11.00	---	Ti 5x(C-0.02) to 0.80
GB 4239-91	Grade 1Cr18Ni9Ti	---	---	0.12	2.00	1.00	0.035	0.030	17.00-19.00	8.00-11.00	---	Ti 5x(C-0.02) to 0.80
ASME SA-240/SA-240M	Type 347H	S34709	---	0.04-0.10	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 8xC to 1.00
ASTM A240/A240M-15a	Type 347H	S34709	---	0.04-0.10	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 8xC to 1.00
ISO 4955:2005	X7CrNiNb18-10	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Nb 10xC to 1.20
SAE J405 JUN98	Type 347H	S34709	---	0.04-0.10	2.00	0.75	0.045	0.030	17.00-19.00	9.00-13.00	---	Cb 8xC to 1.00
EN 10028-7:2007	X3CrNiMoBN17-13-3	---	1.4910	0.04	2.00	0.75	0.035	0.015	16.0-18.0	12.0-14.0	2.00-3.00	N 0.10-0.18; B 0.0015-0.0050
EN 10302:2008	X3CrNiMoBN17-13-3	---	1.4910	0.04	2.00	0.75	0.035	0.015	16.0-18.0	12.0-14.0	2.00-3.00	N 0.10-0.18; B 0.0015-0.0050
ISO 9328-7:2004	Grade X3CrNiMoBN17-13-3	---	---	0.04	2.00	0.75	0.035	0.015	16.0-18.0	12.0-14.0	2.00-3.00	N 0.10-0.18; B 0.0015-0.0050

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10028-7:2007	X8CrNiNb16-13	---	1.4961	0.04-0.10	1.50	0.30-0.60	0.035	0.015	15.0-17.0	12.0-14.0	---	Nb 10xC to 1.20
ISO 9328-7:2004	Grade X8CrNiNb16-13	---	---	0.04-0.10	1.50	0.30-0.60	0.035	0.050	15.0-17.0	12.0-14.0	---	Nb 10xC to 1.20
GB 4238-92	Grade 0Cr15Ni25Ti2MoAlVB	---	---	0.08	2.00	1.00	0.035	0.030	13.00-16.00	24.00-27.00	1.00-1.50	V 0.10-0.50; Al 0.35 min.; Ti 1.90-2.35; B 0.001-0.010
JIS G 4312:2011	Symbol SUH660	---	---	0.08	2.00	1.00	0.040	0.030	13.50-16.00	24.00-27.00	1.00-1.50	V 0.10-0.50; Al 0.35; Ti 1.90-2.35; B 0.001-0.010
EN 10302:2008	X6NiCrTiMoVB25-15-2	---	1.4980	0.030-0.08	1.00-2.00	1.00	0.025	0.015	13.5-16.0	24.0-27.0	1.00-1.50	V 0.10-0.50; Al 0.35; Ti 1.90-2.30; B 0.0030-0.010
EN 10028-7:2007	X5NiCrAlTi31-20	---	1.4958	0.03-0.08	1.50	0.70	0.015	0.010	19.0-22.0	30.0-32.5	---	(Al+Ti) 0.70 max.; (Ni+Co) 30.0 to 32.5; Al 0.20-0.50; Cu 0.50; Ti 0.20-0.50; Co 0.50; Nb 0.10; N 0.030
EN 10302:2008	X5NiCrAlTi31-20	---	1.4958	0.030-0.08	1.50	0.70	0.015	0.010	19.0-22.0	30.0-32.5	---	Al 0.20-0.50; Cu 0.50; Ti 0.20-0.50; Nb 0.10
ISO 9328-7:2004	Grade X5NiCrAlTi31-20	---	---	0.03-0.08	1.50	0.70	0.015	0.010	19.0-22.0	30.0-32.5	---	(Al+Ti) 0.70 max.; (Ni+Co) 30.0 to 32.5; Al 0.20-0.50; Cu 0.50; Ti 0.20-0.50; Co 1.00; Nb 0.10; N 0.11
EN 10302:2008	X12CrCoNi21-20	---	1.4971	0.08-0.16	2.00	1.00	0.035	0.015	20.0-22.5	19.0-21.0	2.50-3.5	W 2.00-3.00; Co 18.5-21.0; Nb 0.75-1.25; N 0.10-0.20
JIS G 4312:2011	Symbol SUH661	---	---	0.08-0.16	1.00-2.00	1.00	0.040	0.030	20.00-22.50	19.00-21.00	2.50-3.50	W 2.00-3.00; Co 18.50-21.00; Nb 0.75-1.25; N 0.10-0.20
ASME SA-240/SA-240M	Type 800	N08800	---	0.10	1.50	1.00	0.045	0.015	19.0-23.0	30.0-35.0	---	Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60; Fe 39.5 min.
ASTM A240/A240M-15a	Type 800	N08800	---	0.10	1.50	1.00	0.045	0.015	19.0-23.0	30.0-35.0	---	Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60; Fe 39.5 min
EN 10095:1999	X10NiCrAlTi32-21	---	1.4876	0.12	2.00	1.00	0.030	0.015	19.00-23.00	30.00-34.00	---	Al 0.15-0.60; Ti 0.15-0.60
SAE J405 JUN98	---	N08800	---	0.10	1.50	1.00	0.045	0.015	19.0-23.0	30.0-35.0	---	Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60
ASME SA-240/SA-240M	Type 800H	N08810	---	0.05-0.10	1.50	1.00	0.045	0.015	19.0-23.0	30.0-35.0	---	Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60; Fe 39.5 min.
	---	N08811	---	0.06-0.10	1.50	1.00	0.040	0.015	19.0-23.0	30.0-35.0	---	Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60; Fe 39.5 min.; (Al+Ti) 0.85-1.20
ASTM A240/A240M-15a	Type 800H	N08810	---	0.05-0.10	1.50	1.00	0.045	0.015	19.0-23.0	30.0-35.0	---	Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60; Fe 39.5 min.
	---	N08811	---	0.06-0.10	1.50	1.00	0.040	0.015	19.0-23.0	30.0-35.0	---	Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60; Fe 39.5 min.; (Al+Ti) 0.85-1.20
EN 10028-7:2007	X8NiCrAlTi32-21	---	1.4959	0.05-0.10	1.50	0.70	0.015	0.010	19.0-22.0	30.0-34.0	---	(Ni+Co) 30.0 to 34.0; Al 0.25-0.65; Cu 0.50; Ti 0.25-0.65; Co 0.50; N 0.030
ISO 4955:2005	X8NiCrAlTi32-21	---	---	0.05-0.10	1.50	1.00	0.015	0.015	19.0-23.0	30.0-34.0	---	Al 0.15-0.60; Cu 0.70; Ti 0.15-0.60
ISO 9328-7:2004	Grade X8NiCrAlTi32-21	---	---	0.05-0.10	1.50	0.70	0.015	0.010	19.0-22.0	30.0-34.0	---	(Ni+Co) 30.0 to 34.0; Al 0.25-0.65; Cu 0.50; Ti 0.25-0.65; Co 1.00; N 0.11
SAE J405 JUN98	---	N08810	---	0.05-0.10	1.50	1.00	0.045	0.015	19.0-23.0	30.0-35.0	---	Al 0.15-0.60; Cu 0.75; Ti 0.15-0.60

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10028-7:2007	X1CrNiMoCuN25-25-5	---	1.4537	0.020	2.00	0.70	0.030	0.010	24.0-26.0	24.0-27.0	4.7-5.7	Cu 1.00-2.00; N 0.17-0.25
EN 10088-2:2014	X1CrNiMoCuN25-25-5	---	1.4537	0.020	2.00	0.70	0.030	0.010	24.0-26.0	24.0-27.0	4.7-5.7	Cu 1.00-2.00; N 0.17-0.25
ISO 9328-7:2004	Grade X1CrNiMoCuN25-25-5	---	---	0.020	2.00	0.70	0.030	0.010	24.0-26.0	24.0-27.0	4.7-5.7	Cu 1.00-2.00; N 0.17-0.25
ASME SA-240/SA-240M	---	N08367	---	0.030	2.00	1.00	0.040	0.030	20.0-22.0	23.5-25.5	6.0-7.0	Cu 0.75; N 0.18-0.25
	---	N08926	---	0.020	2.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.00-7.00	Cu 0.50-1.50; N 0.15-0.25
	---	S31277	---	0.020	3.00	0.50	0.030	0.010	20.5-23.0	26.0-28.0	6.5-8.0	Cu 0.50-1.50; N 0.30-0.40
ASTM A240/A240M-15a	---	N08367	---	0.030	2.00	1.00	0.040	0.030	20.0-22.0	23.5-25.5	6.0-7.0	Cu 0.75; N 0.18-0.25
	---	N08926	---	0.020	2.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.00-7.00	Cu 0.50-1.50; N 0.15-0.25
	---	S31277	---	0.020	3.00	0.50	0.030	0.010	20.5-23.0	26.0-28.0	6.5-8.0	Cu 0.50-1.50; N 0.30-0.40
ASTM B688-96 (2014)	---	N08366	---	0.035	2.00	1.00	0.040	0.030	20.00-22.00	23.50-25.50	6.00-7.00	---
	---	N08367	---	0.030	2.00	1.00	0.040	0.030	20.00-22.00	23.50-25.50	6.00-7.00	Cu 0.75; N 0.18-0.25
EN 10028-7:2007	X1NiCrMoCuN25-20-7	---	1.4529	0.020	1.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.0-7.0	Cu 0.50-1.50; N 0.15-0.25
EN 10088-2:2014	X1NiCrMoCuN25-20-7	---	1.4529	0.020	1.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.0-7.0	Cu 0.50-1.50; N 0.15-0.25
ISO 9328-7:2004	Grade X1NiCrMoCuN25-20-7	---	---	0.020	2.00	0.75	0.030	0.010	19.0-21.0	24.0-26.0	6.0-7.0	Cu 0.50-1.50; N 0.15-0.25
JIS G 4304:2012	Symbol SUS836L	---	---	0.030	2.00	1.00	0.045	0.030	19.00-24.00	24.00-26.00	5.00-7.00	N 0.25
JIS G 4305:2012	Symbol SUS836L	---	---	0.030	2.00	1.00	0.045	0.030	19.00-24.00	24.00-26.00	5.00-7.00	N 0.25
SAE J405 JUN98	---	N08367	---	0.030	2.00	1.00	0.040	0.030	20.00-22.00	23.50-25.50	6.00-7.00	Cu 0.75; N 0.18-0.25
	---	N08926	---	0.020	2.00	0.50	0.030	0.010	19.00-21.00	24.00-26.00	6.0-7.0	Cu 0.5-1.5; N 0.15-0.25
ASME SA-240/SA-240M	Type 904L	N08904	---	0.020	2.00	1.00	0.045	0.035	19.0-23.0	23.0-28.0	4.00-5.00	Cu 1.00-2.00; N 0.10
ASTM A240/A240M-15a	Type 904L	N08904	---	0.020	2.00	1.00	0.045	0.035	19.0-23.0	23.0-28.0	4.00-5.00	Cu 1.00-2.00; N 0.10
EN 10028-7:2007	X1NiCrMoCu25-20-5	---	1.4539	0.020	2.00	0.70	0.030	0.010	19.0-21.0	24.0-26.0	4.0-5.0	Cu 1.20-2.00; N 0.15
EN 10088-2:2014	X1NiCrMoCu25-20-5	---	1.4539	0.020	2.00	0.70	0.030	0.010	19.0-21.0	24.0-26.0	4.0-5.0	Cu 1.20-2.00; N 0.15
ISO 16143-1:2004	X1NiCrMoCu25-20-5	---	---	0.020	2.00	0.75	0.035	0.015	19.0-22.0	23.5-26.0	4.0-5.0	Cu 1.20-2.00; N 0.15
ISO 9328-7:2004	Grade X1NiCrMoCu25-20-5	---	---	0.020	2.00	0.70	0.030	0.010	19.0-21.0	24.0-26.0	4.0-5.0	Cu 1.20-2.00; N 0.15
JIS G 4304:2012	Symbol SUS890L	---	---	0.020	2.00	1.00	0.045	0.030	19.00-23.00	23.00-28.00	4.00-5.00	Cu 1.00-2.00
JIS G 4305:2012	Symbol SUS890L	---	---	0.020	2.00	1.00	0.045	0.030	19.00-23.00	23.00-28.00	4.00-5.00	Cu 1.00-2.00
SAE J405 JUN98	Type 904L	N08904	---	0.020	2.00	1.00	0.045	0.035	19.00-23.00	23.00-28.00	4.0-5.0	Cu 1.0-2.0; N 0.10
EN 10028-7:2007	X1NiCrMoCu31-27-4	---	1.4563	0.020	2.00	0.70	0.030	0.010	26.0-28.0	30.0-32.0	3.0-4.0	Cu 0.70-1.50; N 0.10
EN 10088-2:2014	X1NiCrMoCu31-27-4	---	1.4563	0.020	2.00	0.70	0.030	0.010	26.0-28.0	30.0-32.0	3.0-4.0	Cu 0.70-1.50; N 0.10
ISO 16143-1:2004	X1NiCrMoCu31-27-4	---	---	0.020	2.00	0.70	0.030	0.010	26.0-28.0	30.0-32.0	3.0-4.0	Cu 0.70-1.50; N 0.11
ISO 9328-7:2004	Grade X1NiCrMoCu31-27-4	---	---	0.020	2.00	0.70	0.030	0.010	26.0-28.0	30.0-32.0	3.00-4.0	Cu 0.70-1.50; N 0.11

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 201-1	S20100	---	---	---	260	38	515	75	40	Q+SA	217 max. HB; 95 max. HRB
	Type 201-2	S20100	---	---	---	310	45	655	95	40	Q+SA	241 max. HB; 100 max. HRB
ASME SA-666	Type 201-1	S20100	---	---	---	260	38	515 L	75 L	40 L	A	217 max. HB; 95 max. HRB
	Type 201-2	S20100	---	---	---	310	45	655 L	95 L	40 L	A	241 max. HB; 100 max. HRB
ASTM A240/A240M-15a	Type 201-1	S20100	---	---	---	260	38	515	75	40	SA	217 max. HBW; 95 max. HRBW
	Type 201-2	S20100	---	---	---	310	45	655	95	40	SA	241 max. HBW; 100 max. HRBW
ASTM A666-15	Type 201-1	S20100	---	---	---	260	38	515 L	75 L	40 L	A	217 max. HB; 95 max. HRB
	Type 201-2	S20100	---	---	---	310	45	655 L	95 L	40 L	A	241 max. HB; 100 max. HRB
EN 10088-2:2014	X12CrMnNiN17-7-5	---	1.4372	$t \leq 8$	---	350	---	680-880	---	45 T	SA	---
				$t \leq 13.5$	---	330	---	680-880	---	45 T	SA	see standard for impact data
				$t \leq 75$	---	330	---	680-880	---	40 T	SA	---
GB 3280-92	Grade 1Cr17Mn6Ni5N	---	---	---	---	245	---	635	---	40	ST	241 max. HB; 100 max. HRB
GB 4237-92	Grade 1Cr17Mn6Ni5N	---	---	---	---	245	---	635	---	40	ST	241 max. HB; 100 max. HRB
GB 4239-91	Grade 1Cr17Mn6Ni5N	---	---	---	---	245	---	635	---	40	ST	100 max. HRB
ISO 16143-1:2004	X12CrMnNiN17-7-5	---	---	$t \leq 8$	---	350	---	750-950	---	45 T	SA	---
				$t \leq 13.5$	---	330	---	750-950	---	45 T	SA	---
				$t \leq 75$	---	330	---	750-950	---	40 T	SA	---

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 201L	S20103	---	---	---	260	38	655	95	40	Q+SA	217 max. HB; 95 max. HRB
ASME SA-666	Type 201L	S20103	---	---	---	260	38	655 L	95 L	40 L	A	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 201L	S20103	---	---	---	260	38	655	95	40	SA	217 max. HBW; 95 max. HRBW
ASTM A666-15	Type 201L	S20103	---	---	---	260	38	655 L	95 L	40 L	A	217 max. HB; 95 max. HRB
EN 10088-2:2014	X2CrMnNiN17-7-5	---	1.4371	$t \leq 8$	---	300	---	650-850	---	45 T	SA	---
				$t \leq 13.5$	---	280	---	650-850	---	45 T	SA	see standard for impact data
				$t \leq 75$	---	280	---	630-830	---	35 T	SA	
ASME SA-240/SA-240M	Type 201LN	S20153	---	---	---	310	45	655	95	45	Q+SA	241 max. HB; 100 max. HRB
ASME SA-666	Type 201LN	S20153	---	---	---	310	45	655 L	95 L	45 L	A	241 max. HB; 100 max. HRB
ASTM A240/A240M-15a	Type 201LN	S20153	---	---	---	310	45	655	95	45	SA	241 max. HBW; 100 max. HRBW
ASTM A666-15	Type 201LN	S20153	---	---	---	310	45	655 L	95 L	45 L	A	241 max. HB; 100 max. HRB
ASME SA-240/SA-240M	Type 202	S20200	---	---	---	260	38	620	90	40	Q+SA	241 max. HB
ASME SA-666	Type 202	S20200	---	---	---	260	38	620 L	90 L	40 L	A	241 max. HB
ASTM A240/A240M-15a	Type 202	S20200	---	---	---	260	38	620	90	40	SA	241 max. HB
ASTM A666-15	Type 202	S20200	---	---	---	260	38	620 L	90 L	40 L	A	241 max. HB
EN 10088-2:2014	X12CrMnNiN18-9-5	---	1.4373	$t \leq 8$	---	340	---	680-880	---	45 T	SA	---
				$t \leq 13.5$	---	320	---	680-880	---	45 T	SA	see standard for impact data
				$t \leq 75$	---	320	---	600-800	---	35 T	SA	
GB 3280-92	Grade 1Cr18Mn8Ni5N	---	---	---	---	245	---	590	---	40	ST	207 max. HB; 95 max. HRB
GB 4237-92	Grade 1Cr18Mn8Ni5N	---	---	---	---	245	---	590	---	40	ST	207 max. HB; 95 max. HRB
GB 4239-91	Grade 1Cr18Mn8Ni5N	---	---	---	---	245	---	590	---	40	ST	95 max. HRB

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 301	S30100	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASME SA-666	Type 301	S30100	---	---	---	205	30	515 L	75 L	40 L	A	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 301	S30100	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
ASTM A666-15	Type 301	S30100	---	---	---	205	30	515 L	75 L	40 L	A	217 max. HB; 95 max. HRB
EN 10088-2:2014	X10CrNi18-8	---	1.4310	$t \leq 8$	---	250	---	600-950	---	40 T	SA	---
	X5CrNi17-7	---	1.4319	$t \leq 3$	---	230	---	550-750	---	45 T	SA	---
				$t \leq 6$	---	230	---	550-750	---	45 T	SA	---
GB 3280-92	Grade 1Cr17Ni7	---	---	---	---	205	---	520	---	40	---	187 max. HB; 90 max. HRB
				---	---	510	---	865	---	25	WH	---
				$t < 0.4$	---	755	---	1030	---	9	WH	---
				$t < 0.4$	---	930	---	1210	---	3	WH	---
				$t < 0.4$	---	960	---	1270	---	3	WH	---
				$t < 0.4$	---	960	---	1270	---	4	WH	---
				$t < 0.4$	---	960	---	1270	---	5	WH	---
				$0.4 < t < 0.8$	---	930	---	1210	---	5	WH	---
				$t > 0.4$	---	755	---	1030	---	10	WH	---
				$t \geq 0.8$	---	930	---	1210	---	7	WH	---
	Grade 1Cr17Ni8	---	---	---	---	205	---	570	---	45	ST	187 max. HB; 90 max. HRB
GB 4239-91	Grade 1Cr17Ni7	---	---	---	---	205	---	520	---	40	ST	90 max. HRB
				---	---	510	---	865	---	25	WH	90 max. HRB
				$t < 0.4$	---	755	---	1030	---	9	WH	90 max. HRB
				$t < 0.4$	---	930	---	1205	---	3	WH	90 max. HRB
				$t < 0.4$	---	960	---	1275	---	3	WH	90 max. HRB
				$0.4 \leq t < 0.8$	---	930	---	1205	---	5	WH	90 max. HRB
				$0.4 \leq t < 0.8$	---	960	---	1275	---	4	WH	90 max. HRB
				$t \geq 0.4$	---	755	---	1030	---	10	WH	90 max. HRB
				$t \geq 0.8$	---	930	---	1205	---	7	WH	90 max. HRB
	Grade 1Cr17Ni8	---	---	---	---	205	---	570	---	45	ST	90 max. HRB

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8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ISO 16143-1:2004	X10CrNi18-8	---	---	$t \leq 8$	---	250	---	600-800	---	40 T	SA	---
				$t \leq 13.5$	---	230	---	600-800	---	40 T	SA	---
JIS G 4304:2012	Symbol SUS301	---	---	---	---	205	---	520	---	40	ST	207 max. HBW; 95 max. HRBW; 218 max. HV
	Symbol SUS301J1	---	---	---	---	205	---	570	---	45	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS301	---	---	---	---	205	---	520	---	40	ST	207 max. HBW; 95 max. HRBW; 218 max. HV
				$t < 0.4$	---	510	---	860	---	25	T	---
				$t < 0.4$	---	755	---	1030	---	9	T	---
				$t < 0.4$	---	930	---	1210	---	3	T	---
				$t < 0.4$	---	960	---	1270	---	3	T	---
				$0.4 \leq t < 0.8$	---	510	---	860	---	25	T	---
				$0.4 \leq t < 0.8$	---	755	---	1030	---	10	T	---
				$0.4 \leq t < 0.8$	---	930	---	1210	---	5	T	---
				$0.4 \leq t < 0.8$	---	960	---	1270	---	4	T	---
				$t \geq 0.8$	---	510	---	860	---	25	T	---
				$t \geq 0.8$	---	755	---	1030	---	10	T	---
				$t \geq 0.8$	---	930	---	1210	---	7	T	---
				$t \geq 0.8$	---	960	---	1270	---	5	T	---
	Symbol SUS301J1	---	---	---	---	205	---	570	---	45	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	Type 301L	S30103	---	---	---	220	32	550	80	45	Q+SA	241 max. HB; 100 max. HRB
ASME SA-666	Type 301L	S30103	---	---	---	220	32	550 L	80 L	45 L	A	241 max. HB; 100 max. HRB
ASTM A240/A240M-15a	Type 301L	S30103	---	---	---	220	32	550	80	45	SA	241 max. HBW; 100 max. HRBW
ASTM A666-15	Type 301L	S30103	---	---	---	220	32	550 L	80 L	45 L	A	241 max. HB; 100 max. HRB
JIS G 4304:2012	Symbol SUS301L	---	---	---	---	215	---	550	---	45	ST	207 max. HBW; 95 max. HRBW; 218 max. HV

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8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 4305:2012	Symbol SUS301L	---	---	---	---	215	---	550	---	45	ST	207 max. HBW; 95 max. HRBW; 218 max. HV
				---	---	345	---	690	---	40	T	---
				---	---	410	---	760	---	35	T	---
				---	---	480	---	820	---	25	T	---
				---	---	685	---	930	---	20	T	---
ASME SA-240/SA-240M	Type 301LN	S30153	---	---	---	240	35	550	80	45	Q+SA	241 max. HB; 100 max. HRB
ASME SA-666	Type 301LN	S30153	---	---	---	240	35	550 L	80 L	45 L	A	241 max. HB; 100 max. HRB
ASTM A240/A240M-15a	Type 301LN	S30153	---	---	---	240	35	550	80	45	SA	241 max. HBW; 100 max. HRBW
ASTM A666-15	Type 301LN	S30153	---	---	---	240	35	550 L	80 L	45 L	A	241 max. HB; 100 max. HRB
EN 10028-7:2007	X2CrNiN18-7	---	1.4318	$t \leq 3$	---	350	---	650-850	---	35 T	SA	see standard for impact data
				$t \leq 8$	---	350	---	650-850	---	40 T	SA	
				$t \leq 13.5$	---	330	---	650-850	---	40 T	SA	
				$t \leq 75$	---	330	---	650-850	---	40 T	SA	
EN 10088-2:2014	X2CrNiN18-7	---	1.4318	$t \leq 8$	---	350	---	650-850	---	40 T	SA	---
				$t \leq 13.5$	---	330	---	650-850	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	330	---	630-830	---	45 T	SA	
ISO 9328-7:2004	Grade X2CrNiN18-7	---	---	$t \leq 6$	---	350	---	650-850	---	40 T	SA	---
				$t \leq 12$	---	330	---	650-850	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	330	---	650-850	---	40 T	SA	
ASME SA-240/SA-240M	Type 302	S30200	---	---	---	205	30	515	75	40	Q+SA	201 max. HB; 92 max. HRB
ASME SA-666	Type 302	S30200	---	---	---	205	30	515 L	75 L	40 L	A	201 max. HB; 92 max. HRB
ASTM A240/A240M-15a	Type 302	S30200	---	---	---	205	30	515	75	40	SA	201 max. HBW; 92 max. HRBW
ASTM A666-15	Type 302	S30200	---	---	---	205	30	515 L	75 L	40 L	A	201 max. HB; 92 max. HRB
JIS G 4304:2012	Symbol SUS303	---	---	---	---	205	---	520	---	35	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 3280-92	Grade 1Cr18Ni9Si3	---	---	---	---	205	---	520	---	40	ST	207 max. HB; 95 max. HRB
GB 4237-92	Grade 1Cr18Ni9Si3	---	---	---	---	205	---	502	---	40	ST	207 max. HB; 95 max. HRB
GB 4238-92	Grade 1Cr18Ni9Si3	---	---	---	---	205	---	520	---	40	ST	207 max. HB; 95 max. HRB
GB 4239-91	Grade 1Cr18Ni9Si3	---	---	---	---	205	---	520	---	40	ST	95 max. HRB
JIS G 4304:2012	Symbol SUS302B	---	---	---	---	205	---	520	---	40	ST	207 max. HBW; 95 max. HRBW; 218 max. HV
JIS G 4305:2012	Symbol SUS302B	---	---	---	---	205	---	520	---	40	ST	207 max. HBW; 95 max. HRBW; 218 max. HV
ASME SA-240/SA-240M	Type 304	S30400	---	---	---	205	30	515	75	40	Q+SA	201 max. HB; 92 max. HRB
ASME SA-666	Type 304	S30400	---	---	---	205	30	515 L	75 L	40 L	A	201 max. HB; 92 max. HRB
ASTM A240/A240M-15a	Type 304	S30400	---	---	---	205	30	515	75	40	SA	201 max. HBW; 92 max. HRBW
ASTM A666-15	Type 304	S30400	---	---	---	205	30	515 L	75 L	40 L	A	201 max. HB; 92 max. HRB
EN 10028-7:2007	X5CrNi18-10	---	1.4301	$t \leq 8$	---	230	---	540-750	---	45 T	SA	see standard for impact data
				$t \leq 13.5$	---	210	---	520-720	---	45 T	SA	
				$t \leq 75$	---	210	---	520-720	---	45 T	SA	
EN 10088-2:2014	X5CrNi18-10	---	1.4301	$t \leq 8$	---	230	---	540-750	---	45 T	SA	---
				$t \leq 13.5$	---	210	---	520-720	---	45 T	SA	
				$t \leq 75$	---	210	---	520-720	---	45 T	SA	
GB 3280-92	Grade 0Cr18Ni9	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 0Cr18Ni9	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4238-92	Grade 0Cr18Ni9	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4239-91	Grade 0Cr18Ni9	---	---	---	---	205	---	520	---	40	ST	90 max. HRB
ISO 16143-1:2004	X5CrNi18-9	---	---	$t \leq 8$	---	230	---	540-740	---	45 T	SA	---
				$t \leq 13.5$	---	210	---	540-740	---	45 T	SA	---
				$t \leq 75$	---	210	---	520-720	---	45 T	SA	---
ISO 9328-7:2004	Grade X5CrNi18-9	---	---	$t \leq 6$	---	230	---	540-750	---	45 T	SA	---
				$t \leq 12$	---	210	---	520-720	---	45 T	SA	see standard for impact data
				$t \leq 75$	---	210	---	520-720	---	45 T	SA	

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8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 4304:2012	Symbol SUS304	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS304	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ISO 16143-1:2004	X6CrNiCu17-8-2	---	---	t ≤ 8	---	155	---	450	---	40 T	SA	---
				t ≤ 13.5	---	155	---	450	---	40 T	SA	---
				t ≤ 75	---	155	---	450	---	40 T	SA	---
JIS G 4304:2012	Symbol SUS304J1	---	---	---	---	155	---	450	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS304J1	---	---	---	---	155	---	450	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	Type 304L	S30403	---	---	---	170	25	485	70	40	Q+SA	201 max. HB; 92 max. HRB
ASME SA-666	Type 304L	S30403	---	---	---	170	25	485 L	70 L	40 L	A	201 max. HB; 92 max. HRB
ASTM A240/A240M-15a	Type 304L	S30403	---	---	---	170	25	485	70	40	SA	201 max. HBW; 92 max. HRBW
ASTM A666-15	Type 304L	S30403	---	---	---	170	25	485 L	70 L	40 L	A	201 max. HB; 92 max. HRB
EN 10028-7:2007	X2CrNi19-11	---	1.4306	t ≤ 8	---	220	---	520-670	---	45 T	SA	see standard for impact data
				t ≤ 13.5	---	200	---	520-670	---	45 T	SA	
				t ≤ 75	---	200	---	500-650	---	45 T	SA	
	X2CrNi18-9	---	1.4307	t ≤ 8	---	220	---	520-670	---	45 T	SA	see standard for impact data
				t ≤ 13.5	---	200	---	520-670	---	45 T	SA	
				t ≤ 75	---	200	---	500-650	---	45 T	SA	
EN 10088-2:2014	X2CrNi19-11	---	1.4306	t ≤ 8	---	220	---	520-700	---	45 T	SA	---
				t ≤ 13.5	---	200	---	520-700	---	45 T	SA	see standard for impact data
				t ≤ 75	---	200	---	500-700	---	45 T	SA	
	X2CrNi18-9	---	1.4307	t ≤ 8	---	220	---	520-700	---	45 T	SA	---
				t ≤ 13.5	---	200	---	520-700	---	45 T	SA	see standard for impact data
				t ≤ 75	---	200	---	500-700	---	45 T	SA	
GB 3280-92	Grade 00Cr19Ni10	---	---	---	---	177	---	480	---	40	ST	187 max. HB; 90 max. HRB
	Grade 00Cr19Ni13Mo3	---	---	---	---	177	---	480	---	40	ST	187 max. HB; 90 max. HRB

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8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 4237-92	Grade 00Cr19Ni10	---	---	---	---	177	---	480	---	40	ST	187 min. HB; 90 max. HRB
GB 4239-91	Grade 00Cr19Ni10	---	---	---	---	175	---	480	---	40	ST	90 max. HRB
ISO 16143-1:2004	X2CrNi18-9	---	---	$t \leq 8$	---	220	---	520-720	---	45 T	SA	---
				$t \leq 8$	---	175	---	480-680	---	45 T	SA	---
				$t \leq 13.5$	---	200	---	520-720	---	45 T	SA	---
				$t \leq 75$	---	200	---	500-700	---	45 T	SA	---
	X2CrNi19-11	---	---	$t \leq 8$	---	220	---	520-720	---	45 T	SA	---
				$t \leq 13.5$	---	200	---	520-720	---	45 T	SA	---
ISO 9328-7:2004	Grade X2CrNi18-9	---	---	$t \leq 6$	---	220	---	520-670	---	45 T	SA	---
				$t \leq 12$	---	200	---	520-670	---	45 T	SA	see standard for impact data
				$t \leq 75$	---	200	---	500-650	---	45 T	SA	
	Grade X2CrNi19-11	---	---	$t \leq 6$	---	220	---	520-670	---	45 T	SA	---
				$t \leq 12$	---	200	---	520-670	---	45 T	SA	see standard for impact data
				$t \leq 75$	---	200	---	500-650	---	45 T	SA	
JIS G 4304:2012	Symbol SUS304L	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS304L	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	Type 304H	S30409	---	---	---	205	30	515	75	40	Q+SA	201 max. HB; 92 max. HRB
ASTM A240/A240M-15a	Type 304H	S30409	---	---	---	205	30	515	75	40	SA	201 max. HBW; 92 max. HRBW
EN 10028-7:2007	X6CrNi18-10	---	1.4948	$t \leq 8$	---	230	---	530-740	---	45 T	SA	see standard for impact data
				$t \leq 13.5$	---	210	---	510-710	---	45 T	SA	
				$t \leq 75$	---	190	---	510-710	---	45 T	SA	
ISO 9328-7:2004	Grade X6CrNi18-10	---	---	$t \leq 6$	---	230	---	530-740	---	45 T	SA	---
				$t \leq 12$	---	210	---	510-710	---	45 T	SA	see standard for impact data
				$t \leq 75$	---	190	---	510-710	---	45 T	SA	
ISO 4955:2005	X7CrNi18-9	---	---	$0.5 \leq t < 3$	---	195	---	500-700	---	37 L, 37 T	SA	192 max. HB
				$1.5 \leq t \leq 25$	---	195	---	500-700	---	40	SA	192 max. HB
				$3 \leq t \leq 75$	---	195	---	500-700	---	40 L, 40 T	SA	192 max. HB
				$t \leq 100$	---	195	---	500-700	---	40	SA	192 max. HB
				$5 \leq t \leq 160$	---	195	---	500-700	---	40	SA	192 max. HB

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 304N	S30451	---	---	---	240	35	550	80	30	Q+SA	217 max. HB; 95 max. HRB
ASME SA-666	Type 304N	S30451	---	---	---	240	35	550 L	80 L	30 L	A	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 304N	S30451	---	---	---	240	35	550	80	30	SA	217 max. HBW; 95 max. HRBW
ASTM A666-15	Type 304N	S30451	---	---	---	240	35	550 L	80 L	30 L	A	217 max. HB; 95 max. HRB
EN 10028-7:2007	X5CrNiN19-9	---	1.4315	$t \leq 8$	---	290	---	550-750	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	270	---	550-750	---	40 T	SA	
				$t \leq 75$	---	270	---	550-750	---	40 T	SA	
EN 10088-2:2014	X5CrNiN19-9	---	1.4315	$t \leq 8$	---	290	---	500-750	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	270	---	500-750	---	40 T	SA	
				$t \leq 75$	---	270	---	500-750	---	40 T	SA	
GB 3280-92	Grade 0Cr19Ni9N	---	---	---	---	275	---	550	---	35	ST	217 max. HB; 95 max. HRB
GB 4237-92	Grade 0Cr19Ni9N	---	---	---	---	275	---	550	---	35	ST	217 max. HB; 95 max. HRB
GB 4239-91	Grade 0Cr19Ni9N	---	---	---	---	275	---	550	---	35	ST	95 max. HRB
ISO 9328-7:2004	Grade X5CrNiN18-8	---	---	$t \leq 6$	---	290	---	550-750	---	40 T	SA	see standard for impact data
				$t \leq 12$	---	270	---	550-750	---	40 T	SA	
				$t \leq 75$	---	270	---	550-750	---	40 T	SA	
JIS G 4304:2012	Symbol SUS304N1	---	---	---	---	275	---	550	---	35	ST	217 max. HBW; 95 max. HRBW; 220 max. HV
JIS G 4305:2012	Symbol SUS304N1	---	---	---	---	275	---	550	---	35	ST	217 max. HBW; 95 max. HRBW; 220 max. HV
GB 3280-92	Grade 0Cr19Ni10NbN	---	---	---	---	345	---	685	---	35	ST	250 max. HB; 100 max. HRB
GB 4237-92	Grade 0Cr19Ni10NbN	---	---	---	---	345	---	685	---	35	ST	250 max. HB; 100 max. HRB
GB 4239-91	Grade 0Cr19Ni10NbN	---	---	---	---	345	---	685	---	35	ST	100 max. HRB
JIS G 4304:2012	Symbol SUS304N2	---	---	---	---	345	---	690	---	35	ST	248 max. HBW; 100 max. HRBW; 260 max. HV
	Symbol SUS304N2-X	---	---	---	---	450	---	720	---	25	ST	230-325 HBW
JIS G 4305:2012	Symbol SUS304N2	---	---	---	---	345	---	690	---	35	ST	248 max. HBW; 100 max. HRBW; 260 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 304LN	S30453	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASME SA-666	Type 304LN	S30453	---	---	---	205	30	515 L	75 L	40 L	A	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 304LN	S30453	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
ASTM A666-15	Type 304LN	S30453	---	---	---	205	30	515 L	75 L	40 L	A	217 max. HB; 95 max. HRB
EN 10028-7:2007	X2CrNiN18-10	---	1.4311	$t \leq 8$	---	290	---	550-750	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	270	---	550-750	---	40 T	SA	
				$t \leq 75$	---	270	---	550-750	---	40 T	SA	
EN 10088-2:2014	X2CrNiN18-10	---	1.4311	$t \leq 8$	---	290	---	550-750	---	40 T	SA	--- see standard for impact data
				$t \leq 13.5$	---	270	---	550-750	---	40 T	SA	
				$t \leq 75$	---	270	---	550-750	---	40 T	SA	
GB 3280-92	Grade 00Cr18Ni10N	---	---	---	---	245	---	550	---	40	ST	217 max. HB; 95 max. HRB
GB 4237-92	Grade 00Cr18Ni10N	---	---	---	---	245	---	550	---	40	ST	217 max. HB; 95 max. HRB
GB 4239-91	Grade 00Cr18Ni10N	---	---	---	---	245	---	550	---	40	ST	95 max. HRB
ISO 16143-1:2004	X2CrNiN18-9	---	---	$t \leq 8$	---	290	---	550-750	---	40 T	SA	---
				$t \leq 13.5$	---	270	---	550-750	---	40 T	SA	---
				$t \leq 75$	---	270	---	530-730	---	40 T	SA	---
ISO 9328-7:2004	Grade X2CrNiN18-10	---	---	$t \leq 6$	---	290	---	550-750	---	40 T	SA	--- see standard for impact data
				$t \leq 12$	---	270	---	550-750	---	40 T	SA	
				$t \leq 75$	---	270	---	550-750	---	40 T	SA	
JIS G 4304:2012	Symbol SUS304LN	---	---	---	---	245	---	550	---	40	ST	217 max. HBW; 95 max. HRBW; 220 max. HV
JIS G 4305:2012	Symbol SUS304LN	---	---	---	---	245	---	550	---	40	ST	217 max. HBW; 95 max. HRBW; 220 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 305	S30500	---	---	---	170	25	485	70	40	Q+SA	183 max. HB; 88 max. HRB
ASTM A240/A240M-15a	Type 305	S30500	---	---	---	170	25	485	70	40	SA	183 max. HBW; 88 max. HRBW
EN 10088-2:2014	X4CrNi18-12	---	1.4303	$t \leq 8$	---	220	---	500-650	---	45 T	SA	---
GB 3280-92	Grade 1Cr18Ni12	---	---	---	---	177	---	480	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 1Cr18Ni12	---	---	---	---	177	---	480	---	40	ST	187 max. HB; 90 max. HRB
GB 4239-91	Grade 1Cr18Ni12	---	---	---	---	175	---	480	---	40	ST	90 max. HRB
JIS G 4304:2012	Symbol SUS305	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS305	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	---	S30600	---	---	---	240	35	540	78	40	Q+SA	---
ASTM A240/A240M-15a	---	S30600	---	---	---	240	35	540	78	40	SA	---
EN 10088-2:2014	X1CrNiSi18-15-4	---	1.4361	$t \leq 75$	---	220	---	530-730	---	40 T	SA	see standard for impact data
GB 4238-92	Grade 2Cr23Ni13	---	---	---	---	205	---	560	---	40	ST	201 max. HB; 95 max. HRB
JIS G 4312:2011	Symbol SUH309	---	---	---	---	205	---	560	---	40	ST	201 max. HBW; 95 max. HRBW; 210 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 309S	S30908	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 309S	S30908	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
EN 10095:1999	X12CrNi23-13	---	1.4833	$0.5 \leq t < 3$	---	210	---	500-700	---	33 L, 33 T	SA	192 max. HB
				$t \leq 25$	---	210	---	500-700 L	---	35 L	SA	192 max. HB
				$3 \leq t \leq 75$	---	210	---	500-700	---	35 L, 35 T	SA	192 max. HB
				$t \leq 160$	---	210	---	500-700 L	---	35 L	SA	192 max. HB
GB 3280-92	Grade 0Cr23Ni13	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 0Cr23Ni13	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4238-92	Grade 0Cr23Ni13	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4239-91	Grade 0Cr23Ni13	---	---	---	---	205	---	520	---	40	ST	90 max. HRB
ISO 4955:2005	X12CrNi23-13	---	---	$0.5 \leq t < 3$	---	210	---	---	---	33 L, 33 T	SA	192 max. HB
				$1.5 \leq t \leq 25$	---	210	---	---	---	35	SA	192 max. HB
				$3 \leq t \leq 75$	---	210	---	---	---	35 L, 35 T	SA	192 max. HB
				$t \leq 100$	---	210	---	---	---	35	SA	192 max. HB
				$5 \leq t \leq 160$	---	210	---	---	---	35	SA	192 max. HB
JIS G 4304:2012	Symbol SUS309S	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS309S	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	Type 309H	S30909	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 309H	S30909	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
EN 10028-7:2007	X6CrNi23-13	---	1.4950	$t \leq 8$	---	220	---	530-730	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	200	---	510-710	---	35 T	SA	
				$t \leq 75$	---	200	---	510-710	---	35 T	SA	
ISO 9328-7:2004	Grade X6CrNi23-13	---	---	$t \leq 6$	---	220	---	530-730	---	35 T	SA	--- see standard for impact data
				$t \leq 12$	---	200	---	510-710	---	35 T	SA	
				$t \leq 75$	---	200	---	510-710	---	35 T	SA	

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 4238-92	Grade 1Cr25Ni20Si2	---	---	---	---	---	---	540	---	35	ST	---
	Grade 2Cr25Ni20	---	---	---	---	205	---	590	---	35	ST	201 max. HB; 95 max. HRB
JIS G 4312:2011	Symbol SUH310	---	---	---	---	205	---	590	---	35	ST	201 max. HBW; 95 max. HRBW; 210 max. HV
EN 10095:1999	X15CrNiSi25-21	---	1.4841	$0.5 \leq t < 3$	---	230	---	550-750	---	28 L, 28 T	SA	223 max. HB
				$t \leq 25$	---	230	---	550-750 L	---	30 L	SA	223 max. HB
				$3 \leq t \leq 75$	---	230	---	550-750	---	30 L, 30 T	SA	223 max. HB
				$t \leq 160$	---	230	---	550-750 L	---	30 L	SA	223 max. HB
ASME SA-240/SA-240M	Type 310S	S31008	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 310S	S31008	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
EN 10095:1999	X8CrNi25-21	---	1.4845	$0.5 \leq t < 3$	---	210	---	500-700	---	33 L, 33 T	SA	192 max. HB
				$t \leq 25$	---	210	---	500-700 L	---	35 L	SA	192 max. HB
				$3 \leq t \leq 75$	---	210	---	500-700	---	35 L, 35 T	SA	192 max. HB
				$t \leq 160$	---	210	---	500-700 L	---	35 L	SA	192 max. HB
GB 3280-92	Grade 0Cr25Ni20	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 0Cr25Ni20	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4238-92	Grade 0Cr25Ni20	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4239-91	Grade 0Cr25Ni20	---	---	---	---	205	---	520	---	40	ST	90 max. HRB
ISO 4955:2005	X8CrNi25-21	---	---	$0.5 \leq t < 3$	---	210	---	---	---	33 L, 33 T	SA	192 max. HB
				$1.5 \leq t \leq 25$	---	210	---	---	---	35	SA	192 max. HB
				$3 \leq t \leq 75$	---	210	---	---	---	35 L, 35 T	SA	192 max. HB
				$t \leq 100$	---	210	---	---	---	35	SA	192 max. HB
				$5 \leq t \leq 160$	---	210	---	---	---	35	SA	192 max. HB
JIS G 4304:2012	Symbol SUS310S	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS310S	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 310H	S31009	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 310H	S31009	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
EN 10028-7:2007	X6CrNi25-20	---	1.4951	$t \leq 8$	---	220	---	530-730	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	200	---	510-710	---	35 T	SA	
				$t \leq 75$	---	200	---	510-710	---	35 T	SA	
ISO 9328-7:2004	Grade X6CrNi25-20	---	---	$t \leq 6$	---	220	---	530-730	---	35 T	SA	---
				$t \leq 12$	---	200	---	510-710	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	200	---	510-710	---	35 T	SA	
ASME SA-240/SA-240M	Type 310 MoLN	S31050	---	---	$t \leq 0.25$	270	39	580	84	25	Q+SA	217 max. HB; 95 max. HRB
				---	$t > 0.25$	255	37	540	78	25	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 310 MoLN	S31050	---	---	$t \leq 0.25$	270	39	580	84	25	SA	217 max. HBW; 95 max. HRBW
				---	$t > 0.25$	255	37	540	78	25	SA	217 max. HBW; 95 max. HRBW
EN 10028-7:2007	X1CrNiMoN25-22-2	---	1.4466	$t \leq 75$	---	250	---	540-740	---	40 T	SA	see standard for impact data
EN 10088-2:2014	X1CrNiMoN25-22-2	---	1.4466	$t \leq 75$	---	250	---	540-740	---	40 T	SA	see standard for impact data
ISO 16143-1:2004	X1CrNiMoN25-22-2	---	---	$t \leq 75$	---	250	---	540-740	---	40 T	SA	---
ISO 9328-7:2004	Grade X1CrNiMoN25-22-2	---	---	$t \leq 75$	---	250	---	540-740	---	40 T	SA	see standard for impact data

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	---	S31254	---	---	---	310	45	690	100	35	Q+SA	223 max. HB; 96 max. HRB
				---	---	310	45	655	95	35	Q+SA	223 max. HB; 96 max. HRB
ASTM A240/A240M-15a	---	S31254	---	---	---	310	45	690	100	35	SA	223 max. HBW; 96 max. HRBW
				---	---	310	45	655	95	35	SA	223 max. HBW; 96 max. HRBW
EN 10028-7:2007	X1CrNiMoCuN20-18-7	---	1.4547	$t \leq 8$	---	320	---	650-850	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	300	---	650-850	---	35 T	SA	
				$t \leq 75$	---	300	---	650-850	---	40 T	SA	
EN 10088-2:2014	X1CrNiMoCuN20-18-7	---	1.4547	$t \leq 8$	---	320	---	650-850	---	35 T	SA	---
				$t \leq 13.5$	---	300	---	650-850	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	300	---	650-850	---	40 T	SA	
ISO 9328-7:2004	Grade X1CrNiMoCuN20-18-7	---	---	$t \leq 6$	---	320	---	650-850	---	35 T	SA	---
				$t \leq 12$	---	300	---	650-850	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	300	---	650-850	---	40 T	SA	
JIS G 4304:2012	Symbol SUS312L	---	---	---	---	300	---	650	---	35	ST	223 max. HBW; 96 max. HRBW; 230 max. HV
JIS G 4305:2012	Symbol SUS312L	---	---	---	---	300	---	650	---	35	ST	223 max. HBW; 96 max. HRBW; 230 max. HV
ASME SA-240/SA-240M	Type 316	S31600	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASME SA-666	Type 316	S31600	---	---	---	205	30	515 L	75 L	40 L	A	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 316	S31600	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
ASTM A666-15	Type 316	S31600	---	---	---	205	30	515 L	75 L	40 L	A	217 max. HB; 95 max. HRB
EN 10028-7:2007	X5CrNiMo17-12-2	---	1.4401	$t \leq 8$	---	240	---	530-680	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	530-680	---	40 T	SA	
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
	X3CrNiMo17-13-3	---	1.4436	$t \leq 8$	---	240	---	550-700	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	550-700	---	40 T	SA	
				$t \leq 75$	---	220	---	530-730	---	40 T	SA	

Note: This section continued on next page

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-2:2014	X5CrNiMo17-12-2	---	1.4401	$t \leq 8$	---	240	---	530-680	---	40 T	SA	---
				$t \leq 13.5$	---	220	---	530-680	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
	X3CrNiMo17-13-3	---	1.4436	$t \leq 8$	---	240	---	550-700	---	40 T	SA	---
				$t \leq 13.5$	---	220	---	550-700	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	220	---	530-730	---	40 T	SA	
GB 3280-92	Grade 0Cr17Ni12Mo2	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 0Cr17Ni12Mo2	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4238-92	Grade 0Cr17Ni12Mo2	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4239-91	Grade 0Cr17Ni12Mo2	---	---	---	---	205	---	520	---	40	ST	90 max. HRB
ISO 16143-1:2004	X5CrNiMo17-12-2	---	---	$t \leq 8$	---	240	---	530-730	---	40 T	SA	---
				$t \leq 8$	---	205	---	520-720	---	40 T	SA	---
				$t \leq 13.5$	---	220	---	530-730	---	40 T	SA	---
				$t \leq 75$	---	220	---	510-710	---	40 T	SA	---
	X3CrNiMo17-12-3	---	---	$t \leq 8$	---	240	---	530-730	---	40 T	SA	---
				$t \leq 13.5$	---	220	---	530-730	---	40 T	SA	---
				$t \leq 75$	---	220	---	510-710	---	40 T	SA	---
				$t \leq 6$	---	240	---	550-700	---	40 T	SA	---
ISO 9328-7:2004	Grade X3CrNiMo17-12-3	---	---	$t \leq 12$	---	220	---	550-700	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	220	---	530-730	---	40 T	SA	
				$t \leq 6$	---	240	---	530-680	---	40 T	SA	---
	Grade X5CrNiMo17-12-2	---	---	$t \leq 12$	---	220	---	530-680	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
				$t \leq 6$	---	240	---	530-680	---	40 T	SA	---
JIS G 4304:2012	Symbol SUS316	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS316	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 316L	S31603	---	---	---	170	25	485	70	40	Q+SA	217 max. HB; 95 max. HRB
ASME SA-666	Type 316L	S31603	---	---	---	170	25	485 L	70 L	40 L	A	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 316L	S31603	---	---	---	170	25	485	70	40	SA	217 max. HBW; 95 max. HRBW
ASTM A666-15	Type 316L	S31603	---	---	---	170	25	485 L	70 L	40 L	A	217 max. HB; 95 max. HRB
EN 10028-7:2007	X2CrNiMo17-12-2	---	1.4404	$t \leq 8$	---	240	---	530-680	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	530-680	---	40 T	SA	
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
	X2CrNiMo17-12-3	---	1.4432	$t \leq 8$	---	240	---	550-700	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	550-700	---	40 T	SA	
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
	X2CrNiMo18-14-3	---	1.4435	$t \leq 8$	---	240	---	550-700	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	550-700	---	40 T	SA	
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
EN 10088-2:2014	X2CrNiMo17-12-2	---	1.4404	$t \leq 8$	---	240	---	530-680	---	40 T	SA	---
				$t \leq 13.5$	---	220	---	530-680	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
	X2CrNiMo17-12-3	---	1.4432	$t \leq 8$	---	240	---	550-700	---	40 T	SA	---
				$t \leq 13.5$	---	220	---	550-700	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
	X2CrNiMo18-14-3	---	1.4435	$t \leq 8$	---	240	---	550-700	---	40 T	SA	---
				$t \leq 13.5$	---	220	---	550-700	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	220	---	520-670	---	45 T	SA	
GB 3280-92	Grade 00Cr17Ni14Mo2	---	---	---	---	177	---	480	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 00Cr17Ni14Mo2	---	---	---	---	177	---	480	---	40	ST	187 max. HB; 90 max. HRB
GB 4239-91	Grade 00Cr17Ni14Mo2	---	---	---	---	175	---	480	---	40	ST	90 max. HRB

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8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ISO 16143-1:2004	X2CrNiMo17-12-2	---	---	t ≤ 8	---	240	---	530-730	---	40 T	SA	---
				t ≤ 8	---	175	---	480-680	---	40 T	SA	---
				t ≤ 13.5	---	220	---	530-730	---	40 T	SA	---
				t ≤ 75	---	220	---	510-710	---	40 T	SA	---
	X2CrNiMo17-12-3	---	---	t ≤ 8	---	240	---	530-730	---	40 T	SA	---
				t ≤ 13.5	---	220	---	530-730	---	40 T	SA	---
				t ≤ 75	---	220	---	510-710	---	40 T	SA	---
	X2CrNiMo18-14-3	---	---	t ≤ 6	---	240	---	550-750	---	40 T	SA	---
				t ≤ 12	---	220	---	550-750	---	40 T	SA	---
				t ≤ 75	---	220	---	520-720	---	45 T	SA	---
ISO 9328-7:2004	Grade X2CrNiMo17-12-2	---	---	t ≤ 6	---	240	---	530-680	---	40 T	SA	---
				t ≤ 12	---	220	---	530-680	---	40 T	SA	see standard for impact data
				t ≤ 75	---	220	---	520-670	---	45 T	SA	
	Grade X2CrNiMo17-12-3	---	---	t ≤ 6	---	240	---	550-700	---	40 T	SA	---
				t ≤ 12	---	220	---	550-700	---	40 T	SA	see standard for impact data
				t ≤ 75	---	220	---	520-670	---	45 T	SA	
	Grade X2CrNiMo18-14-3	---	---	t ≤ 6	---	240	---	550-700	---	40 T	SA	---
				t ≤ 12	---	220	---	550-700	---	40 T	SA	see standard for impact data
				t ≤ 75	---	220	---	520-670	---	45 T	SA	
JIS G 4304:2012	Symbol SUS316L	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS316L	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
GB 4237-92	Grade 00Cr18Ni12Mo2Cu2	---	---	---	---	177	---	480	---	35	ST	187 max. HB; 90 max. HRB
GB 4239-91	Grade 00Cr18Ni14Mo2Cu2	---	---	---	---	175	---	480	---	40	ST	90 max. HRB
JIS G 4304:2012	Symbol SUS316J1L	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS316J1L	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
GB 3280-92	Grade 0Cr18Ni12Mo2Cu2	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 0Cr18Ni12Mo2Cu2	---	---	---	---	205	---	520	---	35	ST	187 max. HB; 90 max. HRB
GB 4239-91	Grade 0Cr18Ni12Mo2Cu2	---	---	---	---	205	---	520	---	40	ST	90 max. HRB

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8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 4304:2012	Symbol SUS316J1	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS316J1	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	Type 316Ti	S31635	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 316Ti	S31635	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
EN 10028-7:2007	X6CrNiMoTi17-12-2	---	1.4571	$t \leq 8$	---	240	---	540-690	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	540-690	---	40 T	SA	
				$t \leq 75$	---	220	---	520-670	---	40 T	SA	
EN 10088-2:2014	X6CrNiMoTi17-12-2	---	1.4571	$t \leq 8$	---	240	---	540-690	---	40 T	SA	---
				$t \leq 13.5$	---	220	---	540-690	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	220	---	520-670	---	40 T	SA	
GB 3280-92	Grade 0Cr18Ni12Mo2Ti	---	---	---	---	205	---	530	---	35	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 0Cr18Ni12Mo2Ti	---	---	---	---	205	---	530	---	37	ST	187 max. HB; 90 max. HRB
ISO 16143-1:2004	X6CrNiMoTi17-12-2	---	---	$t \leq 8$	---	240	---	530-730	---	40 T	SA	---
				$t \leq 13.5$	---	220	---	530-730	---	40 T	SA	---
				$t \leq 75$	---	220	---	510-710	---	40 T	SA	---
ISO 9328-7:2004	Grade X6CrNiMoTi17-12-2	---	---	$t \leq 6$	---	240	---	540-690	---	40 T	SA	---
				$t \leq 12$	---	220	---	540-690	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	220	---	520-670	---	40 T	SA	
JIS G 4304:2012	Symbol SUS316Ti	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS316Ti	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	Type 316Cb	S31640	---	---	---	205	30	515	75	30	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 316Cb	S31640	---	---	---	205	30	515	75	30	SA	217 max. HBW; 95 max. HRBW
EN 10028-7:2007	X6CrNiMoNb17-12-2	---	1.4580	$t \leq 75$	---	220	---	520-720	---	40 T	SA	see standard for impact data
EN 10088-2:2014	X6CrNiMoNb17-12-2	---	1.4580	$t \leq 75$	---	220	---	520-720	---	40 T	SA	see standard for impact data
ISO 9328-7:2004	Grade X6CrNiMoNb17-12-2	---	---	$t \leq 75$	---	220	---	520-720	---	40 T	SA	see standard for impact data

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 316N	S31651	---	---	---	240	35	550	80	35	Q+SA	217 max. HB; 95 max. HRB
ASME SA-666	Type 316N	S31651	---	---	---	240	35	550 L	80 L	35 L	A	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 316N	S31651	---	---	---	240	35	550	80	35	SA	217 max. HBW; 95 max. HRBW
ASTM A666-15	Type 316N	S31651	---	---	---	240	35	550 L	80 L	35 L	A	217 max. HB; 95 max. HRB
GB 3280-92	Grade 0Cr17Ni12Mo2N	---	---	---	---	275	---	550	---	35	ST	217 max. HB; 95 max. HRB
GB 4237-92	Grade 0Cr17Ni12Mo2N	---	---	---	---	275	---	550	---	35	ST	217 max. HB; 95 max. HRB
GB 4239-91	Grade 0Cr17Ni12Mo2N	---	---	---	---	275	---	550	---	35	ST	95 max. HRB
JIS G 4304:2012	Symbol SUS316N	---	---	---	---	275	---	550	---	35	ST	217 max. HBW; 95 max. HRBW; 220 max. HV
JIS G 4305:2012	Symbol SUS316N	---	---	---	---	275	---	550	---	35	ST	217 max. HBW; 95 max. HRBW; 220 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 316LN	S31653	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 316LN	S31653	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
EN 10028-7:2007	X2CrNiMoN17-11-2	---	1.4406	$t \leq 8$	---	300	---	580-780	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	280	---	580-780	---	40 T	SA	
				$t \leq 75$	---	280	---	580-780	---	40 T	SA	
	X2CrNiMoN17-13-3	---	1.4429	$t \leq 8$	---	300	---	580-780	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	280	---	580-780	---	35 T	SA	
				$t \leq 75$	---	280	---	580-780	---	40 T	SA	
EN 10088-2:2014	X2CrNiMoN17-11-2	---	1.4406	$t \leq 8$	---	300	---	580-780	---	40 T	SA	---
				$t \leq 13.5$	---	280	---	580-780	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	280	---	580-780	---	40 T	SA	
	X2CrNiMoN17-13-3	---	1.4429	$t \leq 8$	---	300	---	580-780	---	35 T	SA	---
				$t \leq 13.5$	---	280	---	580-780	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	280	---	580-780	---	40 T	SA	
GB 3280-92	Grade 00Cr17Ni13Mo2N	---	---	---	---	245	---	550	---	40	ST	217 max. HB; 95 max. HRB
GB 4237-92	Grade 00Cr17Ni13Mo2N	---	---	---	---	245	---	550	---	40	ST	217 max. HB; 95 max. HRB
GB 4239-91	Grade 00Cr17Ni13Mo2N	---	---	---	---	245	---	550	---	40	ST	95 max. HRB
ISO 16143-1:2004	X2CrNiMoN17-12-3	---	---	$t \leq 8$	---	300	---	580-780	---	35 T	SA	---
				$t \leq 13.5$	---	280	---	580-780	---	35 T	SA	---
				$t \leq 75$	---	280	---	580-780	---	40 T	SA	---
ISO 9328-7:2004	Grade X2CrNiMoN17-11-2	---	---	$t \leq 6$	---	300	---	580-780	---	40 T	SA	---
				$t \leq 12$	---	280	---	580-780	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	280	---	580-780	---	40 T	SA	
	Grade X2CrNiMoN17-13-3	---	---	$t \leq 6$	---	300	---	580-780	---	35 T	SA	---
				$t \leq 12$	---	280	---	580-780	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	280	---	580-780	---	40 T	SA	
JIS G 4304:2012	Symbol SUS316LN	---	---	---	---	245	---	550	---	40	ST	217 max. HBW; 95 max. HRBW; 220 max. HV
JIS G 4305:2012	Symbol SUS316LN	---	---	---	---	245	---	550	---	40	ST	217 max. HBW; 95 max. HRBW; 220 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 317	S31700	---	---	---	205	30	515	75	35	SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 317	S31700	---	---	---	205	30	515	75	35	SA	217 max. HBW; 95 max. HRBW
GB 3280-92	Grade 0Cr19Ni13Mo3	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 0Cr19Ni13Mo3	---	---	---	---	205	---	520	---	35	ST	187 max. HB; 90 max. HRB
GB 4238-92	Grade 0Cr19Ni13Mo3	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4239-91	Grade 0Cr19Ni13Mo3	---	---	---	---	205	---	520	---	40	ST	90 max. HRB
JIS G 4304:2012	Symbol SUS317	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS317	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
GB 3280-92	Grade 0Cr18Ni16Mo5	---	---	---	---	177	---	480	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 0Cr18Ni16Mo5	---	---	---	---	177	---	480	---	35	ST	187 max. HB; 90 max. HRB
GB 4239-91	Grade 0Cr18Ni16Mo5	---	---	---	---	175	---	480	---	40	ST	90 max. HRB
JIS G 4304:2012	Symbol SUS317J1	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS317J1	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	Type 317L	S31703	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 317L	S31703	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
EN 10028-7:2007	X2CrNiMo18-15-4	---	1.4438	$t \leq 8$	---	240	---	550-700	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	550-700	---	35 T	SA	
				$t \leq 75$	---	220	---	520-720	---	40 T	SA	
EN 10088-2:2014	X2CrNiMo18-15-4	---	1.4438	$t \leq 8$	---	240	---	550-700	---	35 T	SA	--- see standard for impact data
				$t \leq 13.5$	---	220	---	550-700	---	35 T	SA	
				$t \leq 75$	---	220	---	520-720	---	40 T	SA	
GB 4237-92	Grade 00Cr19Ni13Mo3	---	---	---	---	177	---	480	---	35	ST	187 max. HB; 90 max. HRB
GB 4239-91	Grade 00Cr19Ni13Mo3	---	---	---	---	175	---	480	---	40	ST	90 max. HRB

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8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ISO 9328-7:2004	Grade X2CrNiMo18-15-4	---	---	$t \leq 6$	---	240	---	550-700	---	35 T	SA	---
				$t \leq 12$	---	220	---	550-700	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	220	---	520-720	---	40 T	SA	
JIS G 4304:2012	Symbol SUS317L	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS317L	---	---	---	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-240/SA-240M	Type 317LMN	S31726	---	---	---	240	35	550	80	40	Q+SA	223 max. HB; 96 max. HRB
ASTM A240/A240M-15a	Type 317LMN	S31726	---	---	---	240	35	550	80	40	SA	223 max. HBW; 96 max. HRBW
EN 10028-7:2007	X2CrNiMoN17-13-5	---	1.4439	$t \leq 8$	---	290	---	580-780	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	270	---	580-780	---	35 T	SA	
				$t \leq 75$	---	270	---	580-780	---	40 T	SA	
EN 10088-2:2014	X2CrNiMoN17-13-5	---	1.4439	$t \leq 8$	---	290	---	580-780	---	35 T	SA	---
				$t \leq 13.5$	---	270	---	580-780	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	270	---	580-780	---	40 T	SA	
ISO 9328-7:2004	Grade X2CrNiMoN17-13-5	---	---	$t \leq 6$	---	290	---	580-780	---	35 T	SA	---
				$t \leq 12$	---	270	---	580-780	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	270	---	580-780	---	40 T	SA	see standard for impact data
ASME SA-240/SA-240M	Type 317LN	S31753	---	---	---	240	35	550	80	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 317LN	S31753	---	---	---	240	35	550	80	40	SA	217 max. HBW; 95 max. HRBW
EN 10028-7:2007	X2CrNiMoN18-12-4	---	1.4434	$t \leq 8$	---	290	---	570-770	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	270	---	570-770	---	35 T	SA	
				$t \leq 75$	---	270	---	540-740	---	40 T	SA	
EN 10088-2:2014	X2CrNiMoN18-12-4	---	1.4434	$t \leq 8$	---	290	---	570-770	---	35 T	SA	---
				$t \leq 13.5$	---	270	---	570-770	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	270	---	540-740	---	40 T	SA	
ISO 9328-7:2004	Grade X2CrNiMoN18-12-4	---	---	$t \leq 6$	---	290	---	570-770	---	35 T	SA	---
				$t \leq 12$	---	270	---	570-770	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	270	---	540-740	---	40 T	SA	

Note: This section continued on next page

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 4304:2012	Symbol SUS317LN	---	---	---	---	245	---	550	---	40	ST	217 max. HBW; 95 max. HRBW; 220 max. HV
JIS G 4305:2012	Symbol SUS317LN	---	---	---	---	245	---	550	---	40	ST	217 max. HBW; 95 max. HRBW; 220 max. HV
ASME SA-240/SA-240M	Type 321	S32100	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 321	S32100	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
EN 10028-7:2007	X6CrNiTi18-10	---	1.4541	$t \leq 8$	---	220	---	520-720	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	200	---	520-720	---	40 T	SA	
				$t \leq 75$	---	200	---	500-700	---	40 T	SA	
EN 10088-2:2014	X6CrNiTi18-10	---	1.4541	$t \leq 8$	---	220	---	520-720	---	40 T	SA	---
				$t \leq 13.5$	---	200	---	520-720	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	200	---	500-700	---	40 T	SA	
GB 3280-92	Grade 0Cr18Ni10Ti	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 0Cr18Ni10Ti	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4238-92	Grade 0Cr18Ni10Ti	---	---	---	---	205 max.	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4239-91	Grade 0Cr18Ni10Ti	---	---	---	---	205	---	520	---	40	ST	90 max. HRB
ISO 16143-1:2004	X6CrNiTi18-10	---	---	$t \leq 8$	---	220	---	520-720	---	40 T	SA	---
				$t \leq 13.5$	---	200	---	520-720	---	40 T	SA	---
				$t \leq 75$	---	200	---	500-700	---	40 T	SA	---
ISO 9328-7:2004	Grade X6CrNiTi18-10	---	---	$t \leq 6$	---	220	---	520-720	---	40 T	SA	---
				$t \leq 12$	---	200	---	520-720	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	200	---	500-700	---	40 T	SA	
JIS G 4304:2012	Symbol SUS321	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS321	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 321H	S32109	---	---	---	205	30	515	75	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	Type 321H	S32109	---	---	---	205	30	515	75	40	SA	217 max. HBW; 95 max. HRBW
GB 3280-92	Grade 1Cr18Ni9	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 1Cr18Ni9	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4239-91	Grade 1Cr18Ni9	---	---	---	---	205	---	520	---	40	ST	90 max. HRB
				---	---	---	---	785	---	20	WH	90 max. HRB
				---	---	---	---	980	---	10	WH	90 max. HRB
				---	---	---	---	1130	---	5	WH	90 max. HRB
ISO 4955:2005	X7CrNiTi18-10	---	---	$0.5 \leq t < 3$	---	190	---	510-710	---	40 L, 40 T	SA	215 max. HB
				$1.5 \leq t \leq 25$	---	190	---	510-710	---	40	SA	215 max. HB
				$3 \leq t \leq 75$	---	190	---	510-710	---	40 L, 40 T	SA	215 max. HB
				$t \leq 100$	---	190	---	510-710	---	40	SA	215 max. HB
				$5 \leq t \leq 160$	---	190	---	510-710	---	40	SA	215 max. HB
EN 10095:1999	X12NiCrSi35-16	---	1.4864	$0.5 \leq t < 3$	---	230	---	550-750	---	28 L, 28 T	SA	223 max. HB
				$t \leq 25$	---	230	---	550-750 L	---	30 L	SA	223 max. HB
				$3 \leq t \leq 75$	---	230	---	550-750	---	30 L, 30 T	SA	223 max. HB
				$t \leq 160$	---	230	---	550-750 L	---	30 L	SA	223 max. HB
GB 4238-92	Grade 1Cr16Ni35	---	---	---	---	205	---	560	---	35	ST	201 max. HB; 95 max. HRB
JIS G 4312:2011	Symbol SUH330	---	---	---	---	205	---	560	---	35	ST	201 max. HBW; 95 max. HRBW; 210 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-2:2014	X2CrMoTi17-1	---	1.4513	$t \leq 8$	---	200	---	400-550	---	23 L, 23 T	A	---
GB 3280-92	Grade 00Cr17Mo	---	---	---	---	245	---	410	---	20	A	217 max. HB; 96 max. HRB
GB 4237-92	Grade 00Cr17Mo	---	---	---	---	245	---	410	---	20	A	217 max. HB; 96 max. HRB
GB 4239-91	Grade 00Cr17Mo	---	---	---	---	245	---	410	---	20	A	96 max. HRB
JIS G 4304:2012	Symbol SUS436L	---	---	---	---	245	---	410	---	20	A	217 max. HBW; 96 max. HRBW; 230 max. HV
JIS G 4305:2012	Symbol SUS436L	---	---	---	---	245	---	410	---	20	A	217 max. HBW; 96 max. HRBW; 230 max. HV
ASME SA-240/SA-240M	Type 347	S34700	---	---	---	205	30	515	75	40	Q+SA	201 max. HB; 92 max. HRB
ASTM A240/A240M-15	Type 347	S34700	---	---	---	205	30	515	75	40	SA	201 max. HBW; 92 max. HRBW
EN 10028-7:2007	X6CrNiNb18-10	---	1.4550	$t \leq 13.5$	---	200	---	520-720	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	200	---	500-700	---	40 T	SA	
EN 10088-2:2014	X6CrNiNb18-10	---	1.4550	$t \leq 8$	---	220	---	520-720	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	200	---	520-720	---	40 T	SA	
				$t \leq 75$	---	200	---	500-700	---	40 T	SA	
GB 3280-92	Grade 0Cr18Ni11Nb	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 0Cr18Ni11Nb	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4238-92	Grade 0Cr18Ni11Nb	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4239-91	Grade 0Cr18Ni11Nb	---	---	---	---	205	---	520	---	40	ST	90 max. HRB
ISO 16143-1:2004	X6CrNiNb18-10	---	---	$t \leq 8$	---	220	---	520-720	---	40 T	SA	---
				$t \leq 13.5$	---	200	---	520-720	---	40 T	SA	---
				$t \leq 75$	---	200	---	500-700	---	40 T	SA	---
ISO 9328-7:2004	Grade X6CrNiNb18-10	---	---	$t \leq 75$	---	200	---	500-700	---	40 T	SA	see standard for impact data
JIS G 4304:2012	Symbol SUS347	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS347	---	---	---	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
EN 10088-2:2014	X11CrNiMnN19-8-6	---	1.4369	$t \leq 4$	---	340	---	750-950	---	35 T	SA	---
EN 10151:2002	X11CrNiMnN19-8-6	---	1.4369	$0.05 \leq t \leq 1.00$	---	---	---	700-1700	---	---	CW	300-475 HV
ISO 16143-1:2004	X11CrNiMnN19-8-6	---	---	$t \leq 4$	---	340	---	750-950	---	35 T	SA	---

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10028-7:2007	X6CrNiTiB18-10	---	1.4941	$t \leq 8$	---	220	---	510-710	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	200	---	510-710	---	40 T	SA	
				$t \leq 75$	---	200	---	490-690	---	40 T	SA	
EN 10302:2008	X6CrNiTiB18-10	---	1.4941	---	---	195	---	490-680	---	35	SA	---
ISO 9328-7:2004	Grade X6CrNiTiB18-10	---	---	$t \leq 6$	---	220	---	510-710	---	40 T	SA	see standard for impact data
				$t \leq 12$	---	200	---	510-710	---	40 T	SA	
				$t \leq 75$	---	200	---	490-690	---	40 T	SA	
GB 3280-92	Grade 0Cr18Ni13Si4	---	---	---	---	205	---	520	---	40	ST	207 max. HB; 95 max. HRB
GB 4237-92	Grade 0Cr18Ni13Si4	---	---	---	---	205	---	520	---	40	ST	207 max. HB; 95 max. HRB
GB 4238-92	Grade 0Cr18Ni13Si4	---	---	---	---	205	---	520	---	40	ST	207 max. HB; 95 max. HRB
GB 4239-91	Grade 0Cr18Ni13Si4	---	---	---	---	205	---	520	---	40	ST	95 max. HRB
JIS G 4304:2012	Symbol SUSXM15J1	---	---	---	---	205	---	520	---	40	ST	207 max. HBW; 95 max. HRBW; 218 max. HV
JIS G 4305:2012	Symbol SUSXM15J1	---	---	---	---	205	---	520	---	40	ST	207 max. HBW; 95 max. HRBW; 218 max. HV
EN 10088-2:2014	X8CrMnCuNB17-8-3	---	1.4597	$t \leq 8$	---	300	---	580-780	---	40 T	SA	---
				$t \leq 13.5$	---	300	---	580-780	---	40 T	SA	see standard for impact data
ISO 16143-1:2004	X8CrMnCuN17-8-3	---	---	$t \leq 8$	---	300	---	580-780	---	40 T	SA	---
				$t \leq 13.5$	---	300	---	580-780	---	40 T	SA	---
ASME SA-240/SA-240M	---	S31060	---	---	---	280	41	600	87	40	Q+SA	217 max. HB; 95 max. HRB
ASTM A240/A240M-15a	---	S31060	---	---	---	280	41	600	87	40	SA	217 max. HBW; 95 max. HRBW
EN 10302:2008	X8CrNiNb16-13	---	1.4961	---	---	200	---	510-690	---	35	SA	---
	X6CrNiMoTiB17-13	---	1.4983	---	---	205	---	530-730	---	35	SA	---

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10028-7:2007	X1CrNi25-21	---	1.4335	$t \leq 75$	---	200	---	470-670	---	40 T	SA	see standard for impact data
EN 10088-2:2014	X1CrNi25-21	---	1.4335	$t \leq 75$	---	200	---	470-670	---	40 T	SA	see standard for impact data
ISO 16143-1:2004	X1CrNi25-21	---	---	$t \leq 75$	---	200	---	470-670	---	40 T	SA	---
ISO 9328-7:2004	Grade X1CrNi25-21	---	---	$t \leq 75$	---	200	---	470-670	---	40 T	SA	see standard for impact data
ASME SA-240/SA-240M	---	S34565	---	---	---	415	60	795	115	35	Q+SA	241 max. HB; 100 max. HRB
ASTM A240/A240M-15a	---	S34565	---	---	---	415	60	795	115	35	SA	241 max. HBW; 100 max. HRBW
EN 10088-2:2014	X2CrNiMnMoN25-18-6-5	---	1.4565	$t \leq 6$	---	420	---	800-950	---	30 T	SA	see standard for impact data
				$t \leq 10$	---	420	---	800-950	---	30 T	SA	
				$t \leq 40$	---	420	---	800-950	---	30 T	SA	
ISO 16143-1:2004	X2CrNiMnMoN25-18-6-5	---	---	$t \leq 6$	---	420	---	800-1000	---	35 T	SA	---
				$t \leq 10$	---	420	---	800-1000	---	35 T	SA	---
				$t \leq 40$	---	420	---	800-1000	---	35 T	SA	---
ASME SA-240/SA-240M	---	S31266	---	---	---	420	61	750	109	35	Q+SA	---
ASTM A240/A240M-15a	---	S31266	---	---	---	420	61	750	109	35	SA	---
EN 10088-2:2014	X1CrNiMoCuNW24-22-6	---	1.4659	$t \leq 75$	---	420	---	800-1000	---	40 T	SA	see standard for impact data
ASME SA-240/SA-240M	---	S32654	---	---	---	430	62	750	109	40	Q+SA	250 max. HB
ASTM A240/A240M-15a	---	S32654	---	---	---	430	62	750	109	40	SA	250 max. HBW
EN 10088-2:2014	X1CrNiMoCuN24-22-8	---	1.4652	$t \leq 8$	---	430	---	750-1000	---	40 T	SA	see standard for impact data
				$t \leq 13.5$	---	430	---	750-1000	---	40 T	SA	
				$t \leq 15$	---	430	---	750-1000	---	40 T	SA	
ISO 16143-1:2004	X1CrNiMoCuN24-22-8	---	---	$t \leq 8$	---	430	---	750-950	---	40 T	SA	---
				$t \leq 13.5$	---	430	---	750-950	---	40 T	SA	---
				$t \leq 75$	---	430	---	750-950	---	40 T	SA	---

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10095:1999	X8CrNiTi18-10	---	1.4878	$0.5 \leq t < 3$	---	190	---	500-720	---	40 L, 40 T	SA	215 max. HB
				$t \leq 25$	---	190	---	500-720 L	---	40 L	SA	215 max. HB
				$3 \leq t \leq 75$	---	190	---	500-720	---	40 L, 40 T	SA	215 max. HB
				$t \leq 160$	---	190	---	500-720 L	---	40 L	SA	215 max. HB
GB 4238-92	Grade 1Cr18Ni9Ti	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 3280-92	Grade 1Cr18Ni9Ti	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4237-92	Grade 1Cr18Ni9Ti	---	---	---	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 4239-91	Grade 1Cr18Ni9Ti	---	---	---	---	205	---	540	---	40	ST	90 max. HRB
		---		---	---	---	---	735	---	20	WH	90 max. HRB
		---		---	---	---	---	885	---	7	WH	90 max. HRB
ASME SA-240/SA-240M	Type 347H	S34709	---	---	---	205	30	515	75	40	Q+SA	201 max. HB; 92 max. HRB
ASTM A240/A240M-15a	Type 347H	S34709	---	---	---	205	30	515	75	40	SA	201 max. HBW; 92 max. HRBW
ISO 4955:2005	X7CrNiNb18-10	---	---	$0.5 \leq t < 3$	---	205	---	510-710	---	28 L, 28 T	SA	192 max. HB
				$1.5 \leq t \leq 25$	---	205	---	510-710	---	30	SA	192 max. HB
				$3 \leq t \leq 75$	---	205	---	510-710	---	30 L, 30 T	SA	192 max. HB
				$t \leq 100$	---	205	---	510-710	---	30	SA	192 max. HB
				$5 \leq t \leq 160$	---	205	---	510-710	---	30	SA	192 max. HB
EN 10028-7:2007	X3CrNiMoBN17-13-3	---	1.4910	$t \leq 3$	---	300	---	580-780	---	35 T	SA	see standard for impact data
				$t \leq 8$	---	300	---	580-780	---	40 T	SA	
				$t \leq 13.5$	---	260	---	550-750	---	40 T	SA	
				$t \leq 75$	---	260	---	550-750	---	40 T	SA	
EN 10302:2008	X3CrNiMoBN17-13-3	---	1.4910	---	---	260	---	550-750	---	35	SA	---
ISO 9328-7:2004	Grade X3CrNiMoBN17-13-3	---	---	$t \leq 6$	---	300	---	580-780	---	40 T	SA	---
				$t \leq 12$	---	260	---	550-750	---	40 T	SA	see standard for impact data
				$t \leq 75$	---	260	---	550-750	---	40 T	SA	see standard for impact data
EN 10028-7:2007	X8CrNiNb16-13	---	1.4961	$t \leq 75$	---	200	---	510-690	---	35 T	SA	see standard for impact data
ISO 9328-7:2004	Grade X8CrNiNb16-13	---	---	$t \leq 75$	---	200	---	510-690	---	35 T	SA	see standard for impact data

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 4238-92	Grade 0Cr15Ni25Ti2MoAlVB	---	---	---	---	---	---	725 max.	---	25	ST	192 max. HB; 91 max. HRB
				---	---	590	---	900	---	15	see standard	248 min. HB; 101 min. HRB
JIS G 4312:2011	Symbol SUH660	---	---	---	---	---	---	730	---	25	ST	192 max. HBW; 91 max. HRBW; 202 max. HV
				---	---	590	---	900	---	15	see standard	248 min. HBW; 24 min. HRC; 261 min. HV
EN 10302:2008	X6NiCrTiMoVB25-15-2	---	1.4980	---	---	600	---	900-1150	---	15	PH	---
EN 10028-7:2007	X5NiCrAlTi31-20	---	1.4958	$t \leq 75$	---	170	---	500-750	---	30 T	SA	see standard for impact data
				$t \leq 75$	---	210	---	500-750	---	30 T	A	
EN 10302:2008	X5NiCrAlTi31-20	---	1.4958	---	---	170	---	500-750	---	35	SA	---
				---	---	210	---	500-750	---	35	A	---
ISO 9328-7:2004	Grade X5NiCrAlTi31-20	---	---	$t \leq 75$	---	170	---	500-750	---	30 T	SA	see standard for impact data
				$t \leq 75$	---	210	---	500-750	---	30 T	A	
EN 10302:2008	X12CrCoNi21-20	---	1.4971	---	---	300	---	690-900	---	30	SA	---
JIS G 4312:2011	Symbol SUH661	---	---	---	---	315	---	690	---	35	ST	248 max. HBW; 100 max. HRBW; 261 max. HV
				---	---	345	---	760	---	30	see standard	192 min. HBW; 91 min. HRBW; 202 min. HV
ASME SA-240/SA-240M	Type 800	N08800	---	$t > 0.50$	$t > 0.020$	205	30	520	75	30	Q+SA	---
ASTM A240/A240M-15a	Type 800	N08800	---	$t > 0.50$	$t > 0.020$	205	30	520	75	30	SA	---
EN 10095:1999	X10NiCrAlTi32-21	---	1.4876	$0.5 \leq t < 3$	---	170	---	450-680	---	28 L, 28 T	SA	192 max. HB
				$t \leq 25$	---	170	---	450-680 L	---	30 L	SA	192 max. HB
				$3 \leq t \leq 75$	---	170	---	450-680	---	30 L, 30 T	SA	192 max. HB
				$t \leq 160$	---	170	---	450-680 L	---	30 L	SA	192 max. HB

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 800H	N08810	---	$t > 0.50$	$t > 0.020$	170	25	450	65	30	Q+SA	---
	---	N08811	---	---	---	170	25	450	65	30	Q+SA	---
ASTM A240/A240M-15a	Type 800H	N08810	---	$t > 0.50$	$t > 0.020$	170	25	450	65	30	SA	---
	---	N08811	---	---	---	170	25	450	65	30	SA	---
EN 10028-7:2007	X8NiCrAlTi32-21	---	1.4959	$t \leq 75$	---	170	---	500-750	---	30 T	SA	see standard for impact data
ISO 4955:2005	X8NiCrAlTi32-21	---	---	$0.5 \leq t < 3$	---	170	---	450-680	---	28 L, 28 T	SA	192 max. HB
				$1.5 \leq t \leq 25$	---	170	---	450-680	---	30	SA	192 max. HB
				$3 \leq t \leq 75$	---	170	---	450-680	---	30 L, 30 T	SA	192 max. HB
				$t \leq 100$	---	170	---	450-680	---	30	SA	192 max. HB
				$5 \leq t \leq 160$	---	170	---	450-680	---	30	SA	192 max. HB
ISO 9328-7:2004	Grade X8NiCrAlTi32-21	---	---	$t \leq 75$	---	170	---	500-750	---	30 T	SA	see standard for impact data
EN 10028-7:2007	X1CrNiMoCuN25-25-5	---	1.4537	$t \leq 75$	---	290	---	600-800	---	40 T	SA	see standard for impact data
EN 10088-2:2014	X1CrNiMoCuN25-25-5	---	1.4537	$t \leq 75$	---	290	---	600-800	---	40 T	SA	see standard for impact data
ISO 9328-7:2004	Grade X1CrNiMoCuN25-25-5	---	---	$t \leq 75$	---	290	---	600-800	---	40 T	SA	see standard for impact data
ASME SA-240/SA-240M	---	N08367	---	---	---	310	45	655	95	30	Q+SA	241 max. HB
	---	---	---	---	---	310	45	690	100	30	Q+SA	100 max. HRB
	---	N08926	---	---	---	295	43	650	94	35	Q+SA	---
	---	S31277	---	---	---	360	52	770	112	40	Q+SA	---
ASTM A240/A240M-15a	---	N08367	---	---	---	310	45	690	100	30	SA	100 max. HRBW
	---	---	---	---	---	310	45	655	65	30	SA	241 max. HRBW
	---	N08926	---	---	---	295	43	650	94	35	SA	---
	---	S31277	---	---	---	360	52	770	112	40	SA	---
ASTM B688-96 (2014)	---	N08366	---	$0.40 \leq t \leq 4.8$	$0.015 \leq t \leq 0.1875$	240	35	515 L	75 L	30	---	95 max. HRB
	---	---	---	$t > 4.8$	$t > 0.1875$	240	35	515 L	75 L	30	---	212 max. HBN
	---	N08367	---	$0.40 \leq t \leq 4.8$	$0.015 \leq t \leq 0.1875$	310	45	690 L	100 L	30	---	100 max. HRB
	---	---	---	$t > 4.8$	$t > 0.1875$	310	45	655 L	95 L	30	---	240 max. HBN
EN 10028-7:2007	X1NiCrMoCuN25-20-7	---	1.4529	$t \leq 75$	---	300	---	650-850	---	40 T	SA	see standard for impact data
EN 10088-2:2014	X1NiCrMoCuN25-20-7	---	1.4529	$t \leq 75$	---	300	---	650-850	---	40 T	SA	see standard for impact data
ISO 9328-7:2004	Grade X1NiCrMoCuN25-20-7	---	---	$t \leq 75$	---	300	---	650-850	---	40 T	SA	see standard for impact data

Note: This section continued on next page

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 4304:2012	Symbol SUS836L	---	---	---	---	275	---	640	---	40	ST	217 max. HBW; 96 max. HRBW; 230 max. HV
JIS G 4305:2012	Symbol SUS836L	---	---	---	---	275	---	640	---	40	ST	217 max. HBW; 96 max. HRBW; 230 max. HV
ASME SA-240/SA-240M	Type 904L	N08904	---	---	---	220	31	490	71	35	Q+SA	90 max. HRB
ASTM A240/A240M-15a	Type 904L	N08904	---	---	---	220	31	490	71	35	SA	90 max. HRBW
EN 10028-7:2007	X1NiCrMoCu25-20-5	---	1.4539	$t \leq 8$	---	240	---	530-730	---	35 T	SA	see standard for impact data
				$t \leq 13.5$	---	220	---	530-730	---	35 T	SA	
				$t \leq 75$	---	220	---	520-720	---	35 T	SA	
EN 10088-2:2014	X1NiCrMoCu25-20-5	---	1.4539	$t \leq 8$	---	240	---	530-730	---	35 T	SA	---
				$t \leq 13.5$	---	220	---	530-730	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	220	---	520-720	---	35 T	SA	
ISO 16143-1:2004	X1NiCrMoCu25-20-5	---	---	$t \leq 6$	---	240	---	530-730	---	35 T	SA	---
				$t \leq 12$	---	220	---	530-730	---	35 T	SA	---
				$t \leq 75$	---	220	---	510-710	---	35 T	SA	---
ISO 9328-7:2004	Grade X1NiCrMoCu25-20-5	---	---	$t \leq 6$	---	240	---	530-730	---	35 T	SA	---
				$t \leq 12$	---	220	---	530-730	---	35 T	SA	see standard for impact data
				$t \leq 75$	---	220	---	520-720	---	35 T	SA	
JIS G 4304:2012	Symbol SUS890L	---	---	---	---	215	---	490	---	35	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
JIS G 4305:2012	Symbol SUS890L	---	---	---	---	215	---	490	---	35	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
EN 10028-7:2007	X1NiCrMoCu31-27-4	---	1.4563	$t \leq 75$	---	220	---	500-700	---	40 T	SA	see standard for impact data
EN 10088-2:2014	X1NiCrMoCu31-27-4	---	1.4563	$t \leq 75$	---	220	---	500-700	---	40 T	SA	see standard for impact data
ISO 16143-1:2004	X1NiCrMoCu31-27-4	---	---	$t \leq 75$	---	220	---	500-700	---	40 T	SA	---
ISO 9328-7:2004	Grade X1NiCrMoCu31-27-4	---	---	$t \leq 75$	---	220	---	500-700	---	40 T	SA	see standard for impact data

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.4A Chemical Composition of Precipitation-Hardening Stainless Steels

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-693	Type 630	S17400	---	0.07	1.00	1.00	0.040	0.030	15.00-17.50	3.00-5.00	---	(Cb+Ta) 0.15 to 0.45; Cu 3.00-5.00
ASTM A693-13	Type 630	S17400	---	0.07	1.00	1.00	0.040	0.030	15.0-17.5	3.0-5.0	---	(Cb+Ta) 0.15 to 0.45; Cu 3.0-5.0
EN 10088-2:2014	X5CrNiCuNb16-4	---	1.4542	0.07	1.50	0.70	0.040	0.015	15.0-17.0	3.0-5.0	0.60	Nb 5xC to 0.45; Cu 3.0-5.0
JIS G 4304:2012	Symbol SUS630	---	---	0.07	1.00	1.00	0.040	0.030	15.00-17.50	3.00-5.00	---	Nb 0.15-0.45; Cu 3.00-5.00
JIS G 4305:2012	Symbol SUS630	---	---	0.07	1.00	1.00	0.040	0.030	15.00-17.50	3.00-5.00	---	Nb 0.15-0.45; Cu 3.00-5.00
ASME SA-693	Type 631	S17700	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.50
ASTM A693-13	Type 631	S17700	---	0.09	1.00	1.00	0.040	0.030	16.0-18.0	6.5-7.7	---	Al 0.75-1.50
EN 10088-2:2014	X7CrNiAl17-7	---	1.4568	0.09	1.00	0.70	0.040	0.015	16.0-18.0	6.5-7.8	---	Al 0.70-1.50
GB 4237-92	Grade 0Cr17Ni7Al	---	---	0.09	1.00	1.00	0.035	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.50
GB 4238-92	Grade 0Cr17Ni7Al	---	---	0.09	1.00	1.00	0.035	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.50; Cu 0.50
GB 4239-91	Grade 0Cr17Ni7Al	---	---	0.09	1.00	1.00	0.035	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.00
ISO 16143-1:2004	X7CrNiAl17-7	---	---	0.09	1.00	0.70	0.040	0.015	16.0-18.0	6.5-7.8	---	Al 0.70-1.50
JIS G 4304:2012	Symbol SUS631	---	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.50
JIS G 4305:2012	Symbol SUS631	---	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.50

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-693	Type 630	S17400	---	0.38 ≤ t ≤ 102	0.015 ≤ t ≤ 4.0	---	---	---	---	---	ST	363 max. HB; 38 max. HRC
				t < 4.762	t < 0.1875	1170	170	1310 L	190 L	5 T	PH 900°F/482°C	40-48 HRC
				t < 4.762	t < 0.1875	1070	155	1170 L	170 L	5 T	PH 925°F/496°C	38-48 HRC
				t < 4.762	t < 0.1875	1000	145	1070 L	155 L	5 T	PH 1025°F/552°C	35-43 HRC
				t < 4.762	t < 0.1875	860	125	1000 L	145 L	5 T	PH 1075°F/579°C	31-40 HRC
				t < 4.762	t < 0.1875	790	115	965 L	140 L	5 T	PH 1100°F/593°C	31-40 HRC
				t < 4.762	t < 0.1875	725	105	930 L	135 L	8 T	PH 1150°F/621°C	28-38 HRC
				t < 4.762	t < 0.1875	515	75	790 L	115 L	9 T	PH 1400°F+1150°F/ 760°C+621°C	255-331 HB; 26-36 HRC
				4.762 ≤ t ≤ 15.88	0.1875 ≤ t ≤ 0.625	1170	170	1310 L	190 L	8 T	PH 900°F/482°C	388-477 HB; 40-48 HRC
				4.762 ≤ t ≤ 15.88	0.1875 ≤ t ≤ 0.625	1070	155	1170 L	170 L	8 T	PH 925°F/496°C	375-477 HB; 38-47 HRC
				4.762 ≤ t ≤ 15.88	0.1875 ≤ t ≤ 0.625	1000	145	1070 L	155 L	8 T	PH 1025°F/552°C	321-415 HB; 33-42 HRC
				4.762 ≤ t ≤ 15.88	0.1875 ≤ t ≤ 0.625	860	125	1000 L	145 L	9 T	PH 1075°F/579°C	293-375 HB; 29-38 HRC
				4.762 ≤ t ≤ 15.88	0.1875 ≤ t ≤ 0.625	790	115	965 L	140 L	10 T	PH 1100°F/593°C	293-375 HB; 29-38 HRC
				4.762 ≤ t ≤ 15.88	0.1875 ≤ t ≤ 0.625	725	105	930 L	135 L	10 T	PH 1150°F/621°C	269-352 HB; 26-36 HRC
				4.762 ≤ t ≤ 15.88	0.1875 ≤ t ≤ 0.625	515	75	790 L	115 L	11 T	PH 1400°F+1150°F/ 760°C+621°C	248-321 HB; 24-34 HRC
				15.90 ≤ t ≤ 102	0.626 ≤ t ≤ 4.0	1170	170	1310 L	190 L	10 T	PH 900°F/482°C	388-477 HB; 40-48 HRC
				15.90 ≤ t ≤ 102	0.626 ≤ t ≤ 4.0	1070	155	1170 L	170 L	10 T	PH 925°F/496°C	375-477 HB; 38-47 HRC
				15.90 ≤ t ≤ 102	0.626 ≤ t ≤ 4.0	1000	145	1070 L	155 L	12 T	PH 1025°F/552°C	321-415 HB; 33-42 HRC
				15.88 ≤ t ≤ 102	0.626 ≤ t ≤ 4.0	860	125	1000 L	145 L	13 T	PH 1075°F/579°C	293-375 HB; 29-38 HRC
				15.88 ≤ t ≤ 102	0.626 ≤ t ≤ 4.0	790	115	965 L	140 L	14 T	PH 1100°F/593°C	293-375 HB; 29-38 HRC
				15.88 ≤ t ≤ 102	0.626 ≤ t ≤ 4.0	725	105	930 L	135 L	16 T	PH 1150°F/621°C	269-352 HB; 26-36 HRC
				15.88 ≤ t ≤ 102	0.626 ≤ t ≤ 4.0	515	75	790 L	115 L	18 T	PH 1400°F+1150°F/ 760°C+621°C	248-321 HB; 24-34 HRC

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8.1 Stainless Steels: Plate, Sheet and Strip

8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A693-13	Type 630	S17400	---	0.38 ≤ t ≤ 102	0.015 ≤ t ≤ 4.0	---	---	---	---	---	ST	363 max. HB; 38 max. HRC
				t < 4.762	t < 0.1875	1170	170	1310 L	190 L	5 T	PH 900°F/482°C	40-48 HRC
				t < 4.762	t < 0.1875	1070	155	1170 L	170 L	5 T	PH 925°F/496°C	38-46 HRC
				t < 4.762	t < 0.1875	1000	145	1070 L	155 L	5 T	PH 1025°F/552°C	35-43 HRC
				t < 4.762	t < 0.1875	860	125	1000 L	145 L	5 T	PH 1075°F/579°C	31-40 HRC
				t < 4.762	t < 0.1875	790	115	965 L	140 L	5 T	PH 1100°F/593°C	31-40 HRC
				t < 4.762	t < 0.1875	725	105	930 L	135 L	8 T	PH 1150°F/621°C	28-38 HRC
				t < 4.762	t < 0.1875	515	75	790 L	115 L	9 T	PH 1400°F+1150°F/ 760°C+621°C	255-331 HB; 26-36 HRC
				4.762 ≤ t ≤ 15.88	0.1875 ≤ t ≤ 0.625	1170	170	1310 L	190 L	8 T	PH 900°F/482°C	388-477 HB; 40-48 HRC
				4.762 ≤ t ≤ 15.88	0.1875 ≤ t ≤ 0.625	1070	155	1170 L	170 L	8 T	PH 925°F/496°C	375-477 HB; 38-47 HRC
				4.762 ≤ t ≤ 15.88	0.1875 ≤ t ≤ 0.625	1000	145	1070 L	155 L	8 T	PH 1025°F/552°C	321-415 HB; 33-42 HRC
				4.762 ≤ t ≤ 15.88	0.1875 ≤ t ≤ 0.625	860	125	1000 L	145 L	9 T	PH 1075°F/579°C	293-375 HB; 29-38 HRC
				4.762 ≤ t ≤ 15.88	0.1875 ≤ t ≤ 0.625	790	115	965 L	140 L	10 T	PH 1100°F/593°C	293-375 HB; 29-38 HRC
				4.762 ≤ t ≤ 15.88	0.1875 ≤ t ≤ 0.625	725	105	930 L	135 L	10 T	PH 1150°F/621°C	269-352 HB; 26-36 HRC
				4.762 ≤ t ≤ 15.88	0.1875 ≤ t ≤ 0.625	515	75	790 L	115 L	11 T	PH 1400°F+1150°F/ 760°C+621°C	248-321 HB; 24-34 HRC
				15.90 ≤ t ≤ 102	0.626 ≤ t ≤ 4.0	1170	170	1310 L	190 L	10 T	PH 900°F/482°C	388-477 HB; 40-48 HRC
				15.90 ≤ t ≤ 102	0.626 ≤ t ≤ 4.0	1070	155	1170 L	170 L	10 T	PH 925°F/496°C	375-477 HB; 38-47 HRC
				15.90 ≤ t ≤ 102	0.626 ≤ t ≤ 4.0	1000	145	1070 L	155 L	12 T	PH 1025°F/552°C	321-415 HB; 33-42 HRC
				15.88 ≤ t ≤ 102	0.626 ≤ t ≤ 4.0	860	125	1000 L	145 L	13 T	PH 1075°F/579°C	293-375 HB; 29-38 HRC
				15.88 ≤ t ≤ 102	0.626 ≤ t ≤ 4.0	790	115	965 L	140 L	14 T	PH 1100°F/593°C	293-375 HB; 29-38 HRC
				15.88 ≤ t ≤ 102	0.626 ≤ t ≤ 4.0	725	105	930 L	135 L	16 T	PH 1150°F/621°C	269-352 HB; 26-36 HRC
				15.88 ≤ t ≤ 102	0.626 ≤ t ≤ 4.0	515	75	790 L	115 L	18 T	PH 1400°F+1150°F/ 760°C+621°C	248-321 HB; 24-34 HRC

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8.1 Stainless Steels: Plate, Sheet and Strip

8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-2:2014	X5CrNiCuNb16-4	---	1.4542	$t \leq 8$	---	700	---	900	---	6 L, 6 T	PH (P900)	---
				$t \leq 8$	---	1150	---	1300	---	3 L, 3 T	PH (P1300)	---
				$t \leq 8$	---	---	---	1275 max.	---	5 L, 5 T	SA	---
				$t \leq 50$	---	---	---	1050 max.	---	---	see standard	---
				$t \leq 50$	---	800	---	950-1150	---	12 L, 12 T	PH (P950)	---
				$t \leq 50$	---	600	---	850-1050	---	14 L, 14 T	PH (P850)	---
				$t \leq 50$	---	1000	---	1070-1270	---	10 L, 10 T	PH (P1070)	---
JIS G 4304:2012	Symbol SUS630	---	---	---	---	---	---	---	---	---	PH (S)	363 max. HBW; 38 max. HRC
				$t \leq 5$	---	725	---	930	---	8	PH (H1150)	277 min. HBW; 28 min. HRC
				$t \leq 5$	---	860	---	1000	---	5	PH (H1075)	302 min. HBW; 31 min. HRC
				$t \leq 5$	---	1000	---	1070	---	5	PH (H1025)	331 min. HBW; 35 min. HRC
				$t \leq 5$	---	1175	---	1310	---	5	PH (H900)	375 min. HBW; 40 min. HRC
				$5 < t \leq 15$	---	725	---	930	---	10	PH (H1150)	277 min. HBW; 28 min. HRC
				$5 < t \leq 15$	---	860	---	1000	---	9	PH (H1075)	302 min. HBW; 31 min. HRC
				$5 < t \leq 15$	---	1000	---	1070	---	8	PH (H1025)	331 min. HBW; 35 min. HRC
				$5 < t \leq 15$	---	1175	---	1310	---	8	PH (H900)	375 min. HBW; 40 min. HRC
				$t > 15$	---	725	---	930	---	16	PH (H1150)	277 min. HBW; 28 min. HRC
				$t > 15$	---	860	---	1000	---	13	PH (H1075)	302 min. HBW; 31 min. HRC
				$t > 15$	---	1000	---	1070	---	12	PH (H1025)	331 min. HBW; 35 min. HRC
				$t > 15$	---	1175	---	1310	---	10	PH (H900)	375 min. HBW; 40 min. HRC

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8.1 Stainless Steels: Plate, Sheet and Strip

8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 4305:2012	Symbol SUS630	---	---	---	---	---	---	---	---	---	PH (S)	363 max. HBW; 38 max. HRC
				$t \leq 5$	---	1175	---	1310	---	5	PH (H900)	375 min. HBW
				$t \leq 5$	---	1000	---	1070	---	5	PH (H1025)	331 min. HBW
				$t \leq 5$	---	860	---	1000	---	5	PH (H1075)	302 min. HBW; 31 min. HRC
				$t \leq 5$	---	725	---	930	---	8	PH (H1150)	277 min. HBW; 28 min. HRC
				$5 < t \leq 15$	---	1175	---	1310	---	8	PH (H900)	375 min. HBW
				$5 < t \leq 15$	---	1000	---	1070	---	8	PH (H1025)	331 min. HBW
				$5 < t \leq 15$	---	860	---	1000	---	9	PH (H1075)	302 min. HBW; 31 min. HRC
				$5 < t \leq 15$	---	725	---	930	---	10	PH (H1150)	277 min. HBW; 28 min. HRC
				$t > 15$	---	1175	---	1310	---	10	PH (H900)	375 min. HBW
				$t > 15$	---	1000	---	1070	---	12	PH (H1025)	331 min. HBW
				$t > 15$	---	860	---	1000	---	13	PH (H1075)	302 min. HBW; 31 min. HRC
				$t > 15$	---	725	---	930	---	16	PH (H1150)	277 min. HBW; 28 min. HRC

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-693	Type 631	S17700	---	$0.038 \leq t \leq 0.124$	$0.0015 \leq t \leq 0.0049$	1035	150	1240 L	180 L	3 T	PH 1400°F+55°F+1050°F/760°C+15°C+566°C	38 min. HRC
				$0.038 \leq t \leq 0.124$	$0.0015 \leq t \leq 0.0049$	1310	190	1450 L	210 L	1 T	PH 1750°F+(-100)°F+950°F/954°C+(-73)°C+510°C	44 min. HRC
				$0.127 \leq t \leq 0.251$	$0.0050 \leq t \leq 0.0099$	1035	150	1240 L	180 L	4 T	PH 1400°F+55°F+1050°F/760°C+15°C+566°C	38 min. HRC
				$0.127 \leq t \leq 0.251$	$0.0050 \leq t \leq 0.0099$	1310	190	1450 L	210 L	2 T	PH 1750°F+(-100)°F+950°F/954°C+(-73)°C+510°C	44 min. HRC
				$t \leq 0.25$	$t \leq 0.010$	450 max.	65 max.	1035 max. L	150 max. L	---	ST	---
				$0.25 \leq t \leq 0.505$	$0.010 \leq t \leq 0.0199$	1035	150	1240 L	180 L	5 T	PH 1400°F+55°F+1050°F/760°C+15°C+566°C	38 min. HRC
				$0.25 \leq t \leq 0.505$	$0.010 \leq t \leq 0.0199$	1310	190	1450 L	210 L	3 T	PH 1750°F+(-100)°F+950°F/954°C+(-73)°C+510°C	44 min. HRC
				$0.038 \leq t \leq 1.27$	$0.0015 \leq t \leq 0.050$	1205	175	1380 L	200 L	1 T	CR	41 min. HRC
				$0.038 \leq t \leq 1.27$	$0.0015 \leq t \leq 0.050$	1580	230	1655 L	240 L	1 T	CR+PH 900°F/482°C	46 min. HRC
				$0.51 \leq t \leq 4.760$	$0.020 \leq t \leq 0.1874$	1035	150	1240 L	180 L	6 T	PH 1400°F+55°F+1050°F/760°C+15°C+566°C	38 min. HRC
				$0.51 \leq t \leq 4.760$	$0.020 \leq t \leq 0.1874$	1310	190	1450 L	210 L	4 T	PH 1750°F+(-100)°F+950°F/954°C+(-73)°C+510°C	44 min. HRC
				$4.762 \leq t \leq 15.88$	$0.1875 \leq t \leq 0.625$	965	140	1170 L	170 L	7 T	PH 1400°F+55°F+1050°F/760°C+15°C+566°C	352 min. HB; 38 min. HRC
				$4.762 \leq t \leq 15.88$	$0.1875 \leq t \leq 0.625$	1240	180	1380 L	200 L	6 T	PH 1750°F+(-100)°F+950°F/954°C+(-73)°C+510°C	401 min. HB; 43 min. HRC
				$0.25 < t \leq 102$	$0.010 < t \leq 4.0$	380 max.	55 max.	1035 max. L	150 max. L	20	ST	92 max. HRB

Note: This section continued on next page.

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A693-13	Type 631	S17700	---	$0.038 \leq t \leq 0.124$	$0.0015 \leq t \leq 0.0049$	1035	150	1240 L	180 L	3 T	PH 1400°F+55°F+1050°F/760°C+15°C+566°C	38 min. HRC
				$0.038 \leq t \leq 0.124$	$0.0015 \leq t \leq 0.0049$	1310	190	1450 L	210 L	1 T	PH 1750°F+(-100)°F+950°F/954°C+(-73)°C+510°C	44 min. HRC
				$0.127 \leq t \leq 0.251$	$0.0050 \leq t \leq 0.0099$	1035	150	1240 L	180 L	4 T	PH 1400°F+55°F+1050°F/760°C+15°C+566°C	38 min. HRC
				$0.127 \leq t \leq 0.251$	$0.0050 \leq t \leq 0.0099$	1310	190	1450 L	210 L	2 T	PH 1750°F+(-100)°F+950°F/954°C+(-73)°C+510°C	44 min. HRC
				$t \leq 0.25$	$t \leq 0.010$	450 max.	65 max.	1035 max. L	150 max. L	---	ST	---
				$0.25 \leq t \leq 0.505$	$0.010 \leq t \leq 0.0199$	1035	150	1240 L	180 L	5 T	PH 1400°F+55°F+1050°F/760°C+15°C+566°C	38 min. HRC
				$0.25 \leq t \leq 0.505$	$0.010 \leq t \leq 0.0199$	1310	190	1450 L	210 L	3 T	PH 1750°F+(-100)°F+950°F/954°C+(-73)°C+510°C	44 min. HRC
				$0.038 \leq t \leq 1.27$	$0.0015 \leq t \leq 0.050$	1205	175	1380 L	200 L	1 T	CR	41 min. HRC
				$0.038 \leq t \leq 1.27$	$0.0015 \leq t \leq 0.050$	1580	230	1655 L	240 L	1 T	CR+PH 900°F/482°C	46 min. HRC
				$0.51 \leq t \leq 4.760$	$0.020 \leq t \leq 0.1874$	1035	150	1240 L	180 L	6 T	PH 1400°F+55°F+1050°F/760°C+15°C+566°C	38 min. HRC
				$0.51 \leq t \leq 4.760$	$0.020 \leq t \leq 0.1874$	1310	190	1450 L	210 L	4 T	PH 1750°F+(-100)°F+950°F/954°C+(-73)°C+510°C	44 min. HRC
				$4.762 \leq t \leq 15.88$	$0.1875 \leq t \leq 0.625$	965	140	1170 L	170 L	7 T	PH 1400°F+55°F+1050°F/760°C+15°C+566°C	352 min. HB; 38 min. HRC
				$4.762 \leq t \leq 15.88$	$0.1875 \leq t \leq 0.625$	1240	180	1380 L	200 L	6 T	PH 1750°F+(-100)°F+950°F/954°C+(-73)°C+510°C	401 min. HB; 43 min. HRC
				$0.25 < t \leq 102$	$0.010 < t \leq 4.0$	380 max.	55 max.	1035 max. L	150 max. L	20	ST	92 max. HRB
EN 10088-2:2014	X7CrNiAl17-7	---	1.4568	$t \leq 8$	---	---	---	1030 max.	---	19 L, 19 T	SA	---
				$t \leq 8$	---	1310	---	1450	---	2 L, 2 T	PH (P1450)	---

Note: This section continued on next page

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 4237-92	Grade 0Cr17Ni7Al	---	---	---	---	380 max.	---	1030 max.	---	20	ST	190 max. HB; 92 max. HRB
				$t \leq 3$	---	960	---	1140	---	3	ST	---
				$t \leq 3$	---	1030	---	1230	---	---	ST	---
				$t > 3$	---	960	---	1140	---	5	ST	---
				$t > 3$	---	1030	---	1230	---	4	ST	---
GB 4238-92	Grade 0Cr17Ni7Al	---	---	---	---	380 max.	---	1030 max.	---	20	ST	190 max. HB; 92 max. HRB
				$t \leq 3$	---	960	---	1140	---	3	ST	---
				$t \leq 3$	---	1030	---	1230	---	---	ST	---
				$t > 3$	---	960	---	1140	---	5	ST	---
				$t > 3$	---	1030	---	1230	---	4	ST	---
GB 4239-91	Grade 0Cr17Ni7Al	---	---	---	---	380 max.	---	1030 max.	---	20	ST	92 max. HRB
				$t \leq 3$	---	960	---	1140	---	3	ST	---
				$t \leq 3$	---	1030	---	---	---	---	ST	---
				$t > 3$	---	960	---	1140	---	5	ST	---
				$t > 3$	---	1030	---	1225, 1225	---	4	ST	---
ISO 16143-1:2004	X7CrNiAl17-7	---	---	$t \leq 8$	---	---	---	1030 max.	---	19	SA	---
				$t \leq 8$	---	1200	---	1300	---	---	PH (+P1300)	---
				$t \leq 8$	---	1310	---	1450	---	2	PH (+P1450)	---
JIS G 4304:2012	Symbol SUS631	---	---	---	---	380 max.	---	1030 max.	---	20	PH (S)	192 max. HBW; 92 max. HRBW
				$t \leq 3$	---	1030	---	1230	---	---	PH (RH950)	40 min. HRC; 392 min. HV
				$t \leq 3$	---	960	---	1140	---	3	PH (TH1050)	35 min. HRC; 345 min. HV
				$t > 3$	---	1030	---	1230	---	4	PH (RH950)	40 min. HRC; 392 min. HV
				$t > 3$	---	960	---	1140	---	5	PH (TH1050)	35 min. HRC; 345 min. HV
JIS G 4305:2012	Symbol SUS631	---	---	---	---	380 max.	---	1030 max.	---	20	PH (S)	192 max. HBW; 92 max. HRBW
				$t \leq 3$	---	960	---	1140	---	3	PH (TH1050)	35 min. HRC; 345 min. HV
				$t \leq 3$	---	1030	---	1230	---	---	PH (RH950)	40 min. HRC; 392 min. HV
				$t > 3$	---	960	---	1140	---	5	PH (TH1050)	35 min. HRC; 345 min. HV
				$t > 3$	---	1030	---	1230	---	4	PH (RH950)	40 min. HRC; 392 min. HV

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.5A Chemical Composition of Duplex (Ferritic-Austenitic) Stainless Steels

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10088-2:2014	X2CrNiMoSi18-5-3	---	1.4424	0.030	1.20-2.00	1.40-2.00	0.035	0.015	18.0-19.0	4.5-5.2	2.50-3.0	N 0.05-0.10
GB 3280-92	Grade 00Cr18Ni5Mo3Si2	---	---	0.03	1.00-2.00	1.30-2.00	0.030	0.030	18.00-19.50	4.50-5.50	2.50-3.00	N 0.10
GB 4237-92	Grade 00Cr18Ni5Mo3Si2	---	---	0.03	1.00-2.00	1.30-2.00	0.030	0.030	18.0-19.5	4.5-5.5	2.5-3.0	N 0.10
ASME SA-240/SA-240M	---	S31803	---	0.030	2.00	1.00	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
	Type 2205	S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
ASTM A240/A240M-15a	---	S31803	---	0.030	2.00	1.00	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
	Type 2205	S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
EN 10028-7:2007	X2CrNiMoN22-5-3	---	1.4462	0.030	2.00	1.00	0.035	0.015	21.0-23.0	4.5-6.5	2.50-3.5	N 0.10-0.22
EN 10088-2:2014	X2CrNiMoN22-5-3	---	1.4462	0.030	2.00	1.00	0.035	0.015	21.0-23.0	4.5-6.5	2.50-3.5	N 0.10-0.22
ISO 16143-1:2004	X2CrNiMoN22-5-3	---	---	0.030	2.00	1.00	0.035	0.015	21.0-23.0	4.5-6.5	2.5-3.5	N 0.10-0.22
ISO 9328-7:2004	Grade X2CrNiMoN22-5-3	---	---	0.030	2.00	1.00	0.035	0.015	21.0-23.0	4.5-6.5	2.5-3.5	N 0.10-0.22
JIS G 4304:2012	Symbol SUS329J3L	---	---	0.030	2.00	1.00	0.040	0.030	21.00-24.00	4.50-6.50	2.50-3.50	N 0.08-0.20
JIS G 4305:2012	Symbol SUS329J3L	---	---	0.030	2.00	1.00	0.040	0.030	21.00-24.00	4.50-6.50	2.50-3.50	N 0.08-0.20
SAE J405 JUN98	---	S31803	---	0.030	2.00	1.00	0.030	0.020	21.0-23.0	4.50-6.50	2.50-3.50	N 0.08-0.20
	---	S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.50-6.50	3.00-3.50	N 0.14-0.20
ASME SA-240/SA-240M	Type 2304	S32304	---	0.030	2.50	1.00	0.040	0.030	21.5-24.5	3.0-5.5	0.05-0.60	Cu 0.05-0.60; N 0.05-0.20
ASTM A240/A240M-15a	Type 2304	S32304	---	0.030	2.50	1.00	0.040	0.030	21.5-24.5	3.0-5.5	0.05-0.60	Cu 0.05-0.60; N 0.05-0.20
EN 10028-7:2007	X2CrNiN23-4	---	1.4362	0.030	2.00	1.00	0.035	0.015	22.0-24.0	3.5-5.5	0.10-0.60	Cu 0.10-0.60; N 0.05-0.20
EN 10088-2:2014	X2CrNiN23-4	---	1.4362	0.030	2.00	1.00	0.035	0.015	22.0-24.5	3.5-5.5	0.10-0.60	Cu 0.10-0.60; N 0.05-0.20
ISO 16143-1:2004	X2CrNiN23-4	---	---	0.030	2.00	1.00	0.035	0.015	22.0-24.0	3.5-5.5	0.10-0.60	Cu 0.10-0.60; N 0.05-0.20
ISO 9328-7:2004	Grade X2CrNiN23-4	---	---	0.030	2.00	1.00	0.035	0.015	22.0-24.0	3.5-5.5	0.10-0.60	Cu 0.10-0.60; N 0.05-0.20
SAE J405 JUN98	---	S32304	---	0.030	2.50	1.00	0.040	0.030	21.5-24.5	3.00-5.00	0.05-0.60	Cu 0.05-3.00; N 0.05-0.20
ASME SA-240/SA-240M	---	S32520	---	0.030	1.50	0.80	0.035	0.020	24.0-26.0	5.5-8.0	3.0-4.0	Cu 0.50-2.00; N 0.20-0.35
ASTM A240/A240M-15a	---	S32520	---	0.030	1.50	0.80	0.035	0.020	24.0-26.0	5.5-8.0	3.0-4.0	Cu 0.50-2.00; N 0.20-0.35
EN 10028-7:2007	X2CrNiMoCuN25-6-3	---	1.4507	0.030	2.00	0.70	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.0	Cu 1.00-2.50; N 0.20-0.30
EN 10088-2:2014	X2CrNiMoCuN25-6-3	---	1.4507	0.030	2.00	0.70	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.0	Cu 1.00-2.50; N 0.20-0.30
ISO 16143-1:2004	X2CrNiMoCuN25-6-3	---	---	0.030	2.00	0.70	0.035	0.015	24.0-26.0	5.0-7.5	2.5-4.0	Cu 1.00-2.50; N 0.15-0.30
ISO 9328-7:2004	Grade X2CrNiMoCuN25-6-3	---	---	0.030	2.00	0.70	0.035	0.015	24.0-26.0	5.0-7.5	2.5-4.0	Cu 1.00-2.50; N 0.15-0.30
SAE J405 JUN98	---	S32520	---	0.030	1.50	0.80	0.035	0.020	24.00-26.00	5.50-8.00	3.00-5.00	Cu 0.50-3.00; N 0.20-0.35
GB 4239-91	Grade 00Cr24Ni6Mo3N	---	---	0.03	1.50	1.00	0.040	0.030	22.00-26.00	4.50-7.50	2.50-4.00	N 0.08-0.30
JIS G 4304:2012	Symbol SUS329J4L	---	---	0.030	1.50	1.00	0.040	0.030	24.00-26.00	5.50-7.50	2.50-3.50	N 0.08-0.30
JIS G 4305:2012	Symbol SUS329J4L	---	---	0.030	1.50	1.00	0.040	0.030	24.00-26.00	5.50-7.50	2.50-3.50	N 0.08-0.30

8.1 Stainless Steels: Plates, Sheet and Strip

8.1.5A Chemical Composition of Duplex (Ferritic-Austenitic) Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-240/SA-240M	Type 2507	S32750	---	0.030	1.20	0.80	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	Cu 0.50; N 0.24-0.32
ASTM A240/A240M-15a	Type 2507	S32750	---	0.030	1.20	0.80	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	Cu 0.50; N 0.24-0.32; [Cr+(3.3xMo)+(16xN)] = 41 min.
EN 10028-7:2007	X2CrNiMoN25-7-4	---	1.4410	0.030	2.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.5	N 0.24-0.35
EN 10088-2:2014	X2CrNiMoN25-7-4	---	1.4410	0.030	2.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.5	N 0.24-0.35
ISO 16143-1:2004	X2CrNiMoN25-7-4	---	---	0.030	2.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.5	N 0.24-0.35
ISO 9328-7:2004	Grade X2CrNiMoN25-7-4	---	---	0.030	2.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.5	N 0.24-0.35
SAE J405 JUN98	---	S32750	---	0.030	1.20	0.80	0.035	0.020	24.0-26.0	6.00-8.00	3.00-5.00	Cu 0.50; N 0.24-0.32
ASME SA-240/SA-240M	---	S32760	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	[Cr+(3.3xMo)+(16xN)] = 40 min.; Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30
ASTM A240/A240M-15a	---	S32760	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	[Cr+(3.3xMo)+(16xN)] = 40 min; Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30
EN 10028-7:2007	X2CrNiMoCuWN25-7-4	---	1.4501	0.030	1.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30
EN 10088-2:2014	X2CrNiMoCuWN25-7-4	---	1.4501	0.030	1.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30
ISO 16143-1:2004	X2CrNiMoCuWN25-7-4	---	---	0.030	1.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30
ISO 9328-7:2004	Grade X2CrNiMoCuWN25-7-4	---	---	0.030	1.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30
SAE J405 JUN98	---	S32760	---	0.030	1.00	1.00	0.030	0.010	24.00-26.00	6.00-8.00	3.00-4.00	[Cr+(3.3xMo)+(16xN)] 40 min.; Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30
ASME SA-240/SA-240M	Type 329	S32900	---	0.08	1.00	0.75	0.040	0.030	23.0-28.0	2.0-5.00	1.00-2.00	---
ASTM A240/A240M-15a	Type 329	S32900	---	0.08	1.00	0.75	0.040	0.030	23.0-28.0	2.0-5.00	1.00-2.00	---
GB 3280-92	Grade 0Cr26Ni5Mo2	---	---	0.08	1.50	1.00	0.035	0.030	23.00-28.00	3.00-6.00	1.00-3.00	---
GB 4237-92	Grade 0Cr26Ni5Mo2	---	---	0.08	1.50	1.00	0.035	0.030	23.00-28.00	3.00-6.00	1.00-3.00	---
GB 4239-91	Grade 0Cr26Ni5Mo2	---	---	0.08	1.50	1.00	0.035	0.030	23.00-28.00	3.00-6.00	1.00-3.00	---
JIS G 4304:2012	Symbol SUS329J1	---	---	0.08	1.50	1.00	0.040	0.030	23.00-28.00	3.00-6.00	1.00-3.00	---
JIS G 4305:2012	Symbol SUS329J1	---	---	0.08	1.50	1.00	0.040	0.030	23.00-28.00	3.00-6.00	1.00-3.00	---
SAE J405 JUN98	Type 329	S32900	---	0.08	1.00	0.75	0.040	0.030	23.00-28.00	2.50-5.00	1.0-2.0	---
ASME SA-240/SA-240M	---	S32906	---	0.030	0.80-1.50	0.80	0.030	0.030	28.0-30.0	5.8-7.5	1.50-2.60	Cu 0.80; N 0.30-0.40
ASTM A240/A240M-15a	---	S32906	---	0.030	0.80-1.50	0.80	0.030	0.030	28.0-30.0	5.8-7.5	1.50-2.60	Cu 0.80; N 0.30-0.40
EN 10088-2:2014	X2CrNiMoN29-7-2	---	1.4477	0.030	0.80-1.50	0.50	0.030	0.015	28.0-30.0	5.8-7.5	1.50-2.60	Cu 0.80; N 0.30-0.40

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.5B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steels

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-2:2014	X2CrNiMoSi18-5-3	---	1.4424	$t \leq 8$	---	450	---	700-900	---	25 L, 25 T	SA	see standard for impact data
				$t \leq 13.5$	---	450	---	700-900	---	25 L, 25 T	SA	
				$t \leq 75$	---	400	---	680-900	---	25 L, 25 T	SA	
GB 3280-92	Grade 00Cr18Ni5Mo3Si2	---	---	---	---	390	---	590	---	20	ST	30 max. HRB
GB 4237-92	Grade 00Cr18Ni5Mo3Si2	---	---	---	---	390	---	590	---	20	ST	---
ASME SA-240/SA-240M	---	S31803	---	---	---	450	65	620	90	25	Q+SA	293 max. HB; 31 max. HRC
	Type 2205	S32205	---	---	---	450	65	655	95	25	Q+SA	293 max. HB; 31 max. HRC
ASTM A240/A240M-15a	---	S31803	---	---	---	450	65	620	90	25	SA	293 max. HBW; 31 max. HRC
	Type 2205	S32205	---	---	---	450	65	655	95	25	SA	293 max. HBW; 31 max. HRC
EN 10028-7:2007	X2CrNiMoN22-5-3	---	1.4462	$t \leq 8$	---	485	---	700-950	---	20 L, 20 T	SA	see standard for impact data
				$t \leq 13.5$	---	445	---	700-950	---	25 L, 25 T	SA	
				$t \leq 75$	---	445	---	640-480	---	25 L, 25 T	SA	
EN 10088-2:2014	X2CrNiMoN22-5-3	---	1.4462	$t \leq 8$	---	500	---	700-950	---	20 L, 20 T	SA	---
				$t \leq 13.5$	---	460	---	700-950	---	25 L, 25 T	SA	see standard for impact data
				$t \leq 75$	---	460	---	640-840	---	25 L, 25 T	SA	
ISO 16143-1:2004	X2CrNiMoN22-5-3	---	---	$t \leq 6$	---	480	---	660	---	20 L, 20 T	SA	---
				$t \leq 12$	---	460	---	660	---	20 L, 20 T	SA	---
				$t \leq 75$	---	460	---	640	---	20 L, 20 T	SA	---
ISO 9328-7:2004	Grade X2CrNiMoN22-5-3	---	---	$t \leq 6$	---	465	---	660-950	---	20 L, 20 T	SA	---
				$t \leq 12$	---	445	---	660-950	---	25 L, 25 T	SA	see standard for impact data
				$t \leq 75$	---	445	---	640-840	---	25 L, 25 T	SA	
JIS G 4304:2012	Symbol SUS329J3L	---	---	---	---	450	---	620	---	18	ST	302 max. HBW; 32 max. HRC; 320 max. HV
JIS G 4305:2012	Symbol SUS329J3L	---	---	---	---	450	---	620	---	18	ST	302 max. HBW; 32 max. HRC; 320 max. HV

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.5B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 2304	S32304	---	---	---	400	58	600	87	25	Q+SA	290 max. HB; 32 max. HRC
ASTM A240/A240M-15a	Type 2304	S32304	---	---	---	400	58	600	87	25	SA	290 max. HBW; 32 max. HRC
EN 10028-7:2007	X2CrNiN23-4	---	1.4362	$t \leq 8$	---	405	---	600-850	---	20 L, 20 T	SA	see standard for impact data
				$t \leq 13.5$	---	385	---	600-850	---	20 L, 20 T	SA	
				$t \leq 75$	---	385	---	630-800	---	25 L, 25 T	SA	
EN 10088-2:2014	X2CrNiN23-4	---	1.4362	$t \leq 8$	---	450	---	650-850	---	20 L, 20 T	SA	---
				$t \leq 13.5$	---	400	---	650-850	---	20 L, 20 T	SA	see standard for impact data
				$t \leq 75$	---	400	---	630-800	---	25 L, 25 T	SA	
ISO 16143-1:2004	X2CrNiN23-4	---	---	$t \leq 6$	---	420	---	600	---	20 L, 20 T	SA	---
				$t \leq 12$	---	400	---	600	---	20 L, 20 T	SA	---
				$t \leq 75$	---	400	---	630	---	25 L, 25 T	SA	---
ISO 9328-7:2004	Grade X2CrNiN23-4	---	---	$t \leq 6$	---	405	---	600-850	---	20 L, 20 T	SA	---
				$t \leq 12$	---	385	---	600-850	---	20 L, 20 T	SA	see standard for impact data
				$t \leq 75$	---	385	---	630-800	---	25 L, 25 T	SA	
ASME SA-240/SA-240M	---	S32520	---	---	---	550	80	770	112	25	Q+SA	310 max. HB
ASTM A240/A240M-15a	---	S32520	---	---	---	550	80	770	112	25	SA	310 max. HBW; 32 max. HRC
EN 10028-7:2007	X2CrNiMoCuN25-6-3	---	1.4507	$t \leq 8$	---	495	---	690-940	---	20 L, 20 T	SA	see standard for impact data
				$t \leq 13.5$	---	475	---	690-940	---	20 L, 20 T	SA	
				$t \leq 75$	---	475	---	690-890	---	25 L, 25 T	SA	
EN 10088-2:2014	X2CrNiMoCuN25-6-3	---	1.4507	$t \leq 8$	---	550	---	750-1000	---	20 L, 20 T	SA	---
				$t \leq 13.5$	---	530	---	750-1000	---	20 L, 20 T	SA	see standard for impact data
				$t \leq 75$	---	530	---	730-930	---	25 L, 25 T	SA	
ISO 16143-1:2004	X2CrNiMoCuN25-6-3	---	---	$t \leq 8$	---	550	---	750	---	17 L, 17 T	SA	---
				$t \leq 13.5$	---	530	---	750	---	17 L, 17 T	SA	---
				$t \leq 75$	---	530	---	730	---	25 L, 25 T	SA	---
ISO 9328-7:2004	Grade X2CrNiMoCuN25-6-3	---	---	$t \leq 6$	---	495	---	690-940	---	20 L, 20 T	SA	---
				$t \leq 12$	---	475	---	690-940	---	20 L, 20 T	SA	see standard for impact data
				$t \leq 75$	---	475	---	690-890	---	25 L, 25 T	SA	

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.5B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 4239-91	Grade 00Cr24Ni6Mo3N	---	---	---	---	450	---	620	---	18	ST	---
JIS G 4304:2012	Symbol SUS329J4L	---	---	---	---	450	---	620	---	18	ST	302 max. HBW; 32 max. HRC; 320 max. HV
JIS G 4305:2012	Symbol SUS329J4L	---	---	---	---	450	---	620	---	18	ST	302 max. HBW; 32 max. HRC; 320 max. HV
ASME SA-240/SA-240M	Type 2507	S32750	---	---	---	550	80	795	116	15	Q+SA	310 max. HB; 32 max. HRC
ASTM A240/A240M-15a	Type 2507	S32750	---	---	---	550	80	795	116	15	SA	310 max. HBW; 32 max. HRC
EN 10028-7:2007	X2CrNiMoN25-7-4	---	1.4410	$t \leq 8$	---	535	---	750-1000	---	20 L, 20 T	SA	see standard for impact data
				$t \leq 13.5$	---	515	---	750-1000	---	20 L, 20 T	SA	
				$t \leq 75$	---	515	---	730-930	---	20 L, 20 T	SA	
EN 10088-2:2014	X2CrNiMoN25-7-4	---	1.4410	$t \leq 8$	---	550	---	750-1000	---	20 L, 20 T	SA	---
				$t \leq 13.5$	---	530	---	750-1000	---	20 L, 20 T	SA	see standard for impact data
				$t \leq 75$	---	530	---	730-930	---	20 L, 20 T	SA	
ISO 16143-1:2004	X2CrNiMoN25-7-4	---	---	$t \leq 6$	---	550	---	750	---	15 L, 15 T	SA	---
				$t \leq 12$	---	530	---	750	---	15 L, 15 T	SA	---
				$t \leq 75$	---	530	---	730	---	20 L, 20 T	SA	---
ISO 9328-7:2004	Grade X2CrNiMoN25-7-4	---	---	$t \leq 6$	---	535	---	750-1000	---	20 L, 20 T	SA	---
				$t \leq 12$	---	515	---	750-1000	---	20 L, 20 T	SA	see standard for impact data
				$t \leq 75$	---	515	---	730-930	---	20 L, 20 T	SA	
ASME SA-240/SA-240M	---	S32760	---	---	---	550	80	750	108	25	Q+SA	270 max. HB
ASTM A240/A240M-15a	---	S32760	---	---	---	550	80	750	108	25	SA	270 max. HBW; 28 max. HRC
EN 10028-7:2007	X2CrNiMoCuWN25-7-4	---	1.4501	$t \leq 75$	---	515	---	730-930	---	25 L, 25 T	SA	see standard for impact data
EN 10088-2:2014	X2CrNiMoCuWN25-7-4	---	1.4501	$t \leq 75$	---	530	---	730-930	---	25 L, 25 T	SA	see standard for impact data
ISO 16143-1:2004	X2CrNiMoCuWN25-7-4	---	---	$t \leq 75$	---	530	---	730	---	25 L, 25 T	SA	---
ISO 9328-7:2004	Grade X2CrNiMoCuWN25-7-4	---	---	$t \leq 75$	---	515	---	730-930	---	25 L, 25 T	SA	see standard for impact data

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.5B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 329	S32900	---	---	---	485	70	620	90	15	Q+SA	269 max. HB; 28 max. HRC
ASTM A240/A240M-15a	Type 329	S32900	---	---	---	485	70	620	90	15	SA	269 max. HBW; 28 max. HRC
GB 3280-92	Grade 0Cr26Ni5Mo2	---	---	---	---	390	---	590	---	18	ST	277 max. HB; 29 max. HRB
GB 4237-92	Grade 0Cr26Ni5Mo2	---	---	---	---	390	---	590	---	18	ST	277 max. HB
GB 4239-91	Grade 0Cr26Ni5Mo2	---	---	---	---	390	---	590	---	18	ST	---
JIS G 4304:2012	Symbol SUS329J1	---	---	---	---	390	---	590	---	18	ST	277 max. HBW; 29 max. HRC; 292 max. HV
JIS G 4305:2012	Symbol SUS329J1	---	---	---	---	390	---	590	---	18	ST	277 max. HBW; 29 max. HRC; 292 max. HV
ASME SA-240/SA-240M	---	S32906	---	t < 10.0	t < 0.4	650	94	800	166	25.0	Q+SA	310 max. HB; 32 max. HRC
				t ≥ 10.0	t ≥ 0.4	550	80	750	109	25.0	Q+SA	310 max. HB; 32 max. HRC
ASTM A240/A240M-15a	---	S32906	---	t < 10.0	t < 0.4	650	94	800	166	25.0	SA	310 max. HBW; 32 max. HRC
				t ≥ 10.0	t ≥ 0.4	550	80	750	109	25.0	SA	310 max. HBW; 32 max. HRC
EN 10088-2:2014	X2CrNiMoN29-7-2	---	1.4477	t ≤ 8	---	650	---	800-1050	---	20 L, 20 T	SA	---
				t ≤ 13.5	---	550	---	750-1000	---	20 L, 20 T	SA	see standard for impact data
				t ≤ 75	---	550	---	750-1000	---	20 L, 20 T	SA	

8.2 Stainless Steels: Bar

8.2.1A Chemical Composition of Martensitic Stainless Steels

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-276	Type 403	S40300	---	0.15	1.00	0.50	0.040	0.030	11.50-13.00	---	---	---
ASME SA-479/SA-479M	Type 403	S40300	---	0.15	1.00	0.50	0.040	0.030	11.5-13.0	---	---	---
ASTM A276/A276M-15	Type 403	S40300	---	0.15	1.00	0.50	0.040	0.030	11.5-13.0	---	---	---
ASTM A479/A479M-14	Type 403	S40300	---	0.15	1.00	0.50	0.040	0.030	11.5-13.0	---	---	---
GB 1220-92	Grade 1Cr12	---	---	0.15	1.00	0.50	0.035	0.030	11.50-13.00	0.60	---	---
GB 4226-84	Grade 1Cr12	---	---	0.15	1.00	0.50	0.035	0.030	11.50-13.00	0.60	---	---
JIS G 4303:2012	Symbol SUS403	---	---	0.15	1.00	0.50	0.040	0.030	11.50-13.00	0.60	---	---
JIS G 4318:1998 A1:2007	Symbol SUS403	---	---	0.15	1.00	0.50	0.040	0.030	11.50-13.00	0.60	---	---
ASME SA-240/SA-240M	Type 410	S41000	---	0.08-0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.75	---	---
ASME SA-276	Type 410	S41000	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	---	---	---
ASME SA-479/SA-479M	Type 410	S41000	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	---	---	---
ASTM A240/A240M-15a	Type 410	S41000	---	0.08-0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.75	---	---
ASTM A276/A276M-15	Type 410	S41000	---	0.08-0.15	1.00	1.00	0.040	0.030	11.5-13.5	---	---	---
ASTM A479/A479M-14	Type 410	S41000	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	---	---	---
EN 10088-3:2014	X12Cr13	---	1.4006	0.08-0.15	1.50	1.00	0.040	0.030	11.5-13.5	0.75	---	---
EN 10263-5:2001	X12Cr13	---	1.4006	0.08-0.15	1.50	1.00	0.040	0.030	11.50-13.50	0.75	---	---
GB 1220-92	Grade 1Cr13	---	---	0.15	1.00	1.00	0.035	0.030	11.50-13.50	0.60	---	---
GB 1221-92	Grade 1Cr13	---	---	0.15	1.00	1.00	0.035	0.030	11.50-13.50	0.60	---	---
GB 4226-84	Grade 1Cr13	---	---	0.15	1.00	1.00	0.035	0.030	11.50-13.50	0.60	---	---
ISO 4954:1993	Type X 12 Cr 13 E	---	---	0.09-0.15	1.00	1.00	0.040	0.030	11.5-13.5	1.0	---	---
JIS G 4303:2012	Symbol SUS410	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.60	---	---
JIS G 4318:1998 A1:2007	Symbol SUS410	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.60	---	---
GB 1220-92	Grade 1Cr13Mo	---	---	0.08-0.18	1.00	0.60	0.035	0.030	11.50-14.00	0.60	0.30-0.60	---
GB 1221-92	Grade 1Cr13Mo	---	---	0.08-0.18	1.00	0.60	0.035	0.030	11.50-14.00	0.60	---	Cu 0.30
JIS G 4303:2012	Symbol SUS410J1	---	---	0.08-0.18	1.00	0.60	0.040	0.030	11.50-14.00	0.60	0.30-0.60	---
ASTM A582/A582M-12e1	Type 416	S41600	---	0.15	1.25	1.00	0.06	0.15 min.	12.0-14.0	---	---	---
GB 1220-92	Grade Y1Cr13	---	---	0.15	1.25	1.00	0.060	0.15 min.	12.00-14.00	0.60	0.60	---
GB 4226-84	Grade Y1Cr13	---	---	0.15	1.25	1.00	0.060	0.15	12.00-14.00	0.60	0.60	---
JIS G 4303:2012	Symbol SUS416	---	---	0.15	1.25	1.00	0.060	0.15 min.	12.00-14.00	0.60	0.60	---
JIS G 4318:1998 A1:2007	Symbol SUS416	---	---	0.15	1.25	1.00	0.060	0.15 min.	12.00-14.00	0.60	0.60	---
EN 10088-3:2014	X12CrS13	---	1.4005	0.06-0.15	1.50	1.00	0.040	0.15-0.35	12.0-14.0	---	0.60	---

8.2 Stainless Steels: Bar

8.2.1A Chemical Composition of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-276	Type 420	S42000	---	0.15 min.	1.00	1.00	0.040	0.030	12.00-14.00	---	---	---
ASTM A276/A276M-15	Type 420	S42000	---	0.15 min.	1.00	1.00	0.040	0.030	12.0-14.0	---	---	---
EN 10088-3:2014	X20Cr13	---	1.4021	0.16-0.25	1.50	1.00	0.040	0.030	12.0-14.0	---	---	---
GB 1220-92	Grade 2Cr13	---	---	0.16-0.25	1.00	1.00	0.035	0.030	12.00-14.00	0.60	---	---
GB 1221-92	Grade 2Cr13	---	---	0.16-0.25	1.00	1.00	0.035	0.030	12.00-14.00	0.60	---	---
GB 4226-84	Grade 2Cr13	---	---	0.16-1.25	1.00	1.00	0.035	0.030	12.00-14.00	0.60	---	---
JIS G 4303:2012	Symbol SUS420J1	---	---	0.16-0.25	1.00	1.00	0.040	0.030	12.00-14.00	0.60	---	---
JIS G 4318:1998 A1:2007	Symbol SUS420J1	---	---	0.16-0.25	1.00	1.00	0.040	0.030	12.00-14.00	0.60	---	---
ASTM A582/A582M-12e1	Type 420F	S42020	---	0.30-0.40	1.25	1.00	0.06	0.15 min.	12.0-14.0	0.50	---	Cu 0.60
EN 10088-3:2014	X30Cr13	---	1.4028	0.26-0.35	1.50	1.00	0.040	0.030	12.0-14.0	---	---	---
GB 1220-92	Grade 3Cr13	---	---	0.26-0.35	1.00	1.00	0.035	0.030	12.00-14.00	0.60	---	---
GB 4226-84	Grade 3Cr13	---	---	0.26-0.40	1.00	1.00	0.035	0.030	12.00-14.00	0.60	---	---
JIS G 4303:2012	Symbol SUS420J2	---	---	0.26-0.40	1.00	1.00	0.040	0.030	12.00-14.00	0.60	---	---
JIS G 4318:1998 A1:2007	Symbol SUS420J2	---	---	0.26-0.40	1.00	1.00	0.040	0.030	12.00-14.00	0.60	---	---
EN 10088-3:2014	X29CrS13	---	1.4029	0.25-0.32	1.50	1.00	0.040	0.15-0.25	12.0-13.5	---	0.60	---
GB 1220-92	Grade Y3Cr13	---	---	0.26-0.40	1.25	1.00	0.060	0.15 min.	12.00-14.00	0.60	0.60	---
GB 4226-84	Grade Y3Cr13	---	---	0.26-0.40	1.25	1.00	0.060	0.15 min.	12.00-14.00	0.60	0.60	---
JIS G 4303:2012	Symbol SUS420F	---	---	0.26-0.40	1.25	1.00	0.060	0.15 min.	12.00-14.00	0.60	0.60	---
JIS G 4318:1998 A1:2007	Symbol SUS420F	---	---	0.26-0.40	1.25	1.00	0.060	0.15 min.	12.00-14.00	0.60	0.60	---
ASME SA-276	Type 431	S43100	---	0.20	1.00	1.00	0.040	0.030	15.00-17.00	1.25-2.50	---	---
ASME SA-479/SA-479M	Type 431	S43100	---	0.20	1.00	1.00	0.040	0.030	15.0-17.0	1.25-2.50	---	---
ASTM A276/A276M-15	Type 431	S43100	---	0.20	1.00	1.00	0.040	0.030	15.0-17.0	1.25-2.50	---	---
ASTM A479/A479M-14	Type 431	S43100	---	0.20	1.00	1.00	0.040	0.030	15.0-17.0	1.25-2.50	---	---
EN 10088-3:2014	X17CrNi16-2	---	1.4057	0.12-0.22	1.50	1.00	0.040	0.030	15.0-17.0	1.50-2.50	---	---
ISO 4954:1993	Type X 19 CrNi 16 2 E	---	---	0.14-0.23	1.00	1.00	0.040	0.030	15.0-17.5	1.5-2.5	---	---
JIS G 4303:2012	Symbol SUS431	---	---	0.20	1.00	1.00	0.040	0.030	15.00-17.00	1.25-2.50	---	---
ASME SA-276	Type 440A	S44002	---	0.60-0.75	1.00	1.00	0.040	0.030	16.00-18.00	---	0.75	---
ASTM A276/A276M-15	Type 440A	S44002	---	0.60-0.75	1.00	1.00	0.040	0.030	16.0-18.0	---	0.75	---
EN 10088-3:2014	X70CrMo15	---	1.4109	0.60-0.75	1.00	0.70	0.040	0.030	14.0-16.0	---	0.40-0.80	---
GB 1220-92	Grade 7Cr17	---	---	0.60-0.75	1.00	1.00	0.035	0.030	16.00-18.00	0.60	0.75	---
JIS G 4303:2012	Symbol SUS440A	---	---	0.60-0.75	1.00	1.00	0.040	0.030	16.00-18.00	0.60	0.75	---
ASME SA-276	Type 440B	S44003	---	0.75-0.95	1.00	1.00	0.040	0.030	16.00-18.00	---	0.75	---
ASTM A276/A276M-15	Type 440B	S44003	---	0.75-0.95	1.00	1.00	0.040	0.030	16.0-18.0	---	0.75	---
GB 1220-92	Grade 8Cr17	---	---	0.75-0.95	1.00	1.00	0.035	0.030	16.00-18.00	0.60	0.75	---
JIS G 4303:2012	Symbol SUS440B	---	---	0.75-0.95	1.00	1.00	0.040	0.030	16.00-18.00	0.60	0.75	---

8.2 Stainless Steels: Bar

8.2.1A Chemical Composition of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-276	Type 440C	S44004	---	0.95-1.20	1.00	1.00	0.040	0.030	16.00-18.00	---	0.75	---
ASTM A276/A276M-15	Type 440C	S44004	---	0.95-1.20	1.00	1.00	0.040	0.030	16.0-18.0	---	0.75	---
GB 1220-92	Grade 11Cr17	---	---	0.95-1.20	1.00	1.00	0.035	0.030	16.00-18.00	0.60	0.75	---
GB 4226-84	Grade 11Cr17	---	---	0.95-1.20	1.00	1.00	0.035	0.030	16.00-18.00	0.60	0.75	---
JIS G 4303:2012	Symbol SUS440C	---	---	0.95-1.20	1.00	1.00	0.040	0.030	16.00-18.00	0.60	0.75	---
JIS G 4318:1998 A1:2007	Symbol SUS440C	---	---	0.95-1.20	1.00	1.00	0.040	0.030	16.00-18.00	0.60	0.75	---
EN 10088-3:2014	X105CrMo17	---	1.4125	0.95-1.20	1.00	1.00	0.040	0.030	16.0-18.0	---	0.40-0.80	---
ASTM A565/A565M-10	Grade XM-32	S64152	---	0.08-0.15	0.50-0.90	0.35	0.025	0.025	11.00-12.50	2.00-3.00	1.50-2.00	V 0.25-0.40; N 0.01-0.05
EN 10269:2013	X12CrNiMoV12-3	---	1.4938	0.08-0.15	0.40-0.90	0.50	0.025	0.015	11.0-12.5	2.00-3.00	1.50-2.00	V 0.25-0.40; N 0.020-0.040
EN 10302:2008	X12CrNiMoV12-3	---	1.4938	0.08-0.15	0.40-0.90	0.50	0.025	0.015	11.0-12.5	2.00-3.00	1.50-2.00	V 0.25-0.40; N 0.020-0.040
EN 10269:2013	X19CrMoNbVN11-1	---	1.4913	0.17-0.23	0.40-0.90	0.50	0.025	0.015	10.0-11.5	0.20-0.60	0.50-0.80	V 0.10-0.30; Nb 0.25-0.55; N 0.05-0.10; Al 0.020; B 0.0015
GB 1221-92	Grade 2Cr12MoVNbN	---	---	0.15-0.20	0.50-1.00	0.50	0.035	0.030	10.00-13.00	0.60	0.30-0.90	V 0.10-0.40; Nb 0.20-0.60; N 0.05-0.10
JIS G 4311:2011	Symbol SUH600	---	---	0.15-0.20	0.50-1.00	0.50	0.040	0.030	10.00-13.00	0.60	0.30-0.90	V 0.10-0.40; Nb 0.20-0.60; N 0.05-0.10; Cu 0.30
ASTM A565/A565M-10	Grade 616	S42200	---	0.20-0.25	0.50-1.00	0.50	0.025	0.025	11.00-12.50	0.50-1.00	0.90-1.25	V 0.20-0.30; W 0.90-1.25
GB 1221-92	Grade 2Cr12NiMoWV	---	---	0.20-0.25	0.50-1.00	0.50	0.035	0.030	11.00-13.00	0.50-1.00	0.75-1.25	V 0.20-0.40; W 0.70-1.25
JIS G 4311:2011	Symbol SUH616	---	---	0.20-0.25	0.50-1.00	0.50	0.040	0.030	11.00-13.00	0.50-1.00	0.75-1.25	V 0.20-0.30; Cu 0.30; W 0.75-1.25
ASME SA-276	---	S41500	---	0.05	0.50-1.00	0.60	0.030	0.030	11.50-14.00	3.50-5.50	0.50-1.00	---
ASME SA-479/SA-479M	---	S41500	---	0.05	0.50-1.00	0.60	0.030	0.030	11.5-14.0	3.5-5.5	0.50-1.00	---
ASTM A276/A276M-15	---	S41500	---	0.05	0.50-1.00	0.60	0.030	0.030	11.5-14.0	3.5-5.5	0.50-1.00	---
ASTM A479/A479M-14	---	S41500	---	0.05	0.50-1.00	0.60	0.030	0.030	11.5-14.0	3.5-5.5	0.50-1.00	---
EN 10088-3:2014	X3CrNiMo13-4	---	1.4313	0.05	1.50	0.70	0.040	0.015	12.0-14.0	3.5-4.5	0.30-0.70	N 0.020 min.
ISO 16143-2:2004	X3CrNiMo13-4	---	---	0.05	0.50-1.00	0.70	0.040	0.015	12.0-14.0	3.5-4.5	0.30-1.00	---
EN 10088-3:2014	X39Cr13	---	1.4031	0.36-0.42	1.00	1.00	0.040	0.030	12.5-14.5	---	---	---
GB 1220-92	Grade 4Cr13	---	---	0.36-0.45	0.80	0.60	0.035	0.030	12.00-14.00	0.60	---	---
ASTM A582/A582M-12e1	Type 440F	S44020	---	0.95-1.20	1.25	1.00	0.06	0.15 min.	16.0-18.0	0.50	---	Cu 0.60
GB 1220-92	Grade Y11Cr17	---	---	0.95-1.20	1.25	1.00	0.060	0.15 min.	16.00-18.00	0.60	0.75	---
JIS G 4303:2012	Symbol SUS440F	---	---	0.95-1.20	1.25	1.00	0.060	0.15 min.	16.00-18.00	0.60	0.75	---
EN 10088-3:2014	X90CrMoV18	---	1.4112	0.85-0.95	1.00	1.00	0.040	0.030	17.0-19.0	---	0.90-1.30	V 0.07-0.12
GB 1220-92	Grade 9Cr18MoV	---	---	0.85-0.95	0.80	0.80	0.035	0.030	17.00-19.00	0.60	1.00-1.30	V 0.07-0.12
GB 1221-92	Grade 8Cr20Si2Ni	---	---	0.75-0.85	0.20-0.60	1.75-2.25	0.030	0.030	19.00-20.50	1.15-1.65	---	---
JIS G 4311:2011	Symbol SUH4	---	---	0.75-0.85	0.20-0.60	1.75-2.25	0.030	0.030	19.00-20.50	1.15-1.65	---	Cu 0.30

8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type 403	S40300	---	---	---	275	40	480	70	20	A and HF	---
				---	---	275	40	480	70	16	A and CF	---
				---	---	550	80	690	100	15	H+T and HF	---
				---	---	550	80	690	100	12	H+T and CF	---
				---	---	620	90	830	120	12	H+T and HF	---
				---	---	620	90	830	120	12	H+T and CF	---
ASME SA-479/SA-479M	Type 403	S40300	---	---	---	275	40	485	70	20	A	223 max. HB
				---	---	275	40	485	70	20	T	223 max. HB
				---	---	585	85	760	110	15	T	269 max. HB
				---	---	690	100	895	130	12	T	331 max. HB
ASTM A276/A276M-15	Type 403	S40300	---	---	---	275	40	480	70	20	A+HF	---
				---	---	275	40	480	70	16	A+CF	---
				---	---	550	80	690	100	15	H+T and HF	---
				---	---	550	80	690	100	12	H+T and CF	---
				---	---	620	90	830	120	12	H+T and HF	---
				---	---	620	90	830	120	12	H+T and CF	---
ASTM A479/A479M-14	Type 403	S40300	---	---	---	275	40	485	70	20	A	223 max. HB
				---	---	275	40	485	70	20	T	223 max. HB
				---	---	585	85	760	110	15	T	269 max. HB
				---	---	690	100	895	130	12	T	331 max. HB
GB 1220-92	Grade 1Cr12	---	---	t ≤ 75	---	390	---	590	---	25	Q+T	170 min. HB; 118 J @ RT
				t ≤ 75	---	---	---	---	---	---	A	200 max. HB
JIS G 4303:2012	Symbol SUS403	---	---	d ≤ 75	---	---	---	---	---	---	A	200 max. HBW; 93 max. HRBW; 210 max. HV
				d ≤ 75	---	390	---	590	---	25	Q+T	170 min. HBW; 87 min. HRBW; 178 min. HV

8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-240/SA-240M	Type 410	S41000	---	---	---	205	30	450	65	20	see standard	217 max. HB; 96 max. HRB
ASME SA-276	Type 410	S41000	---	---	---	275	40	480	70	20	A and HF	---
				---	---	275	40	480	70	16	A and CF	---
				---	---	550	80	690	100	15	H+T and HF	---
				---	---	550	80	690	100	12	H+T and CF	---
				---	---	620	90	830	120	12	H+T and HF	---
				---	---	620	90	830	120	12	H+T and CF	---
ASME SA-479/SA-479M	Type 410	S41000	---	---	---	275	40	485	70	20	A	223 max. HB
				---	---	275	40	485	70	20	T	223 max. HB
				---	---	585	85	760	110	15	T	269 max. HB
				---	---	690	100	895	130	12	T	331 max. HB
ASTM A240/A240M-15a	Type 410	S41000	---	---	---	205	30	450	65	20	---	217 max. HBW; 96 max. HRBW
ASTM A276/A276M-15	Type 410	S41000	---	---	---	275	40	480	70	20	A+HF	---
				---	---	275	40	480	70	16	A+CF	---
				---	---	550	80	690	100	15	H+T and HF	---
				---	---	550	80	690	100	12	H+T and CF	---
				---	---	620	90	830	120	12	H+T and HF	---
				---	---	620	90	830	120	12	H+T and CF	---
ASTM A479/A479M-14	Type 410	S41000	---	---	---	275	40	485	70	20	A	223 max. HB
				---	---	275	40	485	70	20	T	223 max. HB
				---	---	585	85	760	110	15	T	269 max. HB
				---	---	690	100	895	130	12	T	331 max. HB

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8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X12Cr13	---	1.4006	---	---	---	---	730 max.	---	---	A	220 max. HBW
				0.50 < d ≤ 1.00	---	---	---	1100 max.	---	10	A+PH	---
				1.00 < d ≤ 3.00	---	---	---	1050 max.	---	10	A+PH	---
				3.00 < d ≤ 5.00	---	---	---	1000 max.	---	10	A+PH	---
				t ≤ 10	---	---	---	880	---	---	A	280 max. HB
				t ≤ 10	---	550	---	700-1000	---	9 L	Q+T	---
				10 < t ≤ 16	---	---	---	880	---	---	A	280 max. HB
				10 < t ≤ 16	---	500	---	700-1000	---	9 L	Q+T	---
				5.00 < d ≤ 16.00	---	---	---	950 max.	---	15	A+PH	---
				16 < t ≤ 40	---	---	---	800	---	---	A	250 max. HB
				16 < t ≤ 40	---	450	---	650-930	---	10 L	Q+T	L: 25 J @ RT
				40 < t ≤ 63	---	---	---	760	---	---	A	230 max. HB
				40 < t ≤ 63	---	450	---	650-880	---	10 L	Q+T	L: 25 J @ RT
				t ≤ 160	---	450	---	650-850	---	15 L	Q+T	L: 25 J @ RT
				63 < t ≤ 160	---	---	---	730	---	---	A	220 max. HB
				63 < t ≤ 160	---	450	---	650-850	---	15 L	Q+T	L: 25 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---

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8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10263-5:2001	X12Cr13	---	1.4006	2 < d ≤ 5	---	---	---	600 max. L	---	---	CD+A	---
				2 < d ≤ 5	---	---	---	660 max. L	---	---	CD+A	---
				5 < d ≤ 10	---	---	---	600 max. L	---	---	A	---
				5 < d ≤ 10	---	---	---	720 max. L	---	---	A	---
				5 < d ≤ 10	---	---	---	600 max. L	---	---	CD+A	---
				5 < d ≤ 10	---	---	---	640 max. L	---	---	CD+A	---
				10 < d ≤ 25	---	---	---	600 max. L	---	---	A	---
				10 < d ≤ 25	---	---	---	700 max. L	---	---	A	---
				10 < d ≤ 25	---	---	---	600 max. L	---	---	CD+A	---
				25 < d ≤ 100	---	---	---	600 max. L	---	---	A	---
GB 1220-92	Grade 1Cr13	---	---	t ≤ 75	---	345	---	540	---	25	Q+T	159 min. HB; 78 J @ RT
				t ≤ 75	---	---	---	---	---	---	A	200 max. HB
GB 1221-92	Grade 1Cr13	---	---	t ≤ 75	---	345	---	540	---	25	Q+T	159 min. HB; 78 J @ RT
				t ≤ 75	---	---	---	---	---	---	A	200 max. HB
ISO 4954:1993	Type X 12 Cr 13 E	---	---	2 ≤ d ≤ 100	---	---	---	600 max.	---	---	A, CW	---
				2 ≤ d ≤ 100	---	---	---	640 max.	---	---	A, CW	---
JIS G 4303:2012	Symbol SUS410	---	---	d ≤ 75	---	---	---	---	---	---	A	200 max. HBW; 93 max. HRBW; 210 max. HV
				d ≤ 75	---	345	---	540	---	25	Q+T	159 min. HBW; 84 min. HRBW; 166 min. HV
GB 1220-92	Grade 1Cr13Mo	---	---	t ≤ 75	---	490	---	685	---	20	Q+T	192 min. HB; 78 J @ RT
				t ≤ 75	---	---	---	---	---	---	A	200 max. HB
GB 1221-92	Grade 1Cr13Mo	---	---	t ≤ 75	---	490	---	685	---	20	Q+T	192 min. HB; 78 J @ RT
				t ≤ 75	---	---	---	---	---	---	A	200 max. HB
JIS G 4303:2012	Symbol SUS410J1	---	---	d ≤ 75	---	---	---	---	---	---	A	200 max. HBW; 93 max. HRBW; 210 max. HV
				d ≤ 75	---	490	---	690	---	20	Q+T	192 min. HBW; 92 min. HRBW; 200 min. HV

8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A582/A582M-12e1	Type 416	S41600	---	---	---	---	---	---	---	---	A	262 max. HBW
				---	---	---	---	---	---	---	T	248-302 HBW
				---	---	---	---	---	---	---	H	293-352 HBW
GB 1220-92	Grade Y1Cr13	---	---	t ≤ 75	---	345	---	540	---	25	Q+T	159 min. HB; 78 J @ RT
				t ≤ 75	---	---	---	---	---	---	A	200 max. HB
JIS G 4303:2012	Symbol SUS416	---	---	d ≤ 75	---	---	---	---	---	---	A	200 max. HBW; 93 max. HRBW; 210 max. HV
				d ≤ 75	---	345	---	540	---	17	Q+T	159 min. HBW; 84 min. HRBW; 166 min. HV
EN 10088-3:2014	X12CrS13	---	1.4005	---	---	---	---	730 max.	---	---	A	220 max. HBW
				0.50 < d ≤ 1.00	---	---	---	1100 max.	---	10	A+PH	---
				1.00 < d ≤ 3.00	---	---	---	1050 max.	---	10	A+PH	---
				3.00 < d ≤ 5.00	---	---	---	1000 max.	---	10	A+PH	---
				t ≤ 10	---	---	---	880	---	---	A	280 max. HB
				t ≤ 10	---	550	---	700-1000	---	8 L	Q+T	---
				10 < t ≤ 16	---	---	---	880	---	---	A	280 max. HB
				10 < t ≤ 16	---	500	---	700-1000	---	8 L	Q+T	---
				5.00 < d ≤ 16.00	---	---	---	950 max.	---	15	A+PH	---
				16 < t ≤ 40	---	---	---	800	---	---	A	250 max. HB
				16 < t ≤ 40	---	450	---	650-930	---	10 L	Q+T	---
				40 < t ≤ 63	---	---	---	760	---	---	A	230 max. HB
				40 < t ≤ 63	---	450	---	650-880	---	10 L	Q+T	---
				t ≤ 160	---	450	---	650-850	---	12 L	Q+T	---
				63 < t ≤ 160	---	---	---	730	---	---	A	220 max. HB
				63 < t ≤ 160	---	450	---	650-850	---	12 L	Q+T	---
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---

8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type 420	S42000	---	---	---	---	---	---	---	---	A and HF	241 max. HB
				---	---	---	---	---	---	---	A and CF	255 max. HB
ASTM A276/A276M-15	Type 420	S42000	---	---	---	---	---	---	---	---	A+HF	241 max. HBW
				---	---	---	---	---	---	---	A+CF	255 max. HBW
EN 10088-3:2014	X20Cr13	---	1.4021	---	---	---	---	760 max.	---	---	A	230 max. HBW
				0.50 < d ≤ 1.00	---	---	---	1100 max.	---	10	A+PH	---
				1.00 < d ≤ 3.00	---	---	---	1050 max.	---	10	A+PH	---
				3.00 < d ≤ 5.00	---	---	---	1000 max.	---	10	A+PH	---
				t ≤ 10	---	---	---	910	---	---	A	290 max. HB
				t ≤ 10	---	600	---	750-1000	---	8 L	Q+T	---
				10 < t ≤ 16	---	---	---	910	---	---	A	290 max. HB
				10 < t ≤ 16	---	550	---	750-1000	---	8 L	Q+T	---
				5.00 < d ≤ 16.00	---	---	---	950 max.	---	15	A+PH	---
				16 < t ≤ 40	---	---	---	850	---	---	A	260 max. HB
				16 < t ≤ 40	---	500	---	700-950	---	10 L	Q+T	L: 25 J @ RT
				40 < t ≤ 63	---	---	---	800	---	---	A	250 max. HB
				40 < t ≤ 63	---	500	---	700-900	---	12 L	Q+T	L: 25 J @ RT
				t ≤ 160	---	600	---	800-950	---	12 L	Q+T	L: 20 J @ RT
				t ≤ 160	---	500	---	700-850	---	13 L	Q+T	L: 25 J @ RT
				63 < t ≤ 160	---	---	---	760	---	---	A	230 max. HB
				63 < t ≤ 160	---	500	---	700-850	---	13 L	Q+T	L: 25 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---
GB 1220-92	Grade 2Cr13	---	---	t ≤ 75	---	440	---	635	---	20	Q+T	192 min. HB; 63 J @ RT
				t ≤ 75	---	---	---	---	---	---	A	223 max. HB
GB 1221-92	Grade 2Cr13	---	---	t ≤ 75	---	440	---	635	---	20	Q+T	192 min. HB; 63 J @ RT
				t ≤ 75	---	---	---	---	---	---	A	223 max. HB

Note: This section continued on next page

8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 4303:2012	Symbol SUS420J1	---	---	d ≤ 75	---	---	---	---	---	---	A	223 max. HBW; 97 max. HRBW; 234 max. HV
				d ≤ 75	---	440	---	640	---	20	Q+T	192 min. HBW; 92 min. HRBW; 200 min. HV
ASTM A582/A582M-12e1	Type 420F	S42020	---	---	---	---	---	---	---	---	A	262 max. HBW
EN 10088-3:2014	X30Cr13	---	1.4028	---	---	---	---	800 max.	---	---	A	245 max. HBW
				0.50 < d ≤ 1.00	---	---	---	1100 max.	---	10	A+PH	---
				1.00 < d ≤ 3.00	---	---	---	1050 max.	---	10	A+PH	---
				3.00 < d ≤ 5.00	---	---	---	1000 max.	---	10	A+PH	---
				t ≤ 10	---	---	---	950	---	---	A	305 max. HB
				t ≤ 10	---	700	---	900-1050	---	7 L	Q+T	---
				10 < t ≤ 16	---	---	---	950	---	---	A	305 max. HB
				10 < t ≤ 16	---	650	---	900-1150	---	7 L	Q+T	---
				5.00 < d ≤ 16.00	---	---	---	950 max.	---	15	A+PH	---
				16 < t ≤ 40	---	---	---	900	---	---	A	280 max. HB
				16 < t ≤ 40	---	650	---	850-1100	---	9 L	Q+T	L: 12 J @ RT
				40 < t ≤ 63	---	---	---	840	---	---	A	260 max. HB
				40 < t ≤ 63	---	650	---	850-1050	---	9 L	Q+T	L: 12 J @ RT
				t ≤ 160	---	650	---	850-1000	---	10 L	Q+T	L: 12 J @ RT
				63 < t ≤ 160	---	---	---	800	---	---	A	245 max. HB
				63 < t ≤ 160	---	650	---	850-1000	---	10 L	Q+T	L: 15 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---
GB 1220-92	Grade 3Cr13	---	---	t ≤ 75	---	540	---	735	---	12	Q+T	217 min. HB; 24 J @ RT
				t ≤ 75	---	---	---	---	---	---	A	235 max. HB

Note: This section continued on next page

8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 4303:2012	Symbol SUS420J2	---	---	d ≤ 75	---	---	---	---	---	---	A	235 max. HBW; 99 max. HRBW; 247 max. HV
				d ≤ 75	---	540	---	740	---	12	Q+T	217 min. HBW; 95 min. HRBW; 220 min. HV
EN 10088-3:2014	X29CrS13	---	1.4029	t ≤ 10	---	---	---	950	---	---	A	305 max. HB
				t ≤ 10	---	750	---	900-1100	---	8 L	Q+T	---
				10 < t ≤ 16	---	---	---	950	---	---	A	305 max. HB
				10 < t ≤ 16	---	700	---	900-1100	---	8 L	Q+T	---
				16 < t ≤ 40	---	---	---	900	---	---	A	280 max. HB
				16 < t ≤ 40	---	650	---	850-1100	---	10 L	Q+T	---
				40 < t ≤ 63	---	---	---	840	---	---	A	260 max. HB
				40 < t ≤ 63	---	650	---	850-1050	---	10 L	Q+T	---
				t ≤ 160	---	---	---	800 max.	---	---	A	245 max. HBW
				t ≤ 160	---	650	---	850-1000	---	9 L	Q+T	---
				63 < t ≤ 160	---	---	---	800	---	---	A	245 max. HB
GB 1220-92	Grade Y3Cr13	---	---	t ≤ 75	---	540	---	735	---	12	Q+T	217 min. HB; 24 J @ RT
				t ≤ 75	---	---	---	---	---	---	A	235 max. HB
JIS G 4303:2012	Symbol SUS420F	---	---	d ≤ 75	---	---	---	---	---	---	A	235 max. HBW; 99 max. HRBW; 247 max. HV
				d ≤ 75	---	540	---	740	---	8	Q+T	217 min. HBW; 95 min. HRBW; 220 min. HV
ASME SA-276	Type 431	S43100	---	---	---	---	---	---	---	---	A and HF or A and CF	285 max. HB
ASME SA-479/SA-479M	Type 431	S43100	---	---	---	---	---	---	---	---	A	277 max. HB
				---	---	620	90	795	115	15	T	321 max. HB
ASTM A276/A276M-15	Type 431	S43100	---	---	---	---	---	---	---	---	A+HF; or A+CF	285 max. HBW
ASTM A479/A479M-14	Type 431	S43100	---	---	---	---	---	---	---	---	A	277 max. HB
				---	---	620	90	795	115	15	T	321 max. HB

Note: This section continued on next page

8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X17CrNi16-2	---	1.4057	---	---	---	---	950 max.	---	---	A	295 max. HBW
				0.50 < d ≤ 1.00	---	---	---	1100 max.	---	10	A+PH	---
				1.00 < d ≤ 3.00	---	---	---	1050 max.	---	10	A+PH	---
				3.00 < d ≤ 5.00	---	---	---	1000 max.	---	10	A+PH	---
				t ≤ 10	---	---	---	1050	---	---	A	330 max. HB
				t ≤ 10	---	750	---	850-1100	---	7 L	Q+T	---
				10 < t ≤ 16	---	---	---	1050	---	---	A	330 max. HB
				10 < t ≤ 16	---	700	---	850-1100	---	7 L	Q+T	---
				5.00 < d ≤ 16.00	---	---	---	950 max.	---	15	A+PH	---
				16 < t ≤ 40	---	---	---	1000	---	---	A	310 max. HB
				16 < t ≤ 40	---	650	---	800-1050	---	9 L	Q+T	L: 25 J @ RT
				t ≤ 60	---	700	---	900-1050	---	12 L	Q+T	L: 16 J @ RT
				t ≤ 60	---	600	---	800-950	---	14 L	Q+T	L: 25 J @ RT
				40 < t ≤ 63	---	---	---	950	---	---	A	295 max. HB
				40 < t ≤ 63	---	650	---	800-1000	---	12 L	Q+T	L: 25 J @ RT
				60 < t ≤ 160	---	700	---	900-1050	---	10 L	Q+T	L: 15 J @ RT
				60 < t ≤ 160	---	600	---	800-950	---	12 L	Q+T	L: 20 J @ RT
				63 < t ≤ 160	---	---	---	950	---	---	A	295 max. HB
				63 < t ≤ 160	---	650	---	800-950	---	12 L	Q+T	L: 16 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---
ISO 4954:1993	Type X 19 CrNi 16 2 E	---	---	2 ≤ d ≤ 100	---	---	---	800 max.	---	---	A, CW	---
				2 ≤ d ≤ 100	---	---	---	840 max.	---	---	A, CW	---
JIS G 4303:2012	Symbol SUS431	---	---	d ≤ 75	---	---	---	---	---	---	A	302 max. HBW; 32 max. HRC; 320 max. HV
				d ≤ 75	---	590	---	780	---	15	Q+T	229 min. HBW; 98 min. HRBW; 241 min. HV

8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type 440A	S44002	---	---	---	---	---	---	---	---	A and HF	269 max. HB
				---	---	---	---	---	---	---	A and CF	285 max. HB
ASTM A276/A276M-15	Type 440A	S44002	---	---	---	---	---	---	---	---	A+HF	269 max. HBW
				---	---	---	---	---	---	---	A+CF	285 max. HBW
EN 10088-3:2014	X70CrMo15	---	1.4109	t ≤ 100	---	---	---	900 max.	---	---	A	280 max. HBW
GB 1220-92	Grade 7Cr17	---	---	t ≤ 75	---	---	---	---	---	---	Q+T	---
				t ≤ 75	---	---	---	---	---	---	A	255 max. HB
JIS G 4303:2012	Symbol SUS440A	---	---	d ≤ 75	---	---	---	---	---	---	A	255 max. HBW; 25 max. HRC; 269 max. HV
				d ≤ 75	---	---	---	---	---	---	Q+T	54 min. HRBW; 577 min. HV
ASME SA-276	Type 440B	S44003	---	---	---	---	---	---	---	---	A and HF	269 max. HB
				---	---	---	---	---	---	---	A and CF	285 max. HB
ASTM A276/A276M-15	Type 440B	S44003	---	---	---	---	---	---	---	---	A+HF	269 max. HBW
				---	---	---	---	---	---	---	A+CF	285 max. HBW
GB 1220-92	Grade 8Cr17	---	---	t ≤ 75	---	---	---	---	---	---	Q+T	---
				t ≤ 75	---	---	---	---	---	---	A	255 max. HB
JIS G 4303:2012	Symbol SUS440B	---	---	d ≤ 75	---	---	---	---	---	---	A	255 max. HBW; 25 max. HRC; 269 max. HV
				d ≤ 75	---	---	---	---	---	---	Q+T	56 min. HRBW; 613 min. HV
ASME SA-276	Type 440C	S44004	---	---	---	---	---	---	---	---	A and HF	269 max. HB
				---	---	---	---	---	---	---	A and CF	285 max. HB
ASTM A276/A276M-15	Type 440C	S44004	---	---	---	---	---	---	---	---	A+HF	269 max. HBW
				---	---	---	---	---	---	---	A+CF	285 max. HBW
GB 1220-92	Grade 11Cr17	---	---	t ≤ 75	---	---	---	---	---	---	Q+T	---
				t ≤ 75	---	---	---	---	---	---	A	269 max. HB
JIS G 4303:2012	Symbol SUS440C	---	---	d ≤ 75	---	---	---	---	---	---	A	269 max. HBW; 28 max. HRC; 284 max. HV
				d ≤ 75	---	---	---	---	---	---	Q+T	58 min. HRC; 653 min. HV
EN 10088-3:2014	X105CrMo17	---	1.4125	t ≤ 100	---	---	---	---	---	---	A	285 max. HBW
ASTM A565/A565M-10	Grade XM-32	S64152	---	---	---	---	---	---	---	---	A	311 max. HB
				---	---	795	115	1000 L	145 L	15	HT	302-352 HB; 40 J @ RT
EN 10269:2013	X12CrNiMoV12-3	---	1.4938	d ≤ 160	---	760	---	930-1130 L	---	14 L	Q+T	L: 40 J @ 20°C
				---	---	---	---	---	---	---	A	311 max. HBW
EN 10302:2008	X12CrNiMoV12-3	---	1.4938	---	---	760	---	930-1130	---	14	Q+T	---

8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10269:2013	X19CrMoNbVN11-1	---	1.4913	d ≤ 160	---	750	---	900-1050 L	---	12 L	Q+T	L: 20 J @ 20°C
				---	---	---	---	---	---	---	A	302 max. HBW
GB 1221-92	Grade 2Cr12MoVNbN	---	---	t ≤ 75	---	685	---	835	---	15	Q+T	321 max. HB
				t ≤ 75	---	---	---	---	---	---	A	269 max. HB
JIS G 4311:2011	Symbol SUH600	---	---	---	---	---	---	---	---	---	A	269 max. HBW
				t ≤ 75	---	685	---	830	---	15	Q+T	321 max. HBW
ASTM A565/A565M-10	Grade 616	S42200	---	---	---	---	---	---	---	---	A	248 max. HB
				---	---	---	---	---	---	---	HT	285 max. HB
				---	---	760	110	965 L	140 L	13	HT	302-352 HB; 11 J @ RT
				---	---	585	85	825 L	120 L	17	HT	241-285 HB
GB 1221-92	Grade 2Cr12NiMoWV	---	---	t ≤ 75	---	735	---	885	---	10	Q+T	341 max. HB
				t ≤ 75	---	---	---	---	---	---	A	269 max. HB
JIS G 4311:2011	Symbol SUH616	---	---	---	---	---	---	---	---	---	A	269 max. HBW
				t ≤ 75	---	735	---	880	---	10	Q+T	341 max. HBW
ASME SA-276	---	S41500	---	---	---	620	90	795	115	15	H+T and HF or H+T and CF	295 max. HB
ASME SA-479/SA-479M	---	S41500	---	---	---	620	90	795	115	15	N+T	293 max. HB
ASTM A276/A276M-15	---	S41500	---	---	---	620	90	795	115	15	H+T and HF or H+T and CF	295 max. HBW
ASTM A479/A479M-14	---	S41500	---	---	---	620	90	795	115	15	N+T	293 max. HB
EN 10088-3:2014	X3CrNiMo13-4	---	1.4313	---	---	---	---	1100 max.	---	---	A	320 max. HBW
				t ≤ 160	---	800	---	900-1100	---	12 L	Q+T	L: 50 J @ RT
				t ≤ 160	---	620	---	780-980	---	15 L	Q+T	L: 70 J @ RT
				t ≤ 160	---	520	---	700-850	---	15 L	Q+T	L: 70 J @ RT
				160 < t ≤ 250	---	800	---	900-1100	---	10 T	Q+T	T: 40 J @ RT
				160 < t ≤ 250	---	620	---	780-980	---	12 T	Q+T	T: 50 J @ RT
				160 < t ≤ 250	---	520	---	700-850	---	12 T	Q+T	T: 50 J @ RT
ISO 16143-2:2004	X3CrNiMo13-4	---	---	---	---	---	---	1100 max.	---	---	A	320 max. HBW
				t ≤ 160	---	800	---	900-1100	---	12 L	Q+T	---
				t ≤ 160	---	620	---	780-980	---	15 L	Q+T	---
				t ≤ 160	---	520	---	700-800	---	15 L	Q+T	---

8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X39Cr13	---	1.4031	---	---	---	---	800 max.	---	---	A	245 max. HBW
				$t \leq 10$	---	---	---	950	---	---	A	305 max. HB
				$t \leq 10$	---	700	---	850-1100	---	7 L	Q+T	---
				$10 < t \leq 16$	---	---	---	950	---	---	A	305 max. HB
				$10 < t \leq 16$	---	700	---	850-1100	---	7 L	Q+T	---
				$16 < t \leq 40$	---	---	---	900	---	---	A	280 max. HB
				$16 < t \leq 40$	---	650	---	800-1050	---	8 L	Q+T	L: 12 J @ RT
				$40 < t \leq 63$	---	---	---	840	---	---	A	260 max. HB
				$40 < t \leq 63$	---	650	---	800-1000	---	8 L	Q+T	L: 12 J @ RT
				$t \leq 160$	---	650	---	800-1000	---	10 L	Q+T	L: 12 J @ RT
				$63 < t \leq 160$	---	---	---	800	---	---	A	245 max. HB
GB 1220-92	Grade 4Cr13	---	---	$t \leq 75$	---	---	---	---	---	---	Q+T	---
				$t \leq 75$	---	---	---	---	---	---	A	201 max. HB
				---	---	---	---	---	---	---	A	285 max. HB
ASTM A582/A582M-12e1	Type 440F	S44020	---	---	---	---	---	---	---	---	A	285 max. HB
GB 1220-92	Grade Y11Cr17	---	---	$t \leq 75$	---	---	---	---	---	---	Q+T	---
				$t \leq 75$	---	---	---	---	---	---	A	269 max. HB
JIS G 4303:2012	Symbol SUS440F	---	---	$d \leq 75$	---	---	---	---	---	---	A	269 max. HBW; 28 max. HRC; 284 max. HV
				$d \leq 75$	---	---	---	---	---	---	Q+T	58 min. HRC; 653 min. HV
EN 10088-3:2014	X90CrMoV18	---	1.4112	$t \leq 100$	---	---	---	---	---	---	A	265 max. HBW
GB 1220-92	Grade 9Cr18MoV	---	---	$t \leq 75$	---	---	---	---	---	---	Q+T	---
				$t \leq 75$	---	---	---	---	---	---	A	269 max. HB
GB 1221-92	Grade 8Cr20Si2Ni	---	---	$t \leq 75$	---	685	---	885	---	10	Q+T	262 min. HB; 8 J @ RT
				$t \leq 75$	---	---	---	---	---	---	A	321 max. HB
JIS G 4311:2011	Symbol SUH4	---	---	---	---	---	---	---	---	---	A	321 max. HBW
				$t \leq 75$	---	685	---	880	---	10	Q+T	262 min. HBW

8.2 Stainless Steels: Bar

8.2.2A Chemical Composition of Ferritic Stainless Steels

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10088-3:2014	X6Cr13	---	1.4000	0.08	1.00	1.00	0.040	0.030	12.0-14.0	---	---	---
ISO 4955:2005	X6Cr13	---	---	0.08	1.00	1.00	0.040	0.030	12.0-14.0	1.00	---	---
ASME SA-276	Type 405	S40500	---	0.08	1.00	1.00	0.040	0.030	11.50-14.50	---	---	Al 0.10-0.30
ASME SA-479/SA-479M	Type 405	S40500	---	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.50	---	Al 0.10-0.30
ASTM A276/A276M-15	Type 405	S40500	---	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.50	---	Al 0.10-0.30
ASTM A479/A479M-14	Type 405	S40500	---	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.50	---	Al 0.10-0.30
GB 1220-92	Grade 0Cr13Al	---	---	0.08	1.00	1.00	0.035	0.030	11.50-14.50	0.60	---	Al 0.10-0.30
GB 1221-92	Grade 0Cr13Al	---	---	0.08	1.00	1.00	0.040	0.030	11.50-14.50	---	---	Al 0.10-0.30
JIS G 4303:2012	Symbol SUS405	---	---	0.08	1.00	1.00	0.040	0.030	11.50-14.50	0.60	---	Al 0.10-0.30
EN 10088-3:2014	X2CrNi12	---	1.4003	0.030	1.50	1.00	0.040	0.030	10.5-12.5	0.30-1.00	---	N 0.030
GB 1220-92	Grade 00Cr12	---	---	0.030	1.00	1.00	0.035	0.030	11.00-13.00	0.60	---	---
GB 1221-92	Grade 00Cr12	---	---	0.030	1.00	1.00	0.040	0.030	11.00-13.00	---	---	---
JIS G 4303:2012	Symbol SUS410L	---	---	0.030	1.00	1.00	0.040	0.030	11.00-13.50	0.60	---	---
EN 10088-3:2014	X6Cr17	---	1.4016	0.08	1.00	1.00	0.040	0.030	16.0-18.0	---	---	---
EN 10263-5:2001	X6Cr17	---	1.4016	0.08	1.00	1.00	0.040	0.030	16.00-18.00	---	---	---
ISO 4954:1993	Type X 6 Cr 17 E	---	---	0.08	1.00	1.00	0.040	0.030	16.0-18.0	1.0	---	---
ISO 4955:2005	X6Cr17	---	---	0.08	1.00	1.00	0.040	0.030	16.0-18.0	1.00	---	---
ASME SA-276	Type 430	S43000	---	0.12	1.00	1.00	0.040	0.030	16.00-18.00	---	---	---
ASME SA-479/SA-479M	Type 430	S43000	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	---	---
ASTM A276/A276M-15	Type 430	S43000	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	---	---
ASTM A479/A479M-14	Type 430	S43000	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	---	---
GB 1220-92	Grade 1Cr17	---	---	0.12	1.00	0.75	0.035	0.030	16.00-18.00	0.60	---	---
GB 1221-92	Grade 1Cr17	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	---	---	---
GB 4226-84	Grade 1Cr17	---	---	0.12	1.00	0.75	0.035	0.030	16.00-18.00	0.60	---	---
JIS G 4303:2012	Symbol SUS430	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	0.60	---	---
JIS G 4318:1998 A1:2007	Symbol SUS430	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	0.60	---	---
ASTM A582/A582M-12e1	Type 430F	S43020	---	0.12	1.25	1.00	0.06	0.15 min.	16.0-18.0	---	---	---
EN 10088-3:2014	X6CrMoS17	---	1.4105	0.08	1.50	1.50	0.040	0.15-0.35	16.0-18.0	---	0.20-0.60	---
GB 1220-92	Grade Y1Cr17	---	---	0.12	1.25	1.00	0.060	0.15 min.	16.00-18.00	0.60	0.60	---
GB 4226-84	Grade Y1Cr17	---	---	0.12	1.25	1.00	0.060	0.15 min.	16.00-18.00	0.60	0.60	---
ISO 16143-2:2004	X7CrS17	---	---	0.09	1.50	1.50	0.040	0.15 min.	16.0-18.0	---	0.60	---
JIS G 4303:2012	Symbol SUS430F	---	---	0.12	1.25	1.00	0.060	0.15 min.	16.00-18.00	0.60	0.60	---
JIS G 4318:1998 A1:2007	Symbol SUS430F	---	---	0.12	1.25	1.00	0.060	0.15 min.	16.00-18.00	0.60	0.60	---
ASTM A582/A582M-12e1	---	S18235	---	0.025	0.50	1.00	0.030	0.15-0.35	17.5-18.5	1.00	2.00-2.50	(C+N) 0.035 max.; Ti 0.30-1.00; N 0.025
EN 10088-3:2014	X2CrMoTiS18-2	---	1.4523	0.030	0.50	1.00	0.040	0.15-0.35	17.5-19.0	---	2.00-2.50	Ti [4x(C+N)+0.15] to 0.80; (C+N) 0.040 max.

8.2 Stainless Steels: Bar

8.2.2A Chemical Composition of Ferritic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10088-3:2014	X6CrMo17-1	---	1.4113	0.08	1.00	1.00	0.040	0.030	16.0-18.0	---	0.90-1.40	---
EN 10263-5:2001	X6CrMo17-1	---	1.4113	0.08	1.00	1.00	0.040	0.030	16.00-18.00	---	0.90-1.40	---
GB 1220-92	Grade 1Cr17Mo	---	---	0.12	1.00	1.00	0.035	0.030	16.00-18.00	0.60	0.75-1.25	---
ISO 4954:1993	Type X 6 CrMo 17 1 E	---	---	0.08	1.00	1.00	0.040	0.030	16.0-18.0	1.0	0.90-1.30	---
JIS G 4303:2012	Symbol SUS434	---	---	0.12	1.00	1.00	0.040	0.030	16.00-18.00	0.60	0.75-1.25	---
ASME SA-276	Type XM-27	S44627	---	0.010	0.40	0.40	0.020	0.020	25.00-27.50	0.50	0.75-1.50	(Ni+Cu) 0.50 max.; Cu 0.20; Cb 0.05-0.20; N 0.015
ASME SA-479/SA-479M	Type XM-27	S44627	---	0.010	0.40	0.40	0.020	0.020	25.0-27.5	0.50	0.75-1.50	(Ni+Cu) 0.50 max.; Cu 0.20; Cb 0.05-0.20; N 0.015
ASTM A276/A276M-15	Type XM-27	S44627	---	0.010	0.40	0.40	0.020	0.020	25.0-27.5	0.50	0.75-1.50	(Ni+Cu) 0.50 max.; Cu 0.20; Cb 0.05-0.20; N 0.015
ASTM A479/A479M-14	Type XM-27	S44627	---	0.010	0.40	0.40	0.020	0.020	25.0-27.5	0.50	0.75-1.50	(Ni+Cu) 0.50 max.; Cu 0.20; Cb 0.05-0.20; N 0.015
GB 1220-92	Grade 00Cr27Mo	---	---	0.010	0.40	0.40	0.030	0.020	25.00-27.50	0.50	0.75-1.50	(Ni+Cu) 0.50 max.; Cu 0.20; N 0.015
JIS G 4303:2012	Symbol SUSXM27	---	---	0.010	0.40	0.40	0.030	0.020	25.00-27.50	0.50	0.75-1.50	(Ni+Cu) 0.50 max.; Cu 0.20; N 0.015
ASME SA-276	Type 446	S44600	---	0.20	1.50	1.00	0.040	0.030	23.00-27.00	---	---	N 0.25
ASTM A276/A276M-15	Type 446	S44600	---	0.20	1.50	1.00	0.040	0.030	23.0-27.0	0.75	---	N 0.25
EN 10095:1999	X18CrN28	---	1.4749	0.15-0.20	1.00	1.00	0.040	0.015	26.00-29.00	---	---	N 0.15-0.25
GB 1221-92	Grade 2Cr25N	---	---	0.20	1.50	1.00	0.040	0.030	23.00-27.00	---	---	Cu 0.30; N 0.25
JIS G 4311:2011	Symbol SUH446	---	---	0.20	1.50	1.00	0.040	0.030	23.00-27.00	0.60	---	Cu 0.30; N 0.25
ASME SA-276	---	S44700	---	0.010	0.30	0.20	0.025	0.020	28.00-30.00	0.15	3.50-4.20	(C+N) 0.025 max.; Cu 0.15; N 0.020
ASME SA-479/SA-479M	---	S44700	---	0.010	0.30	0.20	0.025	0.020	28.0-30.0	0.15	3.5-4.2	(C+N) 0.025 max.; Cu 0.15; N 0.020
ASTM A276/A276M-15	---	S44700	---	0.010	0.30	0.20	0.025	0.020	28.0-30.0	0.15	3.5-4.2	(C+N) 0.025 max.; Cu 0.15; N 0.020
ASTM A479/A479M-14	---	S44700	---	0.010	0.30	0.20	0.025	0.020	28.0-30.0	0.15	3.5-4.2	(C+N) 0.025 max.; Cu 0.15; N 0.020
GB 1220-92	Grade 00Cr30Mo2	---	---	0.010	0.40	0.40	0.030	0.020	28.50-32.00	0.50	1.50-2.50	(Ni+Cu) 0.50 max.; Cu 0.20; N 0.015
JIS G 4303:2012	Symbol SUS447J1	---	---	0.010	0.40	0.40	0.030	0.020	28.50-32.00	0.50	1.50-2.50	(Ni+Cu) 0.50 max.; Cu 0.20; N 0.015

8.2 Stainless Steels: Bar

8.2.2B Mechanical Properties of Ferritic Stainless Steels

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X6Cr13	---	1.4000	$t \leq 25$	---	230	---	400-630	---	20 L	A	200 max. HBW
ISO 4955:2005	X6Cr13	---	---	$0.5 \leq t < 3$	---	230	---	400-630	---	18 L, 18 T	A	197 max. HB
				$3 \leq t \leq 12$	---	230	---	400-630	---	20 L, 18 T	A	197 max. HB
				$5 \leq t \leq 15$	---	230	---	400-630	---	20	A	197 max. HB
				$5 \leq t \leq 25$	---	230	---	400-630	---	20	A	197 max. HB
				$1.5 \leq t \leq 25$	---	230	---	400-630	---	20	A	197 max. HB
ASME SA-276	Type 405	S40500	---	---	---	---	---	---	---	---	A and HF	207 max. HB
				---	---	---	---	---	---	---	A and CF	217 max. HB
ASME SA-479/SA-479M	Type 405	S40500	---	---	---	170	25	415	60	20	A	207 max. HB
ASTM A276/A276M-15	Type 405	S40500	---	---	---	---	---	---	---	---	A+HF	207 max. HBW
				---	---	---	---	---	---	---	A+CF	217 max. HBW
ASTM A479/A479M-14	Type 405	S40500	---	---	---	170	25	415	60	20	A	207 max. HB
GB 1220-92	Grade 0Cr13Al	---	---	$t \leq 75$	---	177	---	410	---	20	A	183 max. HB; 78 J @ RT
GB 1221-92	Grade 0Cr13Al	---	---	$t \leq 75$	---	177	---	410	---	20	A	183 min. HB
JIS G 4303:2012	Symbol SUS405	---	---	$d \leq 75$	---	175	---	410	---	20	A	183 max. HBW; 90 max. HRBW; 200 max. HV
EN 10088-3:2014	X2CrNi12	---	1.4003	$t \leq 100$	---	260	---	450-600	---	20 L	---	200 max. HBW
GB 1220-92	Grade 00Cr12	---	---	$t \leq 75$	---	196	---	265	---	22	A	183 max. HB
GB 1221-92	Grade 00Cr12	---	---	$t \leq 75$	---	196	---	365	---	22	A	183 min. HB
JIS G 4303:2012	Symbol SUS410L	---	---	$d \leq 75$	---	195	---	360	---	22	A	183 max. HBW; 90 max. HRBW; 200 max. HV

8.2 Stainless Steels: Bar

8.2.2B Mechanical Properties of Ferritic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X6Cr17	---	1.4016	0.05 < d ≤ 0.10	---	---	---	950 max.	---	10	A	---
				0.10 < d ≤ 0.20	---	---	---	900 max.	---	10	A	---
				0.20 < d ≤ 0.50	---	---	---	850 max.	---	15	A	---
				0.50 < d ≤ 1.00	---	---	---	850 max.	---	15	A	---
				1.00 < d ≤ 3.00	---	---	---	800 max.	---	15	A	---
				3.00 < d ≤ 5.00	---	---	---	750 max.	---	15	A	---
				t ≤ 10	---	320	---	500-750	---	8	A	---
				10 < t ≤ 16	---	300	---	480-750	---	8	A	---
				5.00 < d ≤ 16.00	---	---	---	700 max.	---	20	A	---
				16 < t ≤ 40	---	240	---	400-700	---	15	A	---
				40 < t ≤ 63	---	240	---	400-700	---	15	A	---
				t ≤ 100	---	240	---	400-630	---	20 L	A	200 max. HBW
				63 < t ≤ 100	---	240	---	400-630	---	20	A	---
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
EN 10263-5:2001	X6Cr17	---	1.4016	2 < d ≤ 5	---	---	---	560 max. L	---	---	CD+A	---
				2 < d ≤ 5	---	---	---	620 max. L	---	---	CD+A	---
				5 < d ≤ 10	---	---	---	560 max. L	---	---	A	---
				5 < d ≤ 10	---	---	---	660 max. L	---	---	A	---
				5 < d ≤ 10	---	---	---	560 max. L	---	---	CD+A	---
				5 < d ≤ 10	---	---	---	600 max. L	---	---	CD+A	---
				10 < d ≤ 25	---	---	---	560 max. L	---	---	A	---
				10 < d ≤ 25	---	---	---	640 max. L	---	---	A	---
ISO 4954:1993	Type X 6 Cr 17 E	---	---	10 < d ≤ 25	---	---	---	560 max. L	---	---	CD+A	---
				2 ≤ d ≤ 25	---	---	---	560 max.	---	---	A, CW	---
				2 ≤ d ≤ 25	---	---	---	600 max.	---	---	A, CW	---
ISO 4955:2005	X6Cr17	---	---	0.5 ≤ t < 3	---	250	---	430-630	---	18 L, 18 T	A	197 max. HB
				3 ≤ t ≤ 12	---	250	---	430-630	---	20 L, 18 T	A	197 max. HB
				5 ≤ t ≤ 15	---	250	---	430-630	---	20	A	197 max. HB
				1.5 ≤ t ≤ 25	---	250	---	430-630	---	20	A	197 max. HB
				5 ≤ t ≤ 25	---	250	---	430-630	---	20	A	197 max. HB

8.2 Stainless Steels: Bar

8.2.2B Mechanical Properties of Ferritic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type 430	S43000	---	---	---	207	30	415	60	20	A and HF or A and CF	---
ASME SA-479/SA-479M	Type 430	S43000	---	---	---	275	40	485	70	20	A	192 max. HB
ASTM A276/A276M-15	Type 430	S43000	---	---	---	207	30	415	60	20	A+HF or A+CF	---
ASTM A479/A479M-14	Type 430	S43000	---	---	---	275	40	485	70	20	A	192 max. HB
GB 1220-92	Grade 1Cr17	---	---	$t \leq 75$	---	205	---	450	---	22	A	183 max. HB
GB 1221-92	Grade 1Cr17	---	---	$t \leq 75$	---	205	---	450	---	22	A	183 min. HB
JIS G 4303:2012	Symbol SUS430	---	---	$d \leq 75$	---	205	---	450	---	22	A	183 max. HBW; 90 max. HRBW; 200 max. HV
ASTM A582/A582M-12e1	Type 430F	S43020	---	---	---	---	---	---	---	---	A	262 max. HBW
EN 10088-3:2014	X6CrMoS17	---	1.4105	$0.05 < d \leq 0.10$	---	---	---	950 max.	---	10	A	---
				$0.10 < d \leq 0.20$	---	---	---	900 max.	---	10	A	---
				$0.20 < d \leq 0.50$	---	---	---	850 max.	---	15	A	---
				$0.50 < d \leq 1.00$	---	---	---	850 max.	---	15	A	---
				$1.00 < d \leq 3.00$	---	---	---	800 max.	---	15	A	---
				$3.00 < d \leq 5.00$	---	---	---	750 max.	---	15	A	---
				$t \leq 10$	---	330	---	530-780	---	7	A	---
				$10 < t \leq 16$	---	310	---	500-780	---	7	A	---
				$5.00 < d \leq 16.00$	---	---	---	700 max.	---	20	A	---
				$16 < t \leq 40$	---	250	---	430-730	---	12	A	---
				$40 < t \leq 63$	---	250	---	430-730	---	12	A	---
				$t \leq 100$	---	250	---	430-630	---	20 L	A	200 max. HBW
				$63 < t \leq 100$	---	250	---	430-630	---	20	A	---
				$d \geq 0.05$	---	---	---	500-700	---	---	---	---
				$d \geq 0.05$	---	---	---	600-800	---	---	---	---
				$d \geq 0.05$	---	---	---	700-900	---	---	---	---
				$d \geq 0.05$	---	---	---	800-1000	---	---	---	---
				$d \geq 0.05$	---	---	---	900-1100	---	---	---	---
GB 1220-92	Grade Y1Cr17	---	---	$t \leq 75$	---	205	---	450	---	22	A	183 max. HB
ISO 16143-2:2004	X7CrS17	---	---	$t \leq 75$	---	250	---	430	---	20 L	A	262 max. HBW
JIS G 4303:2012	Symbol SUS430F	---	---	$d \leq 75$	---	205	---	450	---	22	A	183 max. HBW; 90 max. HRBW; 200 max. HV
ASTM A582/A582M-12e1	---	S18235	---	---	---	---	---	---	---	---	A	207 max. HBW
EN 10088-3:2014	X2CrMoTiS18-2	---	1.4523	$t \leq 100$	---	280	---	430-600	---	15 L	A	200 max. HBW

8.2 Stainless Steels: Bar

8.2.2B Mechanical Properties of Ferritic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X6CrMo17-1	---	1.4113	0.05 < d ≤ 0.10	---	---	---	950 max.	---	10	A	---
				0.10 < d ≤ 0.20	---	---	---	900 max.	---	10	A	---
				0.20 < d ≤ 0.50	---	---	---	850 max.	---	15	A	---
				0.50 < d ≤ 1.00	---	---	---	850 max.	---	15	A	---
				1.00 < d ≤ 3.00	---	---	---	800 max.	---	15	A	---
				3.00 < d ≤ 5.00	---	---	---	750 max.	---	15	A	---
				t ≤ 10	---	340	---	540-700	---	8	A	---
				10 < t ≤ 16	---	320	---	500-700	---	12	A	---
				5.00 < d ≤ 16.00	---	---	---	700 max.	---	20	A	---
				16 < t ≤ 40	---	280	---	440-700	---	15	A	---
				40 < t ≤ 63	---	280	---	440-700	---	15	A	---
				t ≤ 100	---	280	---	440-660	---	18 L	A	200 max. HBW
				63 < t ≤ 100	---	280	---	440-660	---	18	A	---
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
EN 10263-5:2001	X6CrMo17-1	---	1.4113	2 < d ≤ 5	---	---	---	600 max. L	---	---	CD+A	---
				2 < d ≤ 5	---	---	---	660 max. L	---	---	CD+A	---
				5 < d ≤ 10	---	---	---	600 max. L	---	---	A	---
				5 < d ≤ 10	---	---	---	710 max. L	---	---	A	---
				5 < d ≤ 10	---	---	---	600 max. L	---	---	CD+A	---
				5 < d ≤ 10	---	---	---	640 max. L	---	---	CD+A	---
				10 < d ≤ 25	---	---	---	600 max. L	---	---	A	---
				10 < d ≤ 25	---	---	---	690 max. L	---	---	A	---
GB 1220-92	Grade 1Cr17Mo	---	---	t ≤ 75	---	205	---	450	---	22	A	183 max. HB
ISO 4954:1993	Type X 6 CrMo 17 1 E	---	---	2 ≤ d ≤ 25	---	---	---	600 max.	---	---	A, CW	---
				2 ≤ d ≤ 25	---	---	---	640 max.	---	---	A, CW	---
JIS G 4303:2012	Symbol SUS434	---	---	d ≤ 75	---	205	---	450	---	22	A	183 max. HBW; 90 max. HRBW; 200 max. HV

8.2 Stainless Steels: Bar

8.2.2B Mechanical Properties of Ferritic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type XM-27	S44627	---	---	---	275	40	450	65	20	A and HF	219 max. HB
				---	---	275	40	450	65	16	A and CF	219 max. HB
ASME SA-479/SA-479M	Type XM-27	S44627	---	---	---	275	40	450	65	---	A	217 max. HB
ASTM A276/A276M-15	Type XM-27	S44627	---	---	---	275	40	450	65	20	A+HF	219 max. HBW
				---	---	275	40	450	65	16	A+CF	219 max. HBW
ASTM A479/A479M-14	Type XM-27	S44627	---	---	---	275	40	450	65	---	A	217 max. HB
GB 1220-92	Grade 00Cr27Mo	---	---	$t \leq 75$	---	245	---	410	---	20	A	219 max. HB
JIS G 4303:2012	Symbol SUSXM27	---	---	$d \leq 75$	---	245	---	410	---	20	A	219 max. HBW; 96 max. HRBW; 230 max. HV
ASME SA-276	Type 446	S44600	---	---	---	275	40	450	65	20	A and HF	219 max. HB
				---	---	275	40	450	65	16	A and CF	219 max. HB
ASTM A276/A276M-15	Type 446	S44600	---	---	---	275	40	450	65	20	A+HF	219 max. HBW
				---	---	275	40	450	65	16	A+CF	219 max. HBW
EN 10095:1999	X18CrN28	---	1.4749	$0.5 \leq t < 3$	---	280	---	500-700	---	13 L, 13 T	A	212 max. HB
				$3 \leq t \leq 12$	---	280	---	500-700	---	15 L, 15 T	A	212 max. HB
				$t \leq 25$	---	280	---	500-700 L	---	15 L	A	212 max. HB
GB 1221-92	Grade 2Cr25N	---	---	$t \leq 75$	---	275	---	510	---	20	A	201 max. HB
JIS G 4311:2011	Symbol SUH446	---	---	---	---	275	---	510	---	20	A	201 max. HBW
ASME SA-276	Type 447	S44700	---	---	---	380	55	480	70	20	A and HF	---
				---	---	415	60	520	75	15	A and CF	---
ASME SA-479/SA-479M	---	S44700	---	---	---	380	55	485	70	20	A	---
ASTM A276/A276M-15	Type 447	S44700	---	---	---	380	55	480	70	20	A+HF	---
				---	---	415	60	520	75	15	A+CF	---
ASTM A479/A479M-14	---	S44700	---	---	---	380	55	485	70	20	A	---
GB 1220-92	Grade 00Cr30Mo2	---	---	$t \leq 75$	---	295	---	450	---	20	A	228 max. HB
JIS G 4303:2012	Symbol SUS447J1	---	---	$d \leq 75$	---	295	---	450	---	20	A	228 max. HBW; 98 max. HRBW; 241 max. HV

8.2 Stainless Steels: Bar

8.2.3A Chemical Composition of Austenitic Stainless Steels

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-276	Type 201	S20100	---	0.15	5.50-7.50	1.00	0.060	0.030	16.00-18.00	3.50-5.50	---	N 0.25
ASTM A276/A276M-15	Type 201	S20100	---	0.15	5.5-7.5	1.00	0.060	0.030	16.0-18.0	3.5-5.5	---	N 0.25
EN 10088-3:2014	X12CrMnNiN17-7-5	---	1.4372	0.15	5.5-7.5	1.00	0.045	0.015	16.0-18.0	3.5-5.5	---	N 0.05-0.25
GB 1220-92	Grade 1Cr17Mn6Ni5N	---	---	0.15	5.50-7.50	1.00	0.060	0.030	16.00-18.00	3.50-5.50	---	N 0.25
JIS G 4303:2012	Symbol SUS201	---	---	0.15	5.50-7.50	1.00	0.060	0.030	16.00-18.00	3.50-5.50	---	N 0.25
ASME SA-276	Type 202	S20200	---	0.15	7.50-10.00	1.00	0.060	0.030	17.00-19.00	4.00-6.00	---	N 0.25
ASTM A276/A276M-15	Type 202	S20200	---	0.15	7.5-10.0	1.00	0.060	0.030	17.0-19.0	4.0-6.0	---	N 0.25
GB 1220-92	Grade 1Cr18Mn8Ni5N	---	---	0.15	7.50-10.00	1.00	0.060	0.030	17.00-19.00	4.00-6.00	---	N 0.25
JIS G 4303:2012	Symbol SUS202	---	---	0.15	7.50-10.00	1.00	0.060	0.030	17.00-19.00	4.00-6.00	---	N 0.25
EN 10088-3:2014	X10CrNi18-8	---	1.4310	0.05-0.15	2.00	2.00	0.045	0.015	16.0-19.0	6.0-9.5	0.80	N 0.10
EN 10263-5:2001	X10CrNi18-8	---	1.4310	0.05-0.15	2.00	2.00	0.045	0.015	16.00-19.00	6.00-9.50	0.80	Cu 1.00; N 0.11
GB 1220-92	Grade 1Cr17Ni7	---	---	0.15	2.00	1.00	0.035	0.030	16.00-18.00	6.00-8.00	---	---
JIS G 4303:2012	Symbol SUS301	---	---	0.15	2.00	1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	---
ASME SA-276	Type 302	S30200	---	0.15	2.00	1.00	0.045	0.030	17.00-19.00	8.00-10.00	---	N 0.10
ASME SA-479/SA-479M	Type 302	S30200	---	0.15	2.00	1.00	0.045	0.030	17.0-19.0	8.0-10.0	---	N 0.10
ASTM A276/A276M-15	Type 302	S30200	---	0.15	2.00	1.00	0.045	0.030	17.0-19.0	8.0-10.0	---	N 0.10
ASTM A479/A479M-14	Type 302	S30200	---	0.15	2.00	1.00	0.045	0.030	17.0-19.0	8.0-10.0	---	N 0.10
ISO 4954:1993	Type X 10 CrNi 18 9 E	---	---	0.12	2.00	1.00	0.045	0.030	17.0-19.0	8.0-10.0	---	---
JIS G 4303:2012	Symbol SUS302	---	---	0.15	2.00	1.00	0.045	0.030	17.00-19.00	8.00-10.00	---	---
JIS G 4318:1998 A1:2007	Symbol SUS302	---	---	0.15	2.00	1.00	0.45	0.030	17.00-19.00	8.00-10.00	---	---
ASTM A582/A582M-12e1	Type 303	S30300	---	0.15	2.00	1.00	0.20	0.15 min.	17.0-19.0	8.0-10.0	---	---
EN 10088-3:2014	X8CrNiS18-9	---	1.4305	0.10	2.00	1.00	0.045	0.15-0.35	17.0-19.0	8.0-10.0	---	Cu 1.00; N 0.10
EN 10294-2:2012	X8CrNiS18-9	---	1.4305	0.10	2.00	1.00	0.040	0.15-0.35	17.0-19.0	8.0-10.0	---	Cu 1.00; N 0.10
GB 1220-92	Grade Y1Cr18Ni9	---	---	0.15	2.00	1.00	0.20	0.15 min.	17.00-19.00	8.00-10.00	0.60	---
GB 4226-84	Grade Y1Cr18Ni9	---	---	0.15	2.00	1.00	0.20	0.15 min.	17.00-19.00	8.00-10.00	0.60	---
JIS G 4303:2012	Symbol SUS303	---	---	0.15	2.00	1.00	0.20	0.15 min.	17.00-19.00	8.00-10.00	0.60	---
JIS G 4318:1998 A1:2007	Symbol SUS303	---	---	0.15	2.00	1.00	0.20	0.15 min.	17.00-19.00	8.00-10.00	0.60	---
ASTM A582/A582M-12e1	Type 303Se	S30323	---	0.15	2.00	1.00	0.20	0.06	17.0-19.0	8.0-10.0	---	Se 0.15 min.
GB 1220-92	Grade Y1Cr18Ni9Se	---	---	0.15	2.00	1.00	0.20	0.060	17.00-19.00	8.00-10.00	---	Se 0.15 min.
GB 4226-84	Grade Y1Cr18Ni9Se	---	---	0.15	2.00	1.00	0.20	0.060	17.00-19.00	8.00-10.00	---	Se 0.15 min.
JIS G 4303:2012	Symbol SUS303Se	---	---	0.15	2.00	1.00	0.20	0.060	17.00-19.00	8.00-10.00	---	Se 0.15 min.
JIS G 4318:1998 A1:2007	Symbol SUS303Se	---	---	0.15	2.00	1.00	0.20	0.060	17.00-19.00	8.00-10.00	---	Se 0.15 min.

8.2 Stainless Steels: Bar

8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-276	Type 304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	N 0.10
ASME SA-479/SA-479M	Type 304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-10.5	---	---
ASME SA-666	Type 304	S30400	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10
ASTM A276/A276M-15	Type 304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A314-13a	Type 304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	N 0.10
ASTM A479/A479M-14	Type 304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-10.5	---	---
ASTM A666-15	Type 304	S30400	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10
ASTM A955/A955M-15	Grade 60 [420], Type 304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	N 0.10
	Grade 75 [520], Type 304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	N 0.10
EN 10088-3:2014	X5CrNi18-10	---	1.4301	0.07	2.00	1.00	0.045	0.030	17.5-19.5	8.0-10.5	---	N 0.10
EN 10263-5:2001	X5CrNi18-10	---	1.4301	0.07	2.00	1.00	0.045	0.030	17.00-19.50	8.00-10.50	---	Cu 1.00; N 0.11
EN 10294-2:2012	X5CrNi18-10	---	1.4301	0.07	2.00	1.00	0.040	0.015-0.030	17.5-19.5	8.0-10.5	---	N 0.10
GB 1220-92	Grade 0Cr18Ni9	---	---	0.07	2.00	1.00	0.035	0.030	17.00-19.00	8.00-11.00	---	---
GB 1221-92	Grade 0Cr18Ni9	---	---	0.07	2.00	1.00	0.035	0.030	17.00-19.00	8.00-11.00	---	---
GB 4226-84	Grade 0Cr19Ni9	---	---	0.08	2.00	1.00	0.035	0.030	18.00-20.00	8.00-10.50	---	---
ISO 4954:1993	Type X 5 CrNi 18 9 E	---	---	0.07	2.00	1.00	0.045	0.030	17.0-19.0	8.0-11.0	---	---
JIS G 4303:2012	Symbol SUS304	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
JIS G 4318:1998 A1:2007	Symbol SUS304	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
ASME SA-276	Type 304L	S30403	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	8.00-12.00	---	N 0.10
ASME SA-479/SA-479M	Type 304L	S30403	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
ASME SA-666	Type 304L	S30403	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10
ASTM A276/A276M-15	Type 304L	S30403	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
ASTM A314-13a	Type 304L	S30403	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	8.00-12.00	---	N 0.10
ASTM A479/A479M-14	Type 304L	S30403	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
ASTM A666-15	Type 304L	S30403	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10
EN 10088-3:2014	X2CrNi18-9	---	1.4307	0.030	2.00	1.00	0.045	0.030	17.5-19.5	8.0-10.5	---	N 0.10
EN 10263-5:2001	X2CrNi18-9	---	1.4307	0.030	2.00	1.00	0.045	0.030	17.50-19.50	8.00-10.00	---	Cu 1.00; N 0.11
EN 10294-2:2012	X2CrNi18-9	---	1.4307	0.030	2.00	1.00	0.040	0.015-0.030	17.5-19.5	8.0-10.5	---	N 0.10
	X2CrNi19-11	---	1.4306	0.030	2.00	1.00	0.040	0.015-0.030	17.0-19.0	10.0-12.0	---	N 0.10
GB 1220-92	Grade 00Cr19Ni10	---	---	0.030	2.00	1.00	0.035	0.030	18.00-20.00	8.00-12.00	---	---
GB 4226-84	Grade 00Cr19Ni11	---	---	0.030	2.00	1.00	0.035	0.030	18.00-20.00	9.00-13.00	---	---
ISO 4954:1993	Type X 2 CrNi 18 10 E	---	---	0.030	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	---
JIS G 4303:2012	Symbol SUS304L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	9.00-13.00	---	---
JIS G 4318:1998 A1:2007	Symbol SUS304L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	9.00-13.00	---	---

8.2 Stainless Steels: Bar

8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-276	Type 304N	S30451	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	N 0.10-0.16
ASME SA-479/SA-479M	Type 304N	S30451	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10-0.16
ASME SA-666	Type 304N	S30451	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10-0.16
ASTM A276/A276M-15	Type 304N	S30451	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
ASTM A479/A479M-14	Type 304N	S30451	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10-0.16
ASTM A666-15	Type 304N	S30451	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10-0.16
GB 1220-92	Grade 0Cr19Ni9N	---	---	0.08	2.00	1.00	0.035	0.030	18.00-20.00	7.00-10.50	---	N 0.10-0.25
JIS G 4303:2012	Symbol SUS304N1	---	---	0.08	2.50	1.00	0.045	0.030	18.00-20.00	7.00-10.50	---	N 0.10-0.25
EN 10088-3:2014	X5CrNi19-9	---	1.4315	0.06	2.00	1.00	0.045	0.015	18.0-20.0	8.0-11.0	---	N 0.12-0.22
ASME SA-276	Type 304LN	S30453	---	0.03	2.00	1.00	0.045	0.030	18.00-20.00	8.00-12.00	---	N 0.10-0.16
ASME SA-479/SA-479M	Type 304LN	S30453	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
ASME SA-666	Type 304LN	S30453	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10-0.16
ASTM A276/A276M-15	Type 304LN	S30453	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
ASTM A479/A479M-14	Type 304LN	S30453	---	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
ASTM A666-15	Type 304LN	S30453	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10-0.16
EN 10088-3:2014	X2CrNi18-10	---	1.4311	0.030	2.00	1.00	0.045	0.030	17.5-19.5	8.5-11.5	---	N 0.12-0.22
GB 1220-92	Grade 00Cr18Ni10N	---	---	0.030	2.00	1.00	0.035	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
JIS G 4303:2012	Symbol SUS304LN	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
ASME SA-479/SA-479M	Type 304H	S30409	---	0.04-0.10	2.00	1.00	0.045	0.030	18.0-20.0	8.0-10.5	---	---
ASTM A479/A479M-14	Type 304H	S30409	---	0.04-0.10	2.00	1.00	0.045	0.030	18.0-20.0	8.0-10.5	---	---
EN 10088-3:2014	X9CrNi18-9	---	1.4325	0.03-0.15	2.00	1.00	0.045	0.030	17.0-19.0	8.0-10.0	---	---
ISO 4955:2005	X7CrNi18-9	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	8.0-11.0	---	---
ASME SA-276	Type XM-21	S30452	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	N 0.16-0.30
ASTM A276/A276M-15	Type XM-21	S30452	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-10.0	---	N 0.16-0.30
GB 1220-92	Grade 0Cr19Ni10NbN	---	---	0.08	2.00	1.00	0.035	0.030	18.00-20.00	7.50-10.50	---	Nb 0.15; N 0.15-0.30
JIS G 4303:2012	Symbol SUS304N2	---	---	0.08	2.50	1.00	0.045	0.030	18.00-20.00	7.50-10.50	---	Nb 0.15; N 0.15-0.30
ASME SA-276	Type 305	S30500	---	0.12	2.00	1.00	0.045	0.030	17.00-19.00	10.50-13.00	---	---
ASTM A276/A276M-15	Type 305	S30500	---	0.12	2.00	1.00	0.045	0.030	17.0-19.0	11.0-13.0	---	---
GB 1220-92	Grade 1Cr18Ni12	---	---	0.12	2.00	1.00	0.035	0.030	17.00-19.00	10.50-13.00	---	---
GB 4226-84	Grade 1Cr18Ni12	---	---	0.12	2.00	1.00	0.035	0.030	17.00-19.00	10.50-13.00	---	---
JIS G 4303:2012	Symbol SUS305	---	---	0.12	2.00	1.00	0.045	0.030	17.00-19.00	10.50-13.00	---	---
JIS G 4318:1998 A1:2007	Symbol SUS305	---	---	0.12	2.00	1.00	0.045	0.030	17.00-19.00	10.50-13.00	---	---
EN 10088-3:2014	X4CrNi18-12	---	1.4303	0.06	2.00	1.00	0.045	0.030	17.0-19.0	11.0-13.0	---	N 0.10
EN 10263-5:2001	X4CrNi18-12	---	1.4303	0.06	2.00	1.00	0.045	0.030	17.00-19.00	11.00-13.00	---	N 0.11
EN 10269:2013	X4CrNi18-12	---	1.4303	0.06	2.00	1.00	0.045	0.015	17.0-19.0	11.0-13.0	---	N 0.10
GB 4226-84	Grade 0Cr18Ni12	---	---	0.08	2.00	1.00	0.035	0.030	16.50-19.00	11.00-13.50	---	---
ISO 4954:1993	Type X 5 CrNi 18 12 E	---	---	0.07	2.00	1.00	0.045	0.030	17.0-19.0	11.0-13.0	---	---
JIS G 4318:1998 A1:2007	Symbol SUS305J1	---	---	0.08	2.00	1.00	0.045	0.030	16.50-19.00	11.00-13.50	---	---

8.2 Stainless Steels: Bar

8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-276	Type 309	S30900	---	0.20	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
ASTM A276/A276M-15	Type 309	S30900	---	0.20	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
GB 1221-92	Grade 2Cr23Ni13	---	---	0.20	2.00	1.00	0.035	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 4311:2011	Symbol SUH309	---	---	0.20	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---
ASME SA-276	Type 309S	S30908	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
ASME SA-479/SA-479M	Type 309S	S30908	---	0.08	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASTM A276/A276M-15	Type 309S	S30908	---	0.08	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASTM A479/A479M-14	Type 309S	S30908	---	0.08	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
GB 1220-92	Grade 0Cr23Ni13	---	---	0.08	2.00	1.00	0.035	0.030	22.00-24.00	12.00-15.00	---	---
GB 1221-92	Grade 0Cr23Ni13	---	---	0.08	2.00	1.00	0.035	0.030	22.00-24.00	12.00-15.00	---	---
GB 4226-84	Grade 0Cr23Ni13	---	---	0.08	2.00	1.00	0.035	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 4303:2012	Symbol SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 4318:1998 A1:2007	Symbol SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
ASME SA-276	Type 310	S31000	---	0.25	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
ASTM A276/A276M-15	Type 310	S31000	---	0.25	2.00	1.50	0.045	0.030	24.0-26.0	19.0-22.0	---	---
GB 1221-92	Grade 2Cr25Ni20	---	---	0.25	2.00	1.50	0.035	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 4311:2011	Symbol SUH310	---	---	0.25	2.00	1.50	0.040	0.030	24.00-26.00	19.00-22.00	---	---
ASME SA-276	Type 310S	S31008	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
ASME SA-479/SA-479M	Type 310S	S31008	---	0.08	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A276/A276M-15	Type 310S	S31008	---	0.08	2.00	1.50	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A479/A479M-14	Type 310S	S31008	---	0.08	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
GB 1220-92	Grade 0Cr25Ni20	---	---	0.08	2.00	1.00	0.035	0.030	24.00-26.00	19.00-22.00	---	---
GB 1221-92	Grade 0Cr25Ni20	---	---	0.08	2.00	1.50	0.035	0.030	24.00-26.00	19.00-22.00	---	---
GB 4226-84	Grade 0Cr25Ni20	---	---	0.08	2.00	1.00	0.035	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 4303:2012	Symbol SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 4318:1998 A1:2007	Symbol SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---

8.2 Stainless Steels: Bar

8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-276	---	S31254	---	0.020	1.00	0.80	0.030	0.010	19.50-20.50	17.50-18.50	6.00-6.50	Cu 0.50-1.00; N 0.18-0.22
ASME SA-479/SA-479M	---	S31254	---	0.020	1.00	0.80	0.030	0.010	19.5-20.5	17.5-18.5	6.0-6.5	Cu 0.50-1.00; N 0.18-0.22
ASTM A276/A276M-15	---	S31254	---	0.020	1.00	0.80	0.030	0.010	19.5-20.5	17.5-18.5	6.0-6.5	Cu 0.50-1.00; N 0.18-0.25
ASTM A479/A479M-14	---	S31254	---	0.020	1.00	0.80	0.030	0.010	19.5-20.5	17.5-18.5	6.0-6.5	Cu 0.50-1.00; N 0.18-0.25
EN 10088-3:2014	X1CrNiMoCuN20-18-7	---	1.4547	0.020	1.00	0.70	0.030	0.010	19.5-20.5	17.5-18.5	6.0-7.0	Cu 0.50-1.00; N 0.18-0.25
JIS G 4303:2012	Symbol SUS312L	---	---	0.020	1.00	0.80	0.030	0.015	19.00-21.00	17.50-19.50	6.00-7.00	Cu 0.50-1.00; N 0.16-0.25
EN 10088-3:2014	X1CrNiMoCuNW24-22-6	---	1.4659	0.020	2.00-4.0	0.70	0.030	0.010	23.0-25.0	21.0-23.0	5.5-6.5	Cu 1.00-2.00; W 1.50-2.50; N 0.35-0.50
ISO 16143-2:2004	X1CrNiMoCuNW24-22-6	---	---	0.020	2.00-4.00	0.70	0.030	0.010	23.0-25.0	21.0-23.0	5.5-6.5	Cu 1.00-2.00; W 1.50-2.50; N 0.35-0.5
ASTM A276/A276M-15	---	S32654	---	0.020	2.0-4.0	0.50	0.030	0.005	24.0-25.0	21.0-23.0	7.0-8.0	Cu 0.30-0.60; N 0.45-0.55
ASTM A479/A479M-14	---	S32654	---	0.020	2.0-4.0	0.50	0.030	0.005	24.0-25.0	21.0-23.0	7.0-8.0	Cu 0.30-0.60; N 0.45-0.55
EN 10088-3:2014	X1CrNiMoCuN24-22-8	---	1.4652	0.020	2.00-4.0	0.50	0.030	0.005	23.0-25.0	21.0-23.0	7.0-8.0	Cu 0.30-0.60; N 0.45-0.55
ISO 16143-2:2004	X1CrNiMoCuN24-22-8	---	---	0.020	2.00-4.00	0.50	0.030	0.005	23.0-25.0	21.0-23.0	7.0-8.0	Cu 0.30-0.60; N 0.45-0.55
ASME SA-276	Type 314	S31400	---	0.25	2.00	1.50-3.00	0.045	0.030	23.00-26.00	19.00-22.00	---	---
ASTM A276/A276M-15	Type 314	S31400	---	0.25	2.00	1.50-3.00	0.045	0.030	23.0-26.0	19.0-22.0	---	---
GB 1221-92	Grade 1Cr25Ni20Si2	---	---	0.20	1.50	1.50-2.50	0.035	0.030	24.00-27.00	18.00-21.00	---	---
EN 10095:1999	X15CrNiSi25-21	---	1.4841	0.20	2.00	1.50-2.50	0.045	0.015	24.00-26.00	19.00-22.00	---	N 0.11
ASME SA-276	Type 316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10
ASME SA-479/SA-479M	Type 316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASME SA-666	Type 316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A276/A276M-15	Type 316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A479/A479M-14	Type 316	S31600	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A666-15	Type 316	S31600	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
EN 10088-3:2014	X5CrNiMo17-12-2	---	1.4401	0.07	2.00	1.00	0.045	0.030	16.5-18.5	10.0-13.0	2.00-2.50	N 0.10
	X3CrNiMo17-13-3	---	1.4436	0.05	2.00	1.00	0.045	0.030	16.5-18.5	10.5-13.0	2.50-3.00	N 0.10
EN 10263-5:2001	X5CrNiMo17-12-2	---	1.4401	0.07	2.00	1.00	0.045	0.030	16.50-18.50	10.00-13.00	2.00-2.50	Cu 1.00; N 0.11
	X3CrNiMo17-13-3	---	1.4436	0.05	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.00	2.50-3.00	N 0.11
EN 10294-2:2012	X5CrNiMo17-12-2	---	1.4401	0.07	2.00	1.00	0.040	0.015-0.030	16.5-18.5	10.0-13.0	2.00-2.50	---
GB 1220-92	Grade 0Cr17Ni12Mo2	---	---	0.08	2.00	1.00	0.035	0.030	16.00-18.50	10.00-14.00	2.00-3.00	---
GB 1221-92	Grade 0Cr17Ni12Mo2	---	---	0.08	2.00	1.00	0.035	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
GB 4226-84	Grade 0Cr17Ni12Mo2	---	---	0.08	2.00	1.00	0.035	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
ISO 4954:1993	Type X 5 CrNiMo 17 12 2 E	---	---	0.07	2.00	1.00	0.045	0.030	16.5-18.5	10.5-13.5	2.0-2.5	---
JIS G 4303:2012	Symbol SUS316	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 4318:1998 A1:2007	Symbol SUS316	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---

8.2 Stainless Steels: Bar

8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-276	Type 316L	S31603	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10
ASME SA-479/SA-479M	Type 316L	S31603	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASME SA-666	Type 316L	S31603	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A276/A276M-15	Type 316L	S31603	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A479/A479M-14	Type 316L	S31603	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A666-15	Type 316L	S31603	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A955/A955M-15	Grade 60 [420], Type 316L	S31603	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10
	Grade 75 [520], Type 316L	S31603	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10
EN 10088-3:2014	X2CrNiMo17-12-2	---	1.4404	0.030	2.00	1.00	0.045	0.030	16.5-18.5	10.0-13.0	2.00-2.50	N 0.10
	X2CrNiMo17-12-3	---	1.4432	0.030	2.00	1.00	0.045	0.030	16.5-18.5	10.5-13.0	2.50-3.00	N 0.10
	X2CrNiMo18-14-3	---	1.4435	0.030	2.00	1.00	0.045	0.030	17.0-19.0	12.5-15.0	2.50-3.00	N 0.10
EN 10263-5:2001	X2CrNiMo17-12-2	---	1.4404	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.00-13.00	2.00-2.50	Cu 1.00; N 0.11
	X2CrNiMo17-12-3	---	1.4432	0.030	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.00	2.50-3.00	Cu 1.00; N 0.11
EN 10294-2:2012	X2CrNiMo17-12-2	---	1.4404	0.030	2.00	1.00	0.040	0.015-0.030	16.5-18.5	10.0-13.0	2.00-2.50	N 0.10
	X2CrNiMo18-14-3	---	1.4435	0.030	2.00	1.00	0.040	0.015-0.030	17.0-19.0	12.5-15.0	2.50-3.00	N 0.10
ISO 4954:1993	Type X 2 CrNiMo 17 13 3 E	---	---	0.030	2.00	1.00	0.045	0.030	16.5-18.5	11.5-14.5	2.5-3.0	---
ASME SA-276	Type 316Ti	S31635	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti 5x(C+N) to 0.70; N 0.10
ASME SA-479/SA-479M	Type 316Ti	S31635	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	Ti 5x(C+N) to 0.70; N 0.10
ASTM A276/A276M-15	Type 316Ti	S31635	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	Ti 5x(C+N) to 0.70; N 0.10
ASTM A314-13a	Type 316Ti	S31635	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti 5x(C+N) to 0.70
ASTM A479/A479M-14	Type 316Ti	S31635	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	Ti 5x(C+N) to 0.70; N 0.10
EN 10088-3:2014	X6CrNiMoTi17-12-2	---	1.4571	0.08	2.00	1.00	0.045	0.030	16.5-18.5	10.5-13.5	2.00-2.50	Ti 5xC to 0.70
EN 10263-5:2001	X6CrNiMoTi17-12-2	---	1.4571	0.08	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.00-2.50	Ti 5xC to 0.70; Cu 1.00
EN 10294-2:2012	X6CrNiMoTi17-12-2	---	1.4571	0.08	2.00	1.00	0.040	0.015-0.030	16.5-18.5	10.5-13.5	2.00-2.50	Ti 5xC to 0.70
ISO 16143-2:2004	X6CrNiMoTi17-12-2	---	---	0.08	2.00	1.00	0.045	0.030	16.5-18.5	10.5-13.5	2.00-2.50	Ti 5xC to 0.70
ISO 4954:1993	Type X 6 CrNiMoTi 17 12 2 E	---	---	0.08	2.00	1.00	0.045	0.030	16.5-18.5	11.0-14.0	2.0-2.5	Ti 5xC to 0.80
JIS G 4303:2012	Symbol SUS316Ti	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti 5xC min.
ASME SA-276	Type 316Cb	S31640	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	(Cb+Ta) 10xC to 1.10; N 0.10
ASME SA-479/SA-479M	Type 316Cb	S31640	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	Cb 10xC to 1.10; N 0.10
ASTM A276/A276M-15	Type 316Cb	S31640	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	Cb 10xC to 1.10; N 0.10
ASTM A479/A479M-14	Type 316Cb	S31640	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	Cb 10xC to 1.10; N 0.10
EN 10088-3:2014	X6CrNiMoNb17-12-2	---	1.4580	0.08	2.00	1.00	0.045	0.015	16.5-18.5	10.5-13.5	2.00-2.50	Nb 10xC to 1.00
GB 1220-92	Grade 0Cr18Ni12Mo2Cu2	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	10.00-14.50	1.20-2.75	Cu 1.00-2.50
JIS G 4303:2012	Symbol SUS316J1	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	10.00-14.00	1.20-2.75	Cu 1.00-2.50

8.2 Stainless Steels: Bar

8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB 1220-92	Grade 00Cr17Ni14Mo2	---	---	0.030	2.00	1.00	0.035	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
GB 4226-84	Grade 00Cr17Ni14Mo2	---	---	0.030	2.00	1.00	0.035	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
JIS G 4303:2012	Symbol SUS316L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
JIS G 4318:1998 A1:2007	Symbol SUS316L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
GB 1220-92	Grade 00Cr18Ni14Mo2Cu2	---	---	0.030	2.00	1.00	0.035	0.030	17.00-19.00	12.00-16.00	1.20-2.75	Cu 1.00-2.50
JIS G 4303:2012	Symbol SUS316J1L	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	12.00-16.00	1.20-2.75	Cu 1.00-2.50
ASME SA-479/SA-479M	---	S34565	---	0.030	5.0-7.0	1.00	0.030	0.010	23.0-25.0	16.0-18.0	4.0-5.0	Cb 0.10; N 0.40-0.60
ASTM A276/A276M-15	---	S34565	---	0.030	5.0-7.0	1.00	0.030	0.010	23.0-25.0	16.0-18.0	4.0-5.0	Cb 0.10; N 0.40-0.60
ASTM A479/A479M-14	---	S34565	---	0.030	5.0-7.0	1.00	0.030	0.010	23.0-25.0	16.0-18.0	4.0-5.0	Cb 0.10; N 0.40-0.60
EN 10088-3:2014	X2CrNiMnMoN25-18-6-5	---	1.4565	0.030	5.0-7.0	1.00	0.030	0.015	24.0-26.0	16.0-19.0	4.0-5.0	Nb 0.15; N 0.30-0.60
ISO 16143-2:2004	X2CrNiMnMoN25-18-6-5	---	---	0.030	5.00-7.00	1.00	0.030	0.015	24.0-26.0	16.0-19.0	4.0-5.0	Nb 0.15; N 0.30-0.6
ASME SA-276	Type 316N	S31651	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10-0.16
ASME SA-479/SA-479M	Type 316N	S31651	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
ASME SA-666	Type 316N	S31651	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
ASTM A276/A276M-15	Type 316N	S31651	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
ASTM A479/A479M-14	Type 316N	S31651	---	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
ASTM A666-15	Type 316N	S31651	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
GB 1220-92	Grade 0Cr17Ni12Mo2N	---	---	0.08	2.00	1.00	0.035	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10-0.22
JIS G 4303:2012	Symbol SUS316N	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10-0.22
ASME SA-276	Type 316LN	S31653	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Cu 0.16-0.30; N 0.10-0.16
ASME SA-479/SA-479M	Type 316LN	S31653	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
ASTM A276/A276M-15	Type 316LN	S31653	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-13.0	2.00-3.00	N 0.10-0.16
ASTM A479/A479M-14	Type 316LN	S31653	---	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
EN 10088-3:2014	X2CrNiMoN17-11-2	---	1.4406	0.030	2.00	1.00	0.045	0.030	16.5-18.5	10.0-12.5	2.00-2.50	N 0.12-0.22
	X2CrNiMoN17-13-3	---	1.4429	0.030	2.00	1.00	0.045	0.015	16.5-18.5	11.0-14.0	2.50-3.00	N 0.12-0.22
EN 10263-5:2001	X2CrNiMoN17-13-3	---	1.4429	0.030	2.00	1.00	0.045	0.015	16.50-18.50	11.00-14.00	2.50-3.00	Cu 1.00; N 0.12-0.22
GB 1220-92	Grade 00Cr17Ni13Mo2N	---	---	0.030	2.00	1.00	0.035	0.030	16.00-18.50	10.50-14.50	2.00-3.00	N 0.12-0.22
ISO 4954:1993	Type X 2 CrNiMoN 17 13 3 E	---	---	0.030	2.00	1.00	0.045	0.030	16.5-18.5	11.5-14.5	2.5-3.0	N 0.12-0.22
JIS G 4303:2012	Symbol SUS316LN	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.50-14.50	2.00-3.00	N 0.12-0.22

8.2 Stainless Steels: Bar

8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-276	Type 317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	N 0.10
ASME SA-479/SA-479M	Type 317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
ASTM A276/A276M-15	Type 317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	N 0.10
ASTM A479/A479M-14	Type 317	S31700	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
GB 1220-92	Grade 0Cr19Ni13Mo3	---	---	0.08	2.00	1.00	0.035	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
GB 1221-92	Grade 0Cr19Ni13Mo3	---	---	0.08	2.00	1.00	0.035	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 4303:2012	Symbol SUS317	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
EN 10088-3:2014	X2CrNiMo18-15-4	---	1.4438	0.030	2.00	1.00	0.045	0.030	17.5-19.5	13.0-16.0	3.0-4.0	N 0.10
GB 1220-92	Grade 00Cr19Ni13Mo3	---	---	0.030	2.00	1.00	0.035	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 4303:2012	Symbol SUS317L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
EN 10088-3:2014	X2CrNiMoN17-13-5	---	1.4439	0.030	2.00	1.00	0.045	0.015	16.5-18.5	12.5-14.5	4.0-5.0	N 0.12-0.22
GB 1220-92	Grade 0Cr18Ni16Mo5	---	---	0.040	2.00	1.00	0.035	0.030	16.00-19.00	15.00-17.00	4.00-6.00	---
JIS G 4303:2012	Symbol SUS317J1	---	---	0.040	2.50	1.00	0.045	0.030	16.00-19.00	15.00-17.00	4.00-6.00	---
ASME SA-276	Type 321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5x(C+N) to 0.70
ASME SA-479/SA-479M	Type 321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5x(C+N) to 0.70
	Type 321H	S32109	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 4x(C+N) to 0.70
ASTM A276/A276M-15	Type 321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5x(C+N) to 0.70
ASTM A479/A479M-14	Type 321	S32100	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5x(C+N) to 0.70
	Type 321H	S32109	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 4x(C+N) to 0.70
EN 10088-3:2014	X6CrNiTi18-10	---	1.4541	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.70
EN 10263-5:2001	X6CrNiTi18-10	---	1.4541	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5xC to 0.70; Cu 1.00
GB 1220-92	Grade 0Cr18Ni10Ti	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-12.00	---	Ti 5xC min.
	Grade 1Cr18Ni9	---	---	0.15	2.00	1.00	0.035	0.030	17.00-19.00	8.00-10.00	---	Ti 5x(C-0.02) to 0.80
GB 1221-92	Grade 0Cr18Ni10Ti	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-12.00	---	Ti 5xC min.
GB 4226-84	Grade 0Cr18Ni11Ti	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-13.00	---	Ti 5xC min.
	Grade 1Cr18Ni9	---	---	0.15	2.00	1.00	0.035	0.030	17.00-19.00	8.00-10.00	---	Ti 5x(C-0.02) to 0.80
ISO 4954:1993	Type X 6 CrNiTi 18 10 E	---	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5xC to 0.80
JIS G 4303:2012	Symbol SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5xC min.
JIS G 4318:1998 A1:2007	Symbol SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5xC min.

8.2 Stainless Steels: Bar

8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10088-3:2014	X8CrMnNiN18-9-5	---	1.4374	0.05-0.10	9.0-10.0	0.30-0.60	0.035	0.030	17.5-18.5	5.0-6.0	0.50	Cu 0.40; N 0.25-0.32
ISO 16143-2:2004	X8CrMnNiN18-9-5	---	---	0.05-0.10	9.00-10.00	0.30-0.60	0.035	0.030	17.5-18.5	5.0-6.0	0.50	Cu 0.40; N 0.25-0.32
EN 10088-3:2014	X11CrNiMnN19-8-6	---	1.4369	0.07-0.15	5.0-7.5	0.50-1.00	0.030	0.015	17.5-19.5	6.5-8.5	---	N 0.20-0.30
ISO 16143-2:2004	X11CrNiMnN19-8-6	---	---	0.07-0.15	5.00-7.50	0.50-1.00	0.030	0.015	17.5-19.5	6.5-8.5	---	N 0.20-0.3
ASME SA-276	Type 347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	(Cb+Ta) 10xC min.
	Type 348	S34800	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	(Cb+Ta) 10xC min.; Ta 0.10; Co 0.20
ASME SA-479/SA-479M	Type 347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 10xC to 1.10
	Type 347H	S34709	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 8xC to 1.10
ASTM A276/A276M-15	Type 347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 10xC to 1.10
	Type 348	S34800	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 10xC to 1.10; Ta 0.10; Co 0.20
ASTM A479/A479M-14	Type 347	S34700	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 10xC to 1.10
	Type 347H	S34709	---	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 8xC to 1.10
EN 10088-3:2014	X6CrNiNb18-10	---	1.4550	0.08	2.00	1.00	0.045	0.015	17.0-19.0	9.0-12.0	---	Nb 10xC to 1.00
GB 1220-92	Grade 0Cr18Ni11Nb	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min.
GB 4226-84	Grade 0Cr18Ni11Nb	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min.
JIS G 4303:2012	Symbol SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min.
JIS G 4318:1998 A1:2007	Symbol SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10xC min.
ASME SA-276	---	S30815	---	0.10	0.80	1.40-2.00	0.040	0.030	20.00-22.00	10.00-12.00	---	N 0.14-0.20; Ce 0.03-0.08
ASME SA-479/SA-479M	---	S30815	---	0.05-0.10	0.80	1.40-2.00	0.040	0.030	20.0-22.0	10.0-12.0	---	N 0.14-0.20; Ce 0.03-0.08
ASTM A276/A276M-15	---	S30815	---	0.05-0.10	0.80	1.40-2.00	0.040	0.030	20.0-22.0	10.0-12.0	---	N 0.14-0.20; Ce 0.03-0.08
ASTM A479/A479M-14	---	S30815	---	0.05-0.10	0.80	1.40-2.00	0.040	0.030	20.0-22.0	10.0-12.0	---	N 0.14-0.20; Ce 0.03-0.08
ISO 4955:2005	X7CrNiSiNCe21-11	---	---	0.05-0.10	0.80	1.40-2.00	0.045	0.030	20.0-22.0	10.0-12.0	---	N 0.14-0.20; Ce 0.03-0.08
EN 10088-3:2014	X6CrNiCuS18-9-2	---	1.4570	0.08	2.00	1.00	0.045	0.15-0.35	17.0-19.0	8.0-10.0	0.60	Cu 1.40-1.80; N 0.10
ISO 16143-2:2004	X6CrNiCuS18-9-2	---	---	0.08	2.00	1.00	0.045	0.15	17.0-19.0	8.0-10.0	0.60	Cu 1.40-1.80; N 0.11
EN 10090:1998	X53CrMnNiNbN21-9	---	1.4870	0.48-0.58	8.00-10.00	0.45	0.045	0.030	20.00-22.00	3.25-4.50	---	(Nb+Ta) 2.00 to 3.00; (C+N) 0.90 min.; N 0.38-0.50
ISO 683-15:1992	Grade X 53CrMnNiNbN21 9	---	---	0.48-0.58	8.0-10.0	0.45	0.050	0.030	20.0-22.0	3.25-4.5	---	(Nb+Ta) 2.00 to 3.00; (C+N) > 0.90; N 0.38-0.50
GB 1221-92	Grade 5Cr21Mn9Ni4N	---	---	0.48-0.58	8.00-10.00	0.35	0.040	0.030	20.00-22.00	3.25-4.50	---	N 0.35-0.50
JIS G 4311:2011	Symbol SUH35	---	---	0.48-0.58	8.00-10.00	0.35	0.040	0.030	20.00-22.00	3.25-4.50	---	N 0.35-0.50

8.2 Stainless Steels: Bar

8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-479/SA-479M	---	S35315	---	0.04-0.08	2.00	1.20-2.00	0.040	0.030	24.0-26.0	34.0-36.0	---	N 0.12-0.18; Ce 0.03-0.08
ASTM A479/A479M-14	---	S35315	---	0.04-0.08	2.00	1.20-2.00	0.040	0.030	24.0-26.0	34.0-36.0	---	N 0.12-0.18; Ce 0.03-0.08
EN 10095:1999	X6NiCrSiNCe35-25	---	1.4854	0.04-0.08	2.00	1.20-2.00	0.040	0.015	24.00-26.00	34.00-36.00	---	N 0.12-0.20; Ce 0.03-0.08
ISO 4955:2005	X6NiCrSiNCe35-25	---	---	0.04-0.08	2.00	1.20-2.00	0.040	0.015	24.0-26.0	34.0-36.0	---	N 0.12-0.20; Ce 0.03-0.08
EN 10088-3:2014	X3CrNiCu18-9-4	---	1.4567	0.04	2.00	1.00	0.045	0.030	17.0-19.0	8.5-10.5	---	Cu 3.0-4.0; N 0.10
EN 10263-5:2001	X3CrNiCu18-9-4	---	1.4567	0.04	2.00	1.00	0.045	0.030	17.00-19.00	8.50-10.50	---	Cu 3.00-4.00; N 0.11
EN 10269:2013	X3CrNiCu18-9-4	---	1.4567	0.04	2.00	1.00	0.045	0.015	17.0-19.0	8.5-10.5	---	Cu 3.0-4.0; N 0.10
GB 1220-92	Grade 0Cr18Ni9Cu3	---	---	0.08	2.00	1.00	0.035	0.030	17.00-19.00	8.50-10.50	---	Cu 3.00-4.00
ISO 16143-2:2004	X3CrNiCu18-9-4	---	---	0.04	2.00	1.00	0.045	0.030	17.00-19.00	8.50-10.50	---	Cu 3.00-4.00; N 0.11
ISO 4954:1993	Type X 3 CrNiCu 18 9 3 E	---	---	0.04	2.00	1.00	0.045	0.030	17.0-19.0	8.5-10.5	---	Cu 3.00-4.00
JIS G 4303:2012	Symbol SUSXM7	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	8.50-10.50	---	Cu 3.00-4.00
GB 1220-92	Grade 0Cr18Ni13Si4	---	---	0.08	2.00	3.00-5.00	0.035	0.030	15.00-20.00	11.50-15.00	---	---
GB 1221-92	Grade 0Cr18Ni13Si4	---	---	0.08	2.00	3.00-5.00	0.035	0.030	15.00-20.00	11.50-15.00	---	---
JIS G 4303:2012	Symbol SUSXM15J1	---	---	0.08	2.00	3.00-5.00	0.045	0.030	15.00-20.00	11.50-15.00	---	---
GB 1221-92	Grade 2Cr21Ni12N	---	---	0.15-0.28	1.00-1.60	0.75-1.25	0.035	0.030	20.00-22.00	10.50-12.50	---	N 0.15-0.30
JIS G 4311:2011	Symbol SUH37	---	---	0.15-0.25	1.00-1.60	1.00	0.040	0.030	20.50-22.50	10.00-12.00	---	N 0.15-0.30
EN 10088-3:2014	X8CrMnCuN17-8-3	---	1.4597	0.10	6.5-9.0	2.00	0.040	0.030	15.0-18.0	3.00	1.00	Cu 2.00-3.5; N 0.10-0.30
ISO 16143-2:2004	X8CrMnCuN17-8-3	---	---	0.10	6.50-8.50	2.00	0.040	0.030	16.0-18.0	2.00	1.00	Cu 2.00-3.5; N 0.15-0.3
ASME SA-453/SA-453M	Grade 660, Class A	S66286	---	0.08	2.00	1.00	0.040	0030	13.5-16.0	24.0-27.0	1.00-1.50	V 0.10-0.50; Al 0.35; Ti 1.90-2.35; B 0.001-0.010
ASTM A453/A453M-12	Grade 660, Class A	S66286	---	0.08	2.00	1.00	0.040	0030	13.5-16.0	24.0-27.0	1.00-1.50	V 0.10-0.50; Al 0.35; Ti 1.90-2.35; B 0.001-0.010
EN 10302:2008	X6NiCrTiMoVB25-15-2	---	1.4980	0.030-0.08	1.00-2.00	1.00	0.025	0.015	13.5-16.0	24.0-27.0	1.00-1.50	V 0.10-0.50; Al 0.35; Ti 1.90-2.30; B 0.0030-0.010
GB 1221-92	Grade 0Cr15Ni25Ti2MoAIVB	---	---	0.08	2.00	1.00	0.035	0.030	13.50-16.00	24.00-27.00	1.00-1.50	V 0.10-0.50; Al 0.35; Ti 1.90-2.35; B 0.001-0.010
JIS G 4311:2011	Symbol SUH660	---	---	0.08	2.00	1.00	0.040	0.030	13.50-16.00	24.00-27.00	1.00-1.50	V 0.10-0.50; Al 0.35; Ti 1.90-2.35; B 0.001-0.010
ASME SA-479/SA-479M	---	N08367	---	0.030	2.00	1.00	0.040	0.030	20.0-22.0	23.5-25.5	6.0-7.0	Cu 0.75; N 0.18-0.25
ASTM A479/A479M-14	---	N08367	---	0.030	2.00	1.00	0.040	0.030	20.0-22.0	23.5-25.5	6.0-7.0	Cu 0.75; N 0.18-0.25
ASTM B691-02 (2013)	---	N08367	---	0.030	2.00	1.00	0.040	0.030	20.00-22.00	23.50-25.50	6.00-7.00	Cu 0.75; N 0.18-0.25
JIS G 4303:2012	Symbol SUS836L	---	---	0.030	2.00	1.00	0.045	0.030	19.00-24.00	24.00-26.00	5.00-7.00	N 0.25
EN 10088-3:2014	X1NiCrMoCu25-20-5	---	1.4539	0.020	2.00	0.70	0.030	0.010	19.0-21.0	24.0-26.0	4.0-5.0	Cu 1.20-2.00; N 0.15
JIS G 4303:2012	Symbol SUS890L	---	---	0.020	2.00	1.00	0.045	0.030	19.00-23.00	23.00-28.00	4.00-5.00	Cu 1.00-2.00
EN 10088-3:2014	X1NiCrMoCu31-27-4	---	1.4563	0.020	2.00	0.70	0.030	0.010	26.0-28.0	30.0-32.0	3.0-4.0	Cu 0.70-1.50; N 0.10
EN 10272:2007	X1NiCrMoCu31-27-4	---	1.4563	0.020	2.00	0.70	0.030	0.010	26.0-28.0	30.0-32.0	3.0-4.0	Cu 0.70-1.50; N 0.10
ISO 16143-2:2004	X1NiCrMoCu31-27-4	---	---	0.020	2.00	0.70	0.030	0.010	26.0-28.0	30.0-32.0	3.00-4.00	Cu 0.70-1.50; N 0.11

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type 201	S20100	---	---	---	275	40	515	75	40	A and HF or A and CF	---
ASTM A276/A276M-15	Type 201	S20100	---	---	---	275	40	515	75	40	A+HF or A+CF	---
EN 10088-3:2014	X12CrMnNiN17-7-5	---	1.4372	$t \leq 160$	---	230	---	680-880	---	40 L	SA	260 max. HBW; L: 100 J @ RT
				$160 < t \leq 250$	---	230	---	680-880	---	35 T	SA	260 max. HBW; T: 60 J @ RT
GB 1220-92	Grade 1Cr17Mn6Ni5N	---	---	$t \leq 180$	---	275	---	520	---	40	ST	241 max. HB; 100 max. HRB
JIS G 4303:2012	Symbol SUS201	---	---	$d \leq 180$	---	275	---	520	---	40	ST	241 max. HBW; 100 max. HRBW; 253 max. HV
ASME SA-276	Type 202	S20200	---	---	---	275	40	515	75	40	A and HF or A and CF	---
				$t \leq 19.05$	$t \leq 0.75$	690	100	860	125	12	CW and CF	---
				$19.05 < t \leq 25.40$	$0.75 < t \leq 1$	550	80	795	115	15	CW and CF	---
				$25.40 < t \leq 31.75$	$1 < t \leq 1.25$	450	65	725	105	20	CW and CF	---
				$31.75 < t \leq 38.10$	$1.25 < t \leq 1.5$	345	50	690	100	24	CW and CF	---
				$38.10 < t \leq 44.45$	$1.5 < t \leq 1.75$	310	45	655	95	28	CW and CF	---
ASTM A276/A276M-15	Type 202	S20200	---	---	---	275	40	515	75	40	A+HF or A+CF	---
				$t \leq 19.05$	$t \leq 0.75$	690	100	860	125	12	CW+CF	---
				$19.05 < t \leq 25.40$	$0.75 < t \leq 1$	550	80	795	115	15	CW+CF	---
				$25.40 < t \leq 31.75$	$1 < t \leq 1.25$	450	65	725	105	20	CW+CF	---
				$31.75 < t \leq 38.10$	$1.25 < t \leq 1.5$	345	50	690	100	24	CW+CF	---
				$38.10 < t \leq 44.45$	$1.5 < t \leq 1.75$	310	45	655	95	28	CW+CF	---
GB 1220-92	Grade 1Cr18Mn8Ni5N	---	---	$t \leq 180$	---	275	---	520	---	40	ST	207 max. HB; 95 max. HRB
JIS G 4303:2012	Symbol SUS202	---	---	$d \leq 180$	---	275	---	520	---	40	ST	207 max. HBW; 95 max. HRBW; 218 max. HV

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X10CrNi18-8	---	1.4310	---	---	500	---	800-1000	---	12	CW	---
				0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				t ≤ 40	---	195	---	500-750	---	40 L	SA	230 max. HBW
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---
EN 10263-5:2001	X10CrNi18-8	---	1.4310	2 < d ≤ 5	---	---	---	720 max. L	---	---	CD+SA	---
				2 < d ≤ 5	---	---	---	760 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	660 max. L	---	---	SA	---
				5 < d ≤ 10	---	---	---	890 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	680 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	730 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	660 max. L	---	---	SA	---
				10 < d ≤ 25	---	---	---	850 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	660 max. L	---	---	CD+SA	---
				25 < d ≤ 50	---	---	---	660 max. L	---	---	SA	---
GB 1220-92	Grade 1Cr17Ni7	---	---	t ≤ 180	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
JIS G 4303:2012	Symbol SUS301	---	---	d ≤ 180	---	205	---	520	---	40	ST	207 max. HBW; 95 max. HRBW; 218 max. HV

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type 302	S30200	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A and HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A and CF	---
				$t \leq 19.05$	$t \leq 0.75$	690	100	860	125	12	CW and CF	---
				$19.05 < t \leq 25.40$	$0.75 < t \leq 1$	550	80	795	115	15	CW and CF	---
				$25.40 < t \leq 31.75$	$1 < t \leq 1.25$	450	65	725	105	20	CW and CF	---
				$31.75 < t \leq 38.10$	$1.25 < t \leq 1.5$	345	50	690	100	24	CW and CF	---
				$38.10 < t \leq 44.45$	$1.5 < t \leq 1.75$	310	45	655	95	28	CW and CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A and HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A and CF	---
ASME SA-479/SA-479M	Type 302	S30200	---	---	---	205	30	515	75	30	A	---
ASTM A276/A276M-15	Type 302	S30200	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A+HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A+CF	---
				$t \leq 19.05$	$t \leq 0.75$	690	100	860	125	12	CW+CF	---
				$19.05 < t \leq 25.40$	$0.75 < t \leq 1$	550	80	795	115	15	CW+CF	---
				$25.40 < t \leq 31.75$	$1 < t \leq 1.25$	450	65	725	105	20	CW+CF	---
				$31.75 < t \leq 38.10$	$1.25 < t \leq 1.5$	345	50	690	100	24	CW+CF	---
				$38.10 < t \leq 44.45$	$1.5 < t \leq 1.75$	310	45	655	95	28	CW+CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A+HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A+CF	---
ASTM A479/A479M-14	Type 302	S30200	---	---	---	205	30	515	75	30	SA	---
ISO 4954:1993	Type X 10 CrNi 18 9 E	---	---	$2 \leq d \leq 50$	---	---	---	660 max.	---	---	Q, CD	---
				$2 \leq d \leq 50$	---	---	---	720 max.	---	---	see standard	---
JIS G 4303:2012	Symbol SUS302	---	---	$d \leq 180$	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRC; 200 max. HV

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A582/A582M-12e1	Type 303	S30300	---	---	---	---	---	---	---	---	A	262 max. HBW
EN 10088-3:2014	X8CrNiS18-9	---	1.4305	---	---	350	---	700-850	---	20	CW	---
				---	---	500	---	800-1000	---	12	CW	---
				0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				t ≤ 10	---	400	---	600-950	---	15 L	SA	---
				10 < t ≤ 16	---	400	---	600-950	---	15 L	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				16 < t ≤ 40	---	190	---	500-850	---	20 L	SA	---
				40 < t ≤ 63	---	190	---	500-850	---	20 L	SA	---
				t ≤ 160	---	190	---	500-750	---	35 L	SA	230 max. HBW
				63 < t ≤ 160	---	190	---	500-750	---	35 L	SA	---
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---
EN 10294-2:2012	X8CrNiS18-9	---	1.4305	---	---	190	---	500-700	---	35 L; 30 T	SA	---
GB 1220-92	Grade Y1Cr18Ni9	---	---	t ≤ 180	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
JIS G 4303:2012	Symbol SUS303	---	---	d ≤ 180	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASTM A582/A582M-12e1	Type 303Se	S30323	---	---	---	---	---	---	---	---	A	262 max. HBW
GB 1220-92	Grade Y1Cr18Ni9Se	---	---	t ≤ 180	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
JIS G 4303:2012	Symbol SUS303Se	---	---	d ≤ 180	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type 304	S30400	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A and HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A and CF	---
				$t \leq 19.05$	$t \leq 0.75$	690	100	860	125	12	CW and CF	---
				$19.05 < t \leq 25.40$	$0.75 < t \leq 1$	550	80	795	115	15	CW and CF	---
				$25.40 < t \leq 31.75$	$1 < t \leq 1.25$	450	65	725	105	20	CW and CF	---
				$31.75 < t \leq 38.10$	$1.25 < t \leq 1.5$	345	50	690	100	24	CW and CF	---
				$38.10 < t \leq 44.45$	$1.5 < t \leq 1.75$	310	45	655	95	28	CW and CF	---
				$t \leq 50.8$	$t \leq 2$	515	75	650	95	25	H+CW+CF	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H+CW+CF	---
				$63.5 < t \leq 76.2$	$2.5 < t \leq 3$	380	55	550	80	30	H+CW+CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A and HF	---
ASME SA-479/SA-479M	Type 304	S30400	---	---	---	205	30	515	75	30	A	---
				---	---	450	65	585	85	30	H	---
				$t \leq 50.8$	$t \leq 2$	515	75	655	95	25	H	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H	---
				$63.5 < t \leq 76.2$	$2.5 < t \leq 3$	380	55	550	80	30	H	---
ASME SA-666	Type 304	S30400	---	---	---	205	30	515	75	40	A	201 max. HB; 92 max. HRB
ASTM A276/A276M-15	Type 304	S30400	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A+HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A+CF	---
				$t \leq 19.05$	$t \leq 0.75$	690	100	860	125	12	CW+CF	---
				$19.05 < t \leq 25.40$	$0.75 < t \leq 1$	550	80	795	115	15	CW+CF	---
				$25.40 < t \leq 31.75$	$1 < t \leq 1.25$	450	65	725	105	20	CW+CF	---
				$31.75 < t \leq 38.10$	$1.25 < t \leq 1.5$	345	50	690	100	24	CW+CF	---
				$38.10 < t \leq 44.45$	$1.5 < t \leq 1.75$	310	45	655	95	28	CW+CF	---
				$t \leq 50.8$	$t \leq 2$	515	75	650	95	25	H+CF	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H+CF	---
				$63.5 < t \leq 76.2$	$2.5 < t \leq 3$	380	55	550	80	30	H+CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A+HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A+CF	---
ASTM A479/A479M-14	Type 304	S30400	---	---	---	205	30	515	75	30	SA	---
				---	---	450	65	585	85	30	H	---
				$t \leq 50.8$	$t \leq 2$	515	75	655	95	25	H	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H	---
				$63.5 < t \leq 76.2$	$2.5 < t \leq 3$	380	55	550	80	30	H	---
ASTM A666-15	Type 304	S30400	---	---	---	205	30	515	75	40	A	201 max. HB; 92 max. HRB

Note: This section continued on next page

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A955/A955M-15	Grade 60 [420], Type 304	S30400	---	---	---	420	60	620	90	20	A, HR or SH	---
	Grade 75 [520], Type 304	S30400	---	---	---	520	75	690	100	20	A, HR or SH	---
EN 10088-3:2014	X5CrNi18-10	---	1.4301	---	---	350	---	700-850	---	20	CW	---
				---	---	500	---	800-1000	---	12	CW	---
				0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				t ≤ 10	---	400	---	600-950	---	25 L	SA	---
				10 < t ≤ 16	---	400	---	600-950	---	25 L	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				16 < t ≤ 40	---	190	---	600-850	---	30 L	SA	L: 100 J @ RT
				40 < t ≤ 63	---	190	---	580-850	---	30 L	SA	L: 100 J @ RT
				t ≤ 160	---	190	---	500-700	---	45 L	SA	215 max. HBW; L: 100 J @ RT
				63 < t ≤ 160	---	190	---	500-700	---	45 L	SA	L: 100 J @ RT
				160 < t ≤ 250	---	190	---	500-700	---	35 T	SA	215 max. HBW; T: 60 J @ RT
				160 < t ≤ 250	---	190	---	500-700	---	35 T	SA	T: 60 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10263-5:2001	X5CrNi18-10	---	1.4301	2 < d ≤ 5	---	---	---	700 max. L	---	---	CD+SA	---
				2 < d ≤ 5	---	---	---	750 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	650 max. L	---	---	SA	---
				5 < d ≤ 10	---	---	---	820 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	650 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	700 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	650 max. L	---	---	SA	---
				10 < d ≤ 25	---	---	---	780 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	650 max. L	---	---	CD+SA	---
				25 < d ≤ 50	---	---	---	650 max. L	---	---	SA	---
EN 10294-2:2012	X5CrNi18-10	---	1.4301	---	---	195	---	500-700	---	40 L; 35 T	SA	---
GB 1220-92	Grade 0Cr18Ni9	---	---	t ≤ 180	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 1221-92	Grade 0Cr18Ni9	---	---	t ≤ 180	---	205	---	520	---	40	ST	187 max. HB
ISO 4954:1993	Type X 5 CrNi 18 9 E	---	---	2 ≤ d ≤ 50	---	---	---	650 max.	---	---	Q, CD	---
				2 ≤ d ≤ 50	---	---	---	710 max.	---	---	see standard	---
JIS G 4303:2012	Symbol SUS304	---	---	d ≤ 180	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type 304L	S30403	---	$t \leq 12.5$	$t \leq 0.5$	170	25	485	70	30	A and HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A and CF	---
				$t > 12.5$	$t > 0.5$	170	25	485	70	40	A and HF	---
				$t > 12.70$	$t > 0.5$	170	25	485	70	30	A and CF	---
ASME SA-479/SA-479M	Type 304L	S30403	---	---	---	170	25	485	70	30	SA	---
				---	---	450	65	585	85	30	H	---
				$t \leq 50.8$	$t \leq 2$	515	75	655	95	25	H	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H	---
				$63.5 < t \leq 76.2$	$2.5 < t \leq 3$	380	55	550	80	30	H	---
ASME SA-666	Type 304L	S30403	---	---	---	170	25	485	70	40	A	201 max. HB; 92 max. HRB
ASTM A276/A276M-15	Type 304L	S30403	---	$t \leq 12.5$	$t \leq 0.5$	170	25	485	70	30	A+HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A+CF	---
				$t \leq 19.05$	$t \leq 0.75$	690	100	860	125	12	CW+CF	---
				$19.05 < t \leq 25.40$	$0.75 < t \leq 1$	550	80	795	115	15	CW+CF	---
				$25.40 < t \leq 31.75$	$1 < t \leq 1.25$	450	65	725	105	20	CW+CF	---
				$31.75 < t \leq 38.10$	$1.25 < t \leq 1.5$	345	50	690	100	24	CW+CF	---
				$38.10 < t \leq 44.45$	$1.5 < t \leq 1.75$	310	45	655	95	28	CW+CF	---
				$t \leq 50.8$	$t \leq 2$	515	75	650	95	25	H+CF	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H+CF	---
				$63.5 < t \leq 76.2$	$2.5 < t \leq 3$	380	55	550	80	30	H+CF	---
				$t > 12.5$	$t > 0.5$	170	25	485	70	40	A+HF	---
				$t > 12.70$	$t > 0.5$	170	25	485	70	30	A+CF	---
ASTM A479/A479M-14	Type 304L	S30403	---	---	---	170	25	485	70	30	SA	---
				---	---	450	65	585	85	30	H	---
				$t \leq 50.8$	$t \leq 2$	515	75	655	95	25	H	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H	---
				$63.5 < t \leq 76.2$	$2.5 < t \leq 3$	380	55	550	80	30	H	---
ASTM A666-15	Type 304L	S30403	---	---	---	170	25	485	70	40	A	201 max. HB; 92 max. HRB

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X2CrNi18-9	---	1.4307	---	---	350	---	700-850	---	20	CW	---
				---	---	500	---	800-1000	---	12	CW	---
				0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				t ≤ 10	---	400	---	600-930	---	25 L	SA	---
				10 < t ≤ 16	---	380	---	600-930	---	25 L	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				16 < t ≤ 40	---	175	---	500-830	---	30 L	SA	L: 100 J @ RT
				40 < t ≤ 63	---	175	---	500-830	---	30 L	SA	L: 100 J @ RT
				t ≤ 160	---	175	---	500-700	---	45 L	SA	215 max. HBW; L: 100 J @ RT
				63 < t ≤ 160	---	175	---	500-700	---	45 L	SA	L: 100 J @ RT
				160 < t ≤ 250	---	175	---	500-700	---	35 T	SA	215 max. HBW; T: 60 J @ RT
				160 < t ≤ 250	---	175	---	500-700	---	35 T	SA	T: 60 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10263-5:2001	X2CrNi18-9	---	1.4307	2 < d ≤ 5	---	---	---	680 max. L	---	---	CD+SA	---
				2 < d ≤ 5	---	---	---	730 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	630 max. L	---	---	SA	---
				5 < d ≤ 10	---	---	---	800 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	630 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	680 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	630 max. L	---	---	SA	---
				10 < d ≤ 25	---	---	---	760 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	630 max. L	---	---	CD+SA	---
				25 < d ≤ 50	---	---	---	630 max. L	---	---	SA	---
				25 < d ≤ 50	---	---	---	740 max. L	---	---	CD+SA	---
				25 < d ≤ 50	---	---	---	630 max. L	---	---	CD+SA	---
EN 10294-2:2012	X2CrNi18-9	---	1.4307	---	---	180	---	460-680	---	40 L; 35 T	SA	---
	X2CrNi19-11	---	1.4306	---	---	180	---	460-680	---	40 L; 35 T	SA	---
GB 1220-92	Grade 00Cr19Ni10	---	---	t ≤ 180	---	177	---	480	---	40	ST	187 max. HB; 90 max. HRB
ISO 4954:1993	Type X 2 CrNi 18 10 E	---	---	2 ≤ d ≤ 50	---	---	---	630 max.	---	---	Q, CD	---
				2 ≤ d ≤ 50	---	---	---	680 max.	---	---	see standard	---
JIS G 4303:2012	Symbol SUS304L	---	---	d ≤ 180	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-276	Type 304N	S30451	---	---	---	240	35	550	80	30	A and HF or A and CF	---
				t ≤ 19.05	t ≤ 0.75	690	100	860	125	12	CW and CF	---
				19.05 < t ≤ 25.40	0.75 < t ≤ 1	550	80	795	115	15	CW and CF	---
				25.40 < t ≤ 31.75	1 < t ≤ 1.25	450	65	725	105	20	CW and CF	---
				31.75 < t ≤ 38.10	1.25 < t ≤ 1.5	345	50	690	100	24	CW and CF	---
				38.10 < t ≤ 44.45	1.5 < t ≤ 1.75	310	45	655	95	28	CW and CF	---
				t ≤ 50.8	t ≤ 2	515	75	650	95	25	H+CW+CF	---
				50.8 < t ≤ 63.5	2 < t ≤ 2.5	450	65	620	90	30	H+CW+CF	---
				63.5 < t ≤ 76.2	2.5 < t ≤ 3	380	55	550	80	30	H+CW+CF	---
ASME SA-479/SA-479M	Type 304N	S30451	---	---	---	240	35	550	80	30	A	---
ASME SA-666	Type 304N	S30451	---	---	---	240	35	550	80	30	A	217 max. HB; 95 max. HRB

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A276/A276M-15	Type 304N	S30451	---	---	---	240	35	550	80	30	A+HF or A+CF	---
				$t \leq 19.05$	$t \leq 0.75$	690	100	860	125	12	CW+CF	---
				$19.05 < t \leq 25.40$	$0.75 < t \leq 1$	550	80	795	115	15	CW+CF	---
				$25.40 < t \leq 31.75$	$1 < t \leq 1.25$	450	65	725	105	20	CW+CF	---
				$31.75 < t \leq 38.10$	$1.25 < t \leq 1.5$	345	50	690	100	24	CW+CF	---
				$38.10 < t \leq 44.45$	$1.5 < t \leq 1.75$	310	45	655	95	28	CW+CF	---
				$t \leq 50.8$	$t \leq 2$	515	75	650	95	25	H+CF	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H+CF	---
				$63.5 < t \leq 76.2$	$2.5 < t \leq 3$	380	55	550	80	30	H+CF	---
ASTM A479/A479M-14	Type 304N	S30451	---	---	---	240	35	550	80	30	SA	---
ASTM A666-15	Type 304N	S30451	---	---	---	240	35	550	80	30	A	217 max. HB; 95 max. HRB
GB 1220-92	Grade 0Cr19Ni9N	---	---	$t \leq 180$	---	275	---	550	---	35	ST	217 max. HB; 95 max. HRB
JIS G 4303:2012	Symbol SUS304N1	---	---	$d \leq 180$	---	275	---	550	---	35	ST	217 max. HBW; 95 max. HRBW; 220 max. HV
EN 10088-3:2014	X5CrNiN19-9	---	1.4315	$t \leq 40$	---	270	---	550-750	---	40 L	SA	215 max. HBW; L: 100 J @ RT
ASME SA-276	Type 304LN	S30453	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A and HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A and CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A and HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A and CF	---
ASME SA-479/SA-479M	Type 304LN	S30453	---	---	---	205	30	515	75	30	A	---
ASME SA-666	Type 304LN	S30453	---	---	---	205	30	515	75	40	A	217 max. HB; 95 max. HRB
ASTM A276/A276M-15	Type 304LN	S30453	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A+HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A+CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A+HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A+CF	---
ASTM A479/A479M-14	Type 304LN	S30453	---	---	---	205	30	515	75	30	SA	---
ASTM A666-15	Type 304LN	S30453	---	---	---	205	30	515	75	40	A	217 max. HB; 95 max. HRB
EN 10088-3:2014	X2CrNiN18-10	---	1.4311	$t \leq 160$	---	270	---	550-760	---	40 L	SA	230 max. HBW; L: 100 J @ RT
				$160 < t \leq 250$	---	270	---	550-760	---	30 T	SA	230 max. HBW; T: 60 J @ RT
GB 1220-92	Grade 00Cr18Ni10N	---	---	$t \leq 180$	---	245	---	550	---	40	ST	217 max. HB; 95 max. HRB

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 4303:2012	Symbol SUS304LN	---	---	d ≤ 180	---	245	---	550	---	40	ST	217 max. HBW; 95 max. HRBW; 220 max. HV
ASME SA-479/SA-479M	Type 304H	S30409	---	---	---	205	30	515	75	30	A	---
ASTM A479/A479M-14	Type 304H	S30409	---	---	---	205	30	515	75	30	SA	---
EN 10088-3:2014	X9CrNi18-9	---	1.4325	t ≤ 40	---	190	---	550-750	---	40 L	SA	215 max. HB
ISO 4955:2005	X7CrNi18-9	---	---	0.5 ≤ t < 3	---	195	---	500-700	---	37 L, 37 T	SA	192 max. HB
				1.5 ≤ t ≤ 25	---	195	---	500-700	---	40	SA	192 max. HB
				3 ≤ t ≤ 75	---	195	---	500-700	---	40 L, 40 T	SA	192 max. HB
				t ≤ 100	---	195	---	500-700	---	40	SA	192 max. HB
				5 ≤ t ≤ 160	---	195	---	500-700	---	40	SA	192 max. HB
ASME SA-276	Type XM-21	S30452	---	---	---	345	50	620	90	30	A and HF or A and CF	---
				t ≤ 25.40	t ≤ 1	860	125	1000	145	15	CW and CF	---
				25.40 < t ≤ 31.75	1 < t ≤ 1.25	795	115	930	135	16	CW and CF	---
				31.75 < t ≤ 38.10	1.25 < t ≤ 1.5	725	105	895	135	17	CW and CF	---
				38.10 < t ≤ 44.45	1.5 < t ≤ 1.75	690	100	860	125	18	CW and CF	---
ASTM A276/A276M-15	Type XM-21	S30452	---	---	---	345	50	620	90	30	A+HF or A+CF	---
				t ≤ 25.40	t ≤ 1	860	125	1000	145	15	CW+CF	---
				25.40 < t ≤ 31.75	1 < t ≤ 1.25	795	115	930	135	16	CW+CF	---
				31.75 < t ≤ 38.10	1.25 < t ≤ 1.5	725	105	895	135	17	CW+CF	---
				38.10 < t ≤ 44.45	1.5 < t ≤ 1.75	690	100	860	125	18	CW+CF	---
GB 1220-92	Grade 0Cr19Ni10NbN	---	---	t ≤ 180	---	345	---	685	---	35	ST	250 max. HB; 100 max. HRB
JIS G 4303:2012	Symbol SUS304N2	---	---	d ≤ 180	---	345	---	690	---	35	ST	250 max. HBW; 100 max. HRBW; 260 max. HV
ASME SA-276	Type 305	S30500	---	t ≤ 12.5	t ≤ 0.5	205	30	515	75	30	A and HF	---
				t ≤ 12.70	t ≤ 0.5	310	45	620	90	30	A and CF	---
				t > 12.5	t > 0.5	205	30	515	75	40	A and HF	---
				t > 12.70	t > 0.5	205	30	515	75	30	A and CF	---
ASTM A276/A276M-15	Type 305	S30500	---	t ≤ 12.5	t ≤ 0.5	205	30	515	75	30	A+HF	---
				t ≤ 12.70	t ≤ 0.5	310	45	620	90	30	A+CF	---
				t > 12.5	t > 0.5	205	30	515	75	40	A+HF	---
				t > 12.70	t > 0.5	205	30	515	75	30	A+CF	---
GB 1220-92	Grade 1Cr18Ni12	---	---	t ≤ 180	---	177	---	480	---	40	ST	187 max. HB; 90 max. HRB
JIS G 4303:2012	Symbol SUS305	---	---	d ≤ 180	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X4CrNi18-12	---	1.4303	0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				t ≤ 160	---	190	---	500-700	---	45 L	SA	215 max. HBW; L: 100 J @ RT
				160 < t ≤ 250	---	190	---	500-700	---	35 T	SA	215 max. HBW; T: 60 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---
EN 10263-5:2001	X4CrNi18-12	---	1.4303	2 < d ≤ 5	---	---	---	670 max. L	---	---	CD+SA	---
				2 < d ≤ 5	---	---	---	720 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	650 max. L	---	---	SA	---
				5 < d ≤ 10	---	---	---	800 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	650 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	700 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	650 max. L	---	---	SA	---
				10 < d ≤ 25	---	---	---	770 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	650 max. L	---	---	CD+SA	---
EN 10269:2013	X4CrNi18-12	---	1.4303	d ≤ 25	---	500	---	800-1000 L	---	12 L	CW	L: 80 J @ 20°C
				d ≤ 35	---	350	---	700-850 L	---	20 L	CW	L: 80 J @ 20°C
				d ≤ 160	---	190	---	500-700 L	---	45 L	SA	L: 100 J @ 20°C
ISO 4954:1993	Type X 5 CrNi 18 12 E	---	---	2 ≤ d ≤ 50	---	---	---	650 max.	---	---	Q, CD	---
				2 ≤ d ≤ 50	---	---	---	700 max.	---	---	see standard	---

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type 309	S30900	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A and HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A and CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A and HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A and CF	---
ASTM A276/A276M-15	Type 309	S30900	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A+HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A+CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A+HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A+CF	---
GB 1221-92	Grade 2Cr23Ni13	---	---	$t \leq 180$	---	205	---	560	---	45	ST	201 max. HB
JIS G 4311:2011	Symbol SUH309	---	---	$t \leq 180$	---	205	---	560	---	45	ST	201 max. HBW
ASME SA-276	Type 309S	S30908	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A and HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A and CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A and HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A and CF	---
ASME SA-479/SA-479M	Type 309S	S30908	---	---	---	205	30	515	75	30	A	---
ASTM A276/A276M-15	Type 309S	S30908	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A+HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A+CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A+HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A+CF	---
ASTM A479/A479M-14	Type 309S	S30908	---	---	---	205	30	515	75	30	SA	---
GB 1220-92	Grade 0Cr23Ni13	---	---	$t \leq 180$	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 1221-92	Grade 0Cr23Ni13	---	---	$t \leq 180$	---	205	---	520	---	40	ST	187 max. HB
JIS G 4303:2012	Symbol SUS309S	---	---	$d \leq 180$	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-276	Type 310	S31000	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A and HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A and CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A and HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A and CF	---
ASTM A276/A276M-15	Type 310	S31000	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A+HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A+CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A+HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A+CF	---
GB 1221-92	Grade 2Cr25Ni20	---	---	$t \leq 180$	---	205	---	590	---	40	ST	201 max. HB
JIS G 4311:2011	Symbol SUH310	---	---	$t \leq 180$	---	205	---	590	---	40	ST	201 max. HBW

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type 310S	S31008	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A and HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A and CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A and HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A and CF	---
ASME SA-479/SA-479M	Type 310S	S31008	---	---	---	205	30	515	75	30	A	---
ASTM A276/A276M-15	Type 310S	S31008	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A+HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A+CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A+HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A+CF	---
ASTM A479/A479M-14	Type 310S	S31008	---	---	---	205	30	515	75	30	SA	---
GB 1220-92	Grade 0Cr25Ni20	---	---	$t \leq 180$	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 1221-92	Grade 0Cr25Ni20	---	---	$t \leq 180$	---	205	---	520	---	40	ST	187 max. HB
JIS G 4303:2012	Symbol SUS310S	---	---	$d \leq 180$	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	---	S31254	---	---	---	300	44	650	95	35	A and HF or A and CF	---
ASME SA-479/SA-479M	---	S31254	---	---	---	305	44	655	95	35	A	---
ASTM A276/A276M-15	---	S31254	---	---	---	300	44	650	95	35	A+HF or A+CF	---
ASTM A479/A479M-14	---	S31254	---	---	---	305	44	655	95	35	SA	---
EN 10088-3:2014	X1CrNiMoCuN20-18-7	---	1.4547	0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				t ≤ 160	---	300	---	650-850	---	35 L	SA	260 max. HBW; L: 100 J @ RT
				160 < t ≤ 250	---	300	---	650-850	---	30 T	SA	260 max. HBW; T: 60 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---
JIS G 4303:2012	Symbol SUS312L	---	---	d ≤ 180	---	300	---	650	---	35	ST	223 max. HBW; 96 max. HRBW; 230 max. HV
EN 10088-3:2014	X1CrNiMoCuNW24-22-6	---	1.4659	t ≤ 160	---	420	---	800-1000	---	50 L	SA	290 max. HBW; L: 90 J @ RT
ISO 16143-2:2004	X1CrNiMoCuNW24-22-6	---	---	t ≤ 160	---	420	---	800-1000	---	50 L	SA	---
ASTM A276/A276M-15	---	S32654	---	---	---	430	62	750	109	40	A+HF or A+CF	250 max. HBW
ASTM A479/A479M-14	---	S32654	---	---	---	430	62	750	109	40	SA	250 max. HB
EN 10088-3:2014	X1CrNiMoCuN24-22-8	---	1.4652	t ≤ 50	---	430	---	750-1000	---	40 L	SA	310 max. HBW; L: 100 J @ RT
ISO 16143-2:2004	X1CrNiMoCuN24-22-8	---	---	t ≤ 50	---	430	---	750-1000	---	40 L	SA	---

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type 314	S31400	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A and HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A and CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A and HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A and CF	---
ASTM A276/A276M-15	Type 314	S31400	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A+HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A+CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A+HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A+CF	---
GB 1221-92	Grade 1Cr25Ni20Si2	---	---	$t \leq 180$	---	295	---	590	---	35	ST	187 max. HB
EN 10095:1999	X15CrNiSi25-21	---	1.4841	$0.5 \leq t < 3$	---	230	---	550-750	---	28 L, 28 T	SA	223 max. HB
				$t \leq 25$	---	230	---	550-750 L	---	30 L	SA	223 max. HB
				$3 \leq t \leq 75$	---	230	---	550-750	---	30 L, 30 T	SA	223 max. HB
				$t \leq 160$	---	230	---	550-750 L	---	30 L	SA	223 max. HB

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type 316	S31600	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A and HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A and CF	---
				$t \leq 19.05$	$t \leq 0.75$	690	100	860	125	12	CW and CF	---
				$19.05 < t \leq 25.40$	$0.75 < t \leq 1$	550	80	795	115	15	CW and CF	---
				$25.40 < t \leq 31.75$	$1 < t \leq 1.25$	450	65	725	105	20	CW and CF	---
				$31.75 < t \leq 38.10$	$1.25 < t \leq 1.5$	345	50	690	100	24	CW and CF	---
				$38.10 < t \leq 44.45$	$1.5 < t \leq 1.75$	310	45	655	95	28	CW and CF	---
				$t \leq 50.8$	$t \leq 2$	515	75	650	95	25	H+CW+CF	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H+CW+CF	---
				$63.5 < t \leq 76.2$	$2.5 < t \leq 3$	380	55	550	80	30	H+CW+CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A and HF	---
ASME SA-479/SA-479M	Type 316	S31600	---	---	---	205	30	515	75	30	A	---
				---	---	450	65	585	85	30	H	---
				$t \leq 50.8$	$t \leq 2$	515	75	655	95	30	H	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H	---
				$63.5 < t \leq 76.2$	$2.5 < t \leq 3$	380	55	550	80	30	H	---
ASME SA-666	Type 316	S31600	---	---	---	205	30	515	75	40	A	217 max. HB; 95 max. HRB
ASTM A276/A276M-15	Type 316	S31600	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A+HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A+CF	---
				$t \leq 19.05$	$t \leq 0.75$	690	100	860	125	12	CW+CF	---
				$19.05 < t \leq 25.40$	$0.75 < t \leq 1$	550	80	795	115	15	CW+CF	---
				$25.40 < t \leq 31.75$	$1 < t \leq 1.25$	450	65	725	105	20	CW+CF	---
				$31.75 < t \leq 38.10$	$1.25 < t \leq 1.5$	345	50	690	100	24	CW+CF	---
				$38.10 < t \leq 44.45$	$1.5 < t \leq 1.75$	310	45	655	95	28	CW+CF	---
				$t \leq 50.8$	$t \leq 2$	515	75	650	95	25	H+CF	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H+CF	---
				$63.5 < t \leq 76.2$	$2.5 < t \leq 3$	380	55	550	80	30	H+CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A+HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A+CF	---
ASTM A479/A479M-14	Type 316	S31600	---	---	---	205	30	515	75	30	SA	---
				---	---	450	65	585	85	30	H	---
				$t \leq 50.8$	$t \leq 2$	515	75	655	95	25	H	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H	---
				$63.5 < t \leq 76.2$	$2.5 < t \leq 3$	380	55	550	80	30	H	---
ASTM A666-15	Type 316	S31600	---	---	---	205	30	515	75	40	A	217 max. HB; 95 max. HRB

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X5CrNiMo17-12-2	---	1.4401	---	---	350	---	700-850	---	20	CW	---
				---	---	500	---	800-1000	---	12	CW	---
				0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				t ≤ 10	---	400	---	600-950	---	25 L	SA	---
				10 < t ≤ 16	---	380	---	580-950	---	25 L	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				16 < t ≤ 40	---	200	---	500-850	---	30 L	SA	L: 100 J @ RT
				40 < t ≤ 63	---	200	---	500-850	---	30 L	SA	L: 100 J @ RT
				t ≤ 160	---	200	---	500-700	---	40 L	SA	215 max. HBW; L: 100 J @ RT
				63 < t ≤ 160	---	200	---	500-700	---	40 L	SA	L: 100 J @ RT
				160 < t ≤ 250	---	200	---	500-700	---	30 T	SA	215 max. HBW; T: 60 J @ RT
				160 < t ≤ 250	---	200	---	500-700	---	30 T	SA	T: 60 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X3NiCrMo17-13-3	---	1.4436	0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				t ≤ 10	---	400	---	600-950	---	25 L	SA	---
				10 < t ≤ 16	---	400	---	600-950	---	25 L	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				16 < t ≤ 40	---	200	---	500-850	---	30 L	SA	L: 100 J @ RT
				40 < t ≤ 63	---	190	---	500-850	---	30 L	SA	L: 100 J @ RT
				t ≤ 160	---	200	---	500-700	---	40 L	SA	215 max. HBW; L: 100 J @ RT
				63 < t ≤ 160	---	200	---	500-700	---	40 L	SA	L: 100 J @ RT
				160 < t ≤ 250	---	200	---	500-700	---	30 T	SA	215 max. HBW; T: 60 J @ RT
				160 < t ≤ 250	---	200	---	500-700	---	30 T	SA	T: 60 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10263-5:2001	X5CrNiMo17-12-2	---	1.4401	2 < d ≤ 5	---	---	---	690 max. L	---	---	CD+SA	---
				2 < d ≤ 5	---	---	---	740 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	660 max. L	---	---	SA	---
				5 < d ≤ 10	---	---	---	830 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	670 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	720 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	660 max. L	---	---	SA	---
				10 < d ≤ 25	---	---	---	790 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	660 max. L	---	---	CD+SA	---
	X3CrNiMo17-13-3	---	1.4436	25 < d ≤ 50	---	---	---	660 max. L	---	---	SA	---
				2 < d ≤ 5	---	---	---	690 max. L	---	---	CD+SA	---
				2 < d ≤ 5	---	---	---	740 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	660 max. L	---	---	SA	---
				5 < d ≤ 10	---	---	---	830 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	670 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	720 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	660 max. L	---	---	SA	---
				10 < d ≤ 25	---	---	---	790 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	660 max. L	---	---	CD+SA	---
				25 < d ≤ 50	---	---	---	660 max. L	---	---	SA	---
EN 10294-2:2012	X5CrNiMo17-12-2	---	1.4401	---	---	200	---	500-700	---	40 L; 30 T	SA	---
GB 1220-92	Grade 0Cr17Ni12Mo2	---	---	t ≤ 180	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 1221-92	Grade 0Cr17Ni12Mo2	---	---	t ≤ 180	---	205	---	520	---	40	ST	187 max. HB
ISO 4954:1993	Type X 5 CrNiMo 17 12 2 E	---	---	2 ≤ d ≤ 50	---	---	---	660 max.	---	---	Q, CD	---
				2 ≤ d ≤ 50	---	---	---	710 max.	---	---	see standard	---
JIS G 4303:2012	Symbol SUS316	---	---	d ≤ 180	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type 316L	S31603	---	$t \leq 12.5$	$t \leq 0.5$	170	25	485	70	30	A and HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A and CF	---
				$t > 12.5$	$t > 0.5$	170	25	485	70	40	A and HF	---
				$t > 12.70$	$t > 0.5$	170	25	485	70	30	A and CF	---
ASME SA-479/SA-479M	Type 316L	S31603	---	---	---	170	25	485	70	30	A	---
				---	---	450	65	585	85	30	H	---
				$t \leq 50.8$	$t \leq 2$	515	75	655	95	25	H	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H	---
				$63.5 < t \leq 76.2$	$2.5 < t \leq 3$	380	55	550	80	30	H	---
ASME SA-666	Type 316L	S31603	---	---	---	170	25	485	70	40	A	217 max. HB; 95 max. HRB
ASTM A276/A276M-15	Type 316L	S31603	---	$t \leq 12.5$	$t \leq 0.5$	170	25	485	70	30	A+HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A+CF	---
				$t \leq 19.05$	$t \leq 0.75$	690	100	860	125	12	CW+CF	---
				$19.05 < t \leq 25.40$	$0.75 < t \leq 1$	550	80	795	115	15	CW+CF	---
				$25.40 < t \leq 31.75$	$1 < t \leq 1.25$	450	65	725	105	20	CW+CF	---
				$31.75 < t \leq 38.10$	$1.25 < t \leq 1.5$	345	50	690	100	24	CW+CF	---
				$38.10 < t \leq 44.45$	$1.5 < t \leq 1.75$	310	45	655	95	28	CW+CF	---
				$t \leq 50.8$	$t \leq 2$	515	75	650	95	25	H+CF	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H+CF	---
				$63.5 < t \leq 76.2$	$2.5 < t \leq 3$	380	55	550	80	30	H+CF	---
				$t > 12.5$	$t > 0.5$	170	25	485	70	40	A+HF	---
ASTM A479/A479M-14	Type 316L	S31603	---	$t > 12.70$	$t > 0.5$	170	25	485	70	30	A+CF	---
				---	---	170	25	485	70	30	SA	---
				---	---	450	65	585	85	30	H	---
				$t \leq 50.8$	$t \leq 2$	515	75	655	95	25	H	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H	---
ASTM A666-15	Type 316L	S31603	---	$63.5 < t \leq 76.2$	$2.5 < t \leq 3$	380	55	550	80	30	H	---
ASTM A666-15	Type 316L	S31603	---	---	---	170	25	485	70	40	A	217 max. HB; 95 max. HRB
ASTM A955/A955M-15	Grade 60 [420], Type 316L	S31603	---	---	---	420	60	620	90	20	A, HR or SH	---
	Grade 75 [520], Type 316L	S31603	---	---	---	520	75	690	100	20	A, HR or SH	---

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X2CrNiMo17-12-2	---	1.4404	---	---	350	---	700-850	---	20	CW	---
				---	---	500	---	800-1000	---	12	CW	---
				0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				t ≤ 10	---	400	---	600-930	---	25 L	SA	---
				10 < t ≤ 16	---	380	---	580-930	---	25 L	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				16 < t ≤ 40	---	200	---	500-830	---	30 L	SA	L: 100 J @ RT
				40 < t ≤ 63	---	200	---	500-830	---	30 L	SA	L: 100 J @ RT
				t ≤ 160	---	200	---	500-700	---	40 L	SA	215 max. HBW; L: 100 J @ RT
				63 < t ≤ 160	---	200	---	500-700	---	40 L	SA	L: 100 J @ RT
				160 < t ≤ 250	---	200	---	500-700	---	30 T	SA	215 max. HBW; T: 60 J @ RT
				160 < t ≤ 250	---	200	---	500-700	---	30 T	SA	T: 60 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X2CrNiMo17-12-3	---	1.4432	0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				t ≤ 10	---	400	---	600-930	---	25 L	SA	---
				10 < t ≤ 16	---	380	---	600-880	---	25 L	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				16 < t ≤ 40	---	200	---	500-850	---	30 L	SA	L: 100 J @ RT
				40 < t ≤ 63	---	200	---	500-850	---	30 L	SA	L: 100 J @ RT
				t ≤ 160	---	200	---	500-700	---	40 L	SA	215 max. HBW; L: 100 J @ RT
				63 < t ≤ 160	---	200	---	500-700	---	40 L	SA	L: 100 J @ RT
				160 < t ≤ 250	---	200	---	500-700	---	30 T	SA	215 max. HBW; T: 60 J @ RT
				160 < t ≤ 250	---	200	---	500-700	---	30 T	SA	T: 60 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X2CrNiMo18-14-3	---	1.4435	0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				t ≤ 10	---	400	---	600-950	---	25 L	SA	---
				10 < t ≤ 16	---	400	---	600-950	---	25 L	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				16 < t ≤ 40	---	235	---	500-850	---	30 L	SA	L: 100 J @ RT
				40 < t ≤ 63	---	235	---	500-850	---	30 L	SA	L: 100 J @ RT
				t ≤ 160	---	200	---	500-700	---	40 L	SA	215 max. HBW; L: 100 J @ RT
				63 < t ≤ 160	---	235	---	500-700	---	40 L	SA	L: 100 J @ RT
				160 < t ≤ 250	---	200	---	500-700	---	30 T	SA	215 max. HBW; T: 60 J @ RT
				160 < t ≤ 250	---	235	---	500-700	---	30 T	SA	T: 60 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10263-5:2001	X2CrNiMo17-12-2	---	1.4404	2 < d ≤ 5	---	---	---	670 max. L	---	---	CD+SA	---
				2 < d ≤ 5	---	---	---	720 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	650 max. L	---	---	SA	---
				5 < d ≤ 10	---	---	---	780 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	650 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	700 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	650 max. L	---	---	SA	---
				10 < d ≤ 25	---	---	---	750 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	650 max. L	---	---	CD+SA	---
	X2CrNiMo17-12-3	---	1.4432	25 < d ≤ 50	---	---	---	650 max. L	---	---	SA	---
				2 < d ≤ 5	---	---	---	670 max. L	---	---	CD+SA	---
				2 < d ≤ 5	---	---	---	720 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	650 max. L	---	---	SA	---
				5 < d ≤ 10	---	---	---	780 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	650 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	700 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	650 max. L	---	---	SA	---
				10 < d ≤ 25	---	---	---	750 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	650 max. L	---	---	CD+SA	---
				25 < d ≤ 50	---	---	---	650 max. L	---	---	SA	---
EN 10294-2:2012	X2CrNiMo17-12-2	---	1.4404	---	---	190	---	490-690	---	40 L; 30 T	SA	---
	X2CrNiMo18-14-3	---	1.4435	---	---	190	---	490-690	---	40 L; 30 T	SA	---
ISO 4954:1993	Type X 2 CrNiMo 17 13 3 E	---	---	2 ≤ d ≤ 50	---	---	---	680 max.	---	---	Q, CD	---
				2 ≤ d ≤ 50	---	---	---	730 max.	---	---	see standard	---
ASME SA-276	Type 316Ti	S31635	---	t ≤ 12.5	t ≤ 0.5	205	30	515	75	30	A and HF	---
				t ≤ 12.70	t ≤ 0.5	310	45	620	90	30	A and CF	---
				t > 12.5	t > 0.5	205	30	515	75	40	A and HF	---
				t > 12.70	t > 0.5	205	30	515	75	30	A and CF	---
ASME SA-479/SA-479M	Type 316Ti	S31635	---	---	---	205	30	515	75	30	A	---
ASTM A276/A276M-15	Type 316Ti	S31635	---	t ≤ 12.5	t ≤ 0.5	205	30	515	75	30	A+HF	---
				t ≤ 12.70	t ≤ 0.5	310	45	620	90	30	A+CF	---
				t > 12.5	t > 0.5	205	30	515	75	40	A+HF	---
				t > 12.70	t > 0.5	205	30	515	75	30	A+CF	---
ASTM A479/A479M-14	Type 316Ti	S31635	---	---	---	205	30	515	75	30	SA	---

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X6CrNiMoTi17-12-2	---	1.4571	---	---	350	---	700-850	---	20	CW	---
				---	---	500	---	800-1000	---	12	CW	---
				0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				t ≤ 10	---	400	---	600-950	---	25 L	SA	---
				10 < t ≤ 16	---	380	---	580-950	---	25 L	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				16 < t ≤ 40	---	200	---	500-850	---	30 L	SA	L: 100 J @ RT
				40 < t ≤ 63	---	200	---	500-850	---	30 L	SA	L: 100 J @ RT
				t ≤ 160	---	200	---	500-700	---	40 L	SA	215 max. HBW; L: 100 J @ RT
				63 < t ≤ 160	---	200	---	500-700	---	40 L	SA	L: 100 J @ RT
				160 < t ≤ 250	---	200	---	500-700	---	30 T	SA	215 max. HBW; T: 60 J @ RT
				160 < t ≤ 250	---	200	---	500-700	---	30 T	SA	T: 60 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10263-5:2001	X6CrNiMoTi17-12-2	---	1.4571	2 < d ≤ 5	---	---	---	720 max. L	---	---	CD+SA	---
				2 < d ≤ 5	---	---	---	770 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	680 max. L	---	---	SA	---
				5 < d ≤ 10	---	---	---	850 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	680 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	730 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	680 max. L	---	---	SA	---
				10 < d ≤ 25	---	---	---	810 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	680 max. L	---	---	CD+SA	---
				25 < d ≤ 50	---	---	---	680 max. L	---	---	SA	---
EN 10294-2:2012	X6CrNiMoTi17-12-2	---	1.4571	---	---	190	---	490-690	---	35 L; 30 T	SA	---
ISO 4954:1993	Type X 6 CrNiMoTi 17 12 2 E	---	---	2 ≤ d ≤ 50	---	---	---	680 max.	---	---	Q, CD	---
				2 ≤ d ≤ 50	---	---	---	730 max.	---	---	see standard	---
JIS G 4303:2012	Symbol SUS316Ti	---	---	d ≤ 180	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-276	Type 316Cb	S31640	---	t ≤ 12.5	t ≤ 0.5	205	30	515	75	30	A and HF	---
				t ≤ 12.70	t ≤ 0.5	310	45	620	90	30	A and CF	---
				t > 12.5	t > 0.5	205	30	515	75	40	A and HF	---
				t > 12.70	t > 0.5	205	30	515	75	30	A and CF	---
ASME SA-479/SA-479M	Type 316Cb	S31640	---	---	---	205	30	515	75	30	A	---
ASTM A276/A276M-15	Type 316Cb	S31640	---	t ≤ 12.5	t ≤ 0.5	205	30	515	75	30	A+HF	---
				t ≤ 12.70	t ≤ 0.5	310	45	620	90	30	A+CF	---
				t > 12.5	t > 0.5	205	30	515	75	40	A+HF	---
				t > 12.70	t > 0.5	205	30	515	75	30	A+CF	---
ASTM A479/A479M-14	Type 316Cb	S31640	---	---	---	205	30	515	75	30	SA	---
EN 10088-3:2014	X6CrNiMoNb17-12-2	---	1.4580	t ≤ 160	---	215	---	510-740	---	35 L	SA	230 max. HBW; L: 100 J @ RT
				160 < t ≤ 250	---	215	---	510-740	---	30 T	SA	230 max. HBW; T: 60 J @ RT
GB 1220-92	Grade 0Cr18Ni12Mo2Cu2	---	---	t ≤ 180	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
JIS G 4303:2012	Symbol SUS316J1	---	---	d ≤ 180	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
GB 1220-92	Grade 00Cr17Ni14Mo2	---	---	t ≤ 180	---	177	---	480	---	40	ST	187 max. HB; 90 max. HRB
JIS G 4303:2012	Symbol SUS316L	---	---	d ≤ 180	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
GB 1220-92	Grade 00Cr18Ni14Mo2Cu2	---	---	$t \leq 180$	---	177	---	400	---	40	ST	187 max. HB; 90 max. HRB
JIS G 4303:2012	Symbol SUS316J1L	---	---	$d \leq 180$	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-479/SA-479M	---	S34565	---	---	---	415	60	795	115	35	A	230 max. HB
ASTM A276/A276M-15	---	S34565	---	---	---	415	60	795	115	35	A+HF or A+CF	---
ASTM A479/A479M-14	---	S34565	---	---	---	415	60	795	115	35	SA	230 max. HB
EN 10088-3:2014	X2CrNiMnMoN25-18-6-5	---	1.4565	$t \leq 160$	---	420	---	800-950	---	35 L	SA	L: 100 J @ RT
ISO 16143-2:2004	X2CrNiMnMoN25-18-6-5	---	---	$t \leq 160$	---	420	---	800-1000	---	35 L	SA	---
ASME SA-276	Type 316N	S31651	---	---	---	240	35	550	80	30	A and HF or A and CF	---
				$t \leq 19.05$	$t \leq 0.75$	690	100	860	125	12	CW and CF	---
				$19.05 < t \leq 25.40$	$0.75 < t \leq 1$	550	80	795	115	15	CW and CF	---
				$25.40 < t \leq 31.75$	$1 < t \leq 1.25$	450	65	725	105	20	CW and CF	---
				$31.75 < t \leq 38.10$	$1.25 < t \leq 1.5$	345	50	690	100	24	CW and CF	---
				$38.10 < t \leq 44.45$	$1.5 < t \leq 1.75$	310	45	655	95	28	CW and CF	---
				$t \leq 50.8$	$t \leq 2$	515	75	650	95	25	H+CW+CF	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H+CW+CF	---
ASME SA-479/SA-479M	Type 316N	S31651	---	---	---	240	35	550	80	30	A	---
	ASME SA-666	S31651	---	---	---	240	35	550	80	35	A	217 max. HB; 95 max. HRB
ASTM A276/A276M-15	Type 316N	S31651	---	---	---	240	35	550	80	30	A+HF or A+CF	---
				$t \leq 19.05$	$t \leq 0.75$	690	100	860	125	12	CW+CF	---
				$19.05 < t \leq 25.40$	$0.75 < t \leq 1$	550	80	795	115	15	CW+CF	---
				$25.40 < t \leq 31.75$	$1 < t \leq 1.25$	450	65	725	105	20	CW+CF	---
				$31.75 < t \leq 38.10$	$1.25 < t \leq 1.5$	345	50	690	100	24	CW+CF	---
				$38.10 < t \leq 44.45$	$1.5 < t \leq 1.75$	310	45	655	95	28	CW+CF	---
				$t \leq 50.8$	$t \leq 2$	515	75	650	95	25	H+CF	---
				$50.8 < t \leq 63.5$	$2 < t \leq 2.5$	450	65	620	90	30	H+CF	---
ASTM A479/A479M-14	Type 316N	S31651	---	---	---	240	35	550	80	30	SA	---
	ASTM A666-15	S31651	---	---	---	240	35	550	80	35	A	217 max. HB; 95 max. HRB
GB 1220-92	Grade 0Cr17Ni12Mo2N	---	---	$t \leq 180$	---	275	---	550	---	35	ST	217 max. HB; 95 max. HRB

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 4303:2012	Symbol SUS316N	---	---	$d \leq 180$	---	275	---	550	---	35	ST	217 max. HBW; 95 max. HRBW; 220 max. HV
ASME SA-276	Type 316LN	S31653	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A and HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A and CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A and HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A and CF	---
ASME SA-479/SA-479M	Type 316LN	S31653	---	---	---	205	30	515	75	30	A	---
ASTM A276/A276M-15	Type 316LN	S31653	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A+HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A+CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A+HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A+CF	---
ASTM A479/A479M-14	Type 316LN	S31653	---	---	---	205	30	515	75	30	SA	---
EN 10088-3:2014	X2CrNiMoN17-11-2	---	1.4406	$t \leq 160$	---	280	---	580-800	---	40 L	SA	250 max. HBW; L: 100 J @ RT
				$160 < t \leq 250$	---	280	---	580-800	---	30 T	SA	250 max. HBW; T: 60 J @ RT
	X2CrNiMoN17-13-3	---	1.4429	$t \leq 160$	---	280	---	580-800	---	40 L	SA	250 max. HBW; L: 100 J @ RT
				$160 < t \leq 250$	---	280	---	580-800	---	30 T	SA	250 max. HBW; T: 60 J @ RT
EN 10263-5:2001	X2CrNiMoN17-13-3	---	1.4429	$2 < d \leq 5$	---	---	---	820 max. L	---	---	CD+SA	---
				$2 < d \leq 5$	---	---	---	870 max. L	---	---	CD+SA	---
				$5 < d \leq 10$	---	---	---	780 max. L	---	---	SA	---
				$5 < d \leq 10$	---	---	---	940 max. L	---	---	CD+SA	---
				$5 < d \leq 10$	---	---	---	800 max. L	---	---	CD+SA	---
				$5 < d \leq 10$	---	---	---	850 max. L	---	---	CD+SA	---
				$10 < d \leq 25$	---	---	---	780 max. L	---	---	SA	---
				$10 < d \leq 25$	---	---	---	910 max. L	---	---	CD+SA	---
				$10 < d \leq 25$	---	---	---	780 max. L	---	---	CD+SA	---
GB 1220-92	Grade 00Cr17Ni13Mo2N	---	---	$25 < d \leq 50$	---	---	---	780 max. L	---	---	SA	---
				$t \leq 180$	---	245	---	550	---	40	ST	217 max. HB; 95 max. HRB
ISO 4954:1993	Type X 2 CrNiMoN 17 13 3 E	---	---	$2 \leq d \leq 50$	---	---	---	780 max.	---	---	Q, CD	---
				$2 \leq d \leq 50$	---	---	---	840 max.	---	---	see standard	---
JIS G 4303:2012	Symbol SUS316LN	---	---	$d \leq 180$	---	245	---	550	---	40	ST	217 max. HBW; 95 max. HRBW; 220 max. HV

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type 317	S31700	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A and HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A and CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A and HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A and CF	---
ASME SA-479/SA-479M	Type 317	S31700	---	---	---	205	30	515	75	30	A	---
ASTM A276/A276M-15	Type 317	S31700	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A+HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A+CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A+HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A+CF	---
ASTM A479/A479M-14	Type 317	S31700	---	---	---	205	30	515	75	30	SA	---
GB 1220-92	Grade 0Cr19Ni13Mo3	---	---	$t \leq 180$	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 1221-92	Grade 0Cr19Ni13Mo3	---	---	$t \leq 180$	---	205	---	540	---	40	ST	187 max. HB
JIS G 4303:2012	Symbol SUS317	---	---	$d \leq 180$	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
EN 10088-3:2014	X2CrNiMo18-15-4	---	1.4438	$t \leq 160$	---	200	---	500-700	---	40 L	SA	215 max. HBW; L: 100 J @ RT
				$160 < t \leq 250$	---	200	---	500-700	---	30 T	SA	215 max. HBW; T: 60 J @ RT
GB 1220-92	Grade 00Cr19Ni13Mo3	---	---	$t \leq 180$	---	177	---	480	---	40	ST	187 max. HB; 90 max. HRB
JIS G 4303:2012	Symbol SUS317L	---	---	$d \leq 180$	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
EN 10088-3:2014	X2CrNiMoN17-13-5	---	1.4439	$t \leq 160$	---	280	---	580-800	---	35 L	SA	250 max. HBW; L: 100 J @ RT
				$160 < t \leq 250$	---	280	---	580-800	---	30 T	SA	250 max. HBW; T: 60 J @ RT
GB 1220-92	Grade 0Cr18Ni16Mo5	---	---	$t \leq 180$	---	177	---	480	---	40	ST	187 max. HB; 90 max. HRB
JIS G 4303:2012	Symbol SUS317J1	---	---	$d \leq 180$	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type 321	S32100	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A and HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A and CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A and HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A and CF	---
ASME SA-479/SA-479M	Type 321	S32100	---	---	---	205	30	515	75	30	A	---
	Type 321H	S32109	---	---	---	205	30	515	75	30	A	---
ASTM A276/A276M-15	Type 321	S32100	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A+HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A+CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A+HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A+CF	---
ASTM A479/A479M-14	Type 321	S32100	---	---	---	205	30	515	75	30	SA	---
	Type 321H	S32109	---	---	---	205	30	515	75	30	SA	---

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X6CrNiTi18-10	---	1.4541	---	---	350	---	700-850	---	20	CW	---
				---	---	500	---	800-1000	---	12	CW	---
				0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				t ≤ 10	---	400	---	600-950	---	25 L	SA	---
				10 < t ≤ 16	---	380	---	580-950	---	25 L	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				16 < t ≤ 40	---	190	---	500-850	---	30 L	SA	L: 100 J @ RT
				40 < t ≤ 63	---	190	---	500-850	---	30 L	SA	L: 100 J @ RT
				t ≤ 160	---	190	---	500-700	---	40 L	SA	215 max. HBW; L: 100 J @ RT
				63 < t ≤ 160	---	190	---	500-700	---	40 L	SA	L: 100 J @ RT
				160 < t ≤ 250	---	190	---	500-700	---	30 T	SA	215 max. HBW; T: 60 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---

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8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10263-5:2001	X6CrNiTi18-10	---	1.4541	2 < d ≤ 5	---	---	---	720 max. L	---	---	CD+SA	---
				2 < d ≤ 5	---	---	---	770 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	680 max. L	---	---	SA	---
				5 < d ≤ 10	---	---	---	850 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	680 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	730 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	680 max. L	---	---	SA	---
				10 < d ≤ 25	---	---	---	810 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	680 max. L	---	---	CD+SA	---
				25 < d ≤ 50	---	---	---	680 max. L	---	---	SA	---
GB 1220-92	Grade 0Cr18Ni10Ti	---	---	t ≤ 180	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
	Grade 1Cr18Ni9	---	---	t ≤ 180	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
GB 1221-92	Grade 0Cr18Ni10Ti	---	---	t ≤ 180	---	205	---	520	---	40	ST	187 max. HB
ISO 4954:1993	Type X 6 CrNiTi 18 10 E	---	---	2 ≤ d ≤ 50	---	---	---	680 max.	---	---	Q, CD	---
				2 ≤ d ≤ 50	---	---	---	730 max.	---	---	see standard	---
JIS G 4303:2012	Symbol SUS321	---	---	d ≤ 180	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X8CrMnNiN18-9-5	---	1.4374	0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				t ≤ 10	---	350	---	700-900	---	35 L	SA	260 max. HBW
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---
ISO 16143-2:2004	X8CrMnNiN18-9-5	---	---	t ≤ 10	---	350	---	700-900	---	35 L	SA	---
EN 10088-3:2014	X11CrNiMnN19-8-6	---	1.4369	t ≤ 15	---	340	---	750-950	---	35 L, 35 T	SA	300 max. HBW; L: 100 J @ RT; T: 60 J @ RT
ISO 16143-2:2004	X11CrNiMnN19-8-6	---	---	t < 4	---	340	---	750-950	---	35 T	SA	---
				t < 15	---	340	---	750-950	---	35 L	SA	---
				0.05 < t ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < t ≤ 0.20	---	---	---	1070 max.	---	20	SA	---
				0.20 < t ≤ 0.50	---	---	---	1020 max.	---	30	SA	---
				0.50 < t ≤ 1.00	---	---	---	970 max.	---	30	SA	---
				1.00 < t ≤ 3.00	---	---	---	920 max.	---	30	SA	---
				3.00 < t ≤ 5.00	---	---	---	870 max.	---	35	SA	---
				5.00 < t ≤ 16.00	---	---	---	820 max.	---	35	SA	---

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-276	Type 347	S34700	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A and HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A and CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A and HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A and CF	---
	Type 348	S34800	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A and HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A and CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A and HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A and CF	---
ASME SA-479/SA-479M	Type 347	S34700	---	---	---	205	30	515	75	30	A	---
	Type 347H	S34709	---	---	---	205	30	515	75	30	A	---
ASTM A276/A276M-15	Type 347	S34700	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A+HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A+CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A+HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A+CF	---
	Type 348	S34800	---	$t \leq 12.5$	$t \leq 0.5$	205	30	515	75	30	A+HF	---
				$t \leq 12.70$	$t \leq 0.5$	310	45	620	90	30	A+CF	---
				$t > 12.5$	$t > 0.5$	205	30	515	75	40	A+HF	---
				$t > 12.70$	$t > 0.5$	205	30	515	75	30	A+CF	---
ASTM A479/A479M-14	Type 347	S34700	---	---	---	205	30	515	75	30	SA	---
	Type 347H	S34709	---	---	---	205	30	515	75	30	SA	---
EN 10088-3:2014	X6CrNiNb18-10	---	1.4550	$t \leq 160$	---	205	---	510-740	---	40 L	SA	230 max. HBW; L: 100 J @ RT
				$160 < t \leq 250$	---	205	---	510-740	---	30 T	SA	230 max. HBW; T: 60 J @ RT
GB 1220-92	Grade 0Cr18Ni11Nb	---	---	$t \leq 180$	---	205	---	520	---	40	ST	187 max. HB; 90 max. HRB
JIS G 4303:2012	Symbol SUS347	---	---	$d \leq 180$	---	205	---	520	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
ASME SA-276	---	S30815	---	---	---	310	45	600	87	40	A and HF or A and CF	---
ASME SA-479/SA-479M	---	S30815	---	---	---	310	45	600	87	40	A	---
ASTM A276/A276M-15	---	S30815	---	---	---	310	45	600	87	40	A+HF or A+CF	---
ASTM A479/A479M-14	---	S30815	---	---	---	310	45	600	87	40	SA	---
ISO 4955:2005	X7CrNiSiNc21-11	---	---	$0.5 \leq t < 3$	---	310	---	650-850	---	37 L, 37 T	SA	210 max. HB
				$1.5 \leq t \leq 25$	---	310	---	650-850	---	40	SA	210 max. HB
				$3 \leq t \leq 75$	---	310	---	650-850	---	40 L, 40 T	SA	210 max. HB
				$t \leq 100$	---	310	---	650-850	---	40	SA	210 max. HB
				$5 \leq t \leq 160$	---	310	---	650-850	---	40	SA	210 max. HB

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X6CrNiCuS18-9-2	---	1.4570	0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				t ≤ 10	---	400	---	600-950	---	15 L	SA	---
				10 < t ≤ 16	---	400	---	600-950	---	15 L	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				16 < t ≤ 40	---	185	---	500-910	---	20 L	SA	---
				40 < t ≤ 63	---	185	---	500-910	---	20 L	SA	---
				t ≤ 160	---	185	---	500-710	---	35 L	SA	215 max. HBW
				63 < t ≤ 160	---	185	---	500-710	---	35 L	SA	---
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---
ISO 16143-2:2004	X6CrNiCuS18-9-2	---	---	t ≤ 160	---	185	---	500-710	---	35 L	SA	---
EN 10090:1998	X53CrMnNiNbN21-9	---	1.4870	---	---	---	---	1300 approx.	---	---	CTC	385 HB approx.
				---	---	---	---	1300 max.	---	---	Q	385 max. HB
ISO 683-15:1992	Grade X 53CrMnNiNbN 21 9	---	---	---	---	---	---	---	---	---	CTC	---
				---	---	---	---	1300 max.	---	---	Q	385 max. HB
GB 1221-92	Grade 5Cr21Mn9Ni4N	---	---	t ≤ 25	---	560	---	885	---	8	ST	302 min. HB
JIS G 4311:2011	Symbol SUH35	---	---	t ≤ 25	---	560	---	880	---	8	see standard	302 min. HBW

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-479/SA-479M	---	S35315	---	---	---	270	39	650	94	40	A	---
ASTM A479/A479M-14	---	S35315	---	---	---	270	39	650	94	40	SA	---
EN 10095:1999	X6NiCrSiNCe35-25	---	1.4854	$0.5 \leq t \leq 3$	---	300	---	650-850	---	40 L, 40 T	SA	210 max. HB
				$t \leq 25$	---	300	---	650-850 L	---	40 L	SA	210 max. HB
				$3 \leq t \leq 75$	---	300	---	650-850	---	40 L, 40 T	SA	210 max. HB
				$t \leq 160$	---	300	---	650-850 L	---	40 L	SA	210 max. HB
ISO 4955:2005	X6NiCrSiNCe35-25	---	---	$1.5 \leq t \leq 25$	---	300	---	---	---	40	SA	210 max. HB
				$0.5 \leq t \leq 75$	---	300	---	---	---	40 L, 40 T	SA	210 max. HB
				$t \leq 100$	---	300	---	---	---	40	SA	210 max. HB
				$5 \leq t \leq 160$	---	300	---	---	---	40	SA	210 max. HB
EN 10088-3:2014	X3CrNiCu18-9-4	---	1.4567	$0.05 < d \leq 0.10$	---	---	---	1100 max.	---	20	SA	---
				$0.10 < d \leq 0.20$	---	---	---	1050 max.	---	20	SA	---
				$0.20 < d \leq 0.50$	---	---	---	1000 max.	---	30	SA	---
				$0.50 < d \leq 1.00$	---	---	---	950 max.	---	30	SA	---
				$1.00 < d \leq 3.00$	---	---	---	900 max.	---	30	SA	---
				$3.00 < d \leq 5.00$	---	---	---	850 max.	---	35	SA	---
				$t \leq 10$	---	400	---	600-850	---	25 L	SA	---
				$10 < t \leq 16$	---	340	---	600-850	---	25 L	SA	---
				$5.00 < d \leq 16.00$	---	---	---	800 max.	---	35	SA	---
				$16 < t \leq 40$	---	175	---	450-800	---	30 L	SA	L: 100 J @ RT
				$40 < t \leq 63$	---	175	---	450-800	---	30 L	SA	L: 100 J @ RT
				$t \leq 160$	---	175	---	450-650	---	45 L	SA	215 max. HBW
				$63 < t \leq 160$	---	175	---	450-650	---	40 L	SA	L: 100 J @ RT
				$d \geq 0.05$	---	---	---	500-700	---	---	---	---
				$d \geq 0.05$	---	---	---	600-800	---	---	---	---
				$d \geq 0.05$	---	---	---	700-900	---	---	---	---
				$d \geq 0.05$	---	---	---	800-1000	---	---	---	---
				$d \geq 0.05$	---	---	---	900-1100	---	---	---	---
				$d \geq 0.05$	---	---	---	1000-1250	---	---	---	---
				$d \geq 0.05$	---	---	---	1100-1350	---	---	---	---
				$d \geq 0.05$	---	---	---	1200-1450	---	---	---	---
				$d \geq 0.05$	---	---	---	1400-1700	---	---	---	---
				$d \geq 0.05$	---	---	---	1600-1900	---	---	---	---
				$d \geq 0.05$	---	---	---	1800-2100	---	---	---	---

Note: This section continued on next page

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10263-5:2001	X3CrNiCu18-9-4	---	1.4567	2 < d ≤ 5	---	---	---	600 max. L	---	---	CD+SA	---
				2 < d ≤ 5	---	---	---	650 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	590 max. L	---	---	SA	---
				5 < d ≤ 10	---	---	---	740 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	590 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	640 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	590 max. L	---	---	SA	---
				10 < d ≤ 25	---	---	---	700 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	590 max. L	---	---	CD+SA	---
				25 < d ≤ 50	---	---	---	590 max. L	---	---	SA	---
EN 10269:2013	X3CrNiCu18-9-4	---	1.4567	d ≤ 35	---	350	---	700-850 L	---	20 L	CW	L: 80 J @ 20°C
				d ≤ 160	---	175	---	450-650 L	---	45 L	SA	L: 100 J @ 20°C
GB 1220-92	Grade 0Cr18Ni9Cu3	---	---	t ≤ 180	---	177	---	480	---	40	ST	---
ISO 16143-2:2004	X3CrNiCu18-9-4	---	---	---	---	---	---	450-650	---	---	SA	---
ISO 4954:1993	Type X 3 CrNiCu 18 9 3 E	---	---	2 ≤ d ≤ 50	---	---	---	590 max.	---	---	Q, CD	---
				2 ≤ d ≤ 50	---	---	---	620 max.	---	---	see standard	---
JIS G 4303:2012	Symbol SUSXM7	---	---	d ≤ 180	---	175	---	480	---	40	ST	187 max. HBW; 90 max. HRBW; 200 max. HV
GB 1220-92	Grade 0Cr18Ni13Si4	---	---	t ≤ 180	---	205	---	520	---	40	ST	207 max. HB; 95 max. HRB
GB 1221-92	Grade 0Cr18Ni13Si4	---	---	t ≤ 180	---	205	---	520	---	40	ST	207 max. HB
JIS G 4303:2012	Symbol SUSXM15J1	---	---	d ≤ 180	---	205	---	520	---	40	ST	207 max. HBW; 95 max. HRBW; 218 max. HV
GB 1221-92	Grade 2Cr21Ni12N	---	---	t ≤ 25	---	430	---	820	---	26	ST	269 max. HB
JIS G 4311:2011	Symbol SUH37	---	---	t ≤ 25	---	390	---	780	---	35	see standard	248 max. HBW

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X8CrMnCuNB17-8-3	---	1.4597	0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				t ≤ 160	---	270	---	560-780	---	40 L	SA	245 max. HBW; L: 100 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---
ISO 16143-2:2004	X8CrMnCuN17-8-3	---	---	t ≤ 160	---	270	---	560-760	---	40 L	SA	---
ASME SA-453/SA-453M	Grade 660, Class A	S66286	---	---	---	585	85	895	130	15	S+H	248-341 HB; 24-37 HRC
ASTM A453/A453M-12	Grade 660, Class A	S66286	---	---	---	585	85	895	130	15	S+H	248-341 HB; 24-37 HRC
EN 10302:2008	X6NiCrTiMoVB25-15-2	---	1.4980	---	---	600	---	900-1150	---	15	PH	---
GB 1221-92	Grade 0Cr15Ni25Ti2MoAlVB	---	---	t ≤ 180	---	590	---	900	---	15	ST	248 min. HB
JIS G 4311:2011	Symbol SUH660	---	---	t ≤ 180	---	590	---	900	---	15	see standard	248 min. HBW
ASME SA-479/SA-479M	---	N08367	---	---	---	310	45	655	95	30	A	241 max. HB
ASTM A479/A479M-14	---	N08367	---	---	---	310	45	655	95	30	SA	241 max. HB
ASTM B691-02 (2013)	---	N08367	---	---	---	310	45	655	95	30	CFA or HFA	---
JIS G 4303:2012	Symbol SUS836L	---	---	d ≤ 180	---	205	---	520	---	35	ST	217 max. HBW; 96 max. HRBW; 230 max. HV

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X1NiCrMoCu25-20-5	---	1.4539	0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				t ≤ 10	---	400	---	600-930	---	20 L	SA	---
				10 < t ≤ 16	---	400	---	600-930	---	20 L	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				16 < t ≤ 40	---	230	---	530-880	---	25 L	SA	L: 100 J @ RT
				40 < t ≤ 63	---	230	---	530-880	---	25 L	SA	L: 100 J @ RT
				t ≤ 160	---	230	---	530-730	---	35 L	SA	230 max. HBW; L: 100 J @ RT
				63 < t ≤ 160	---	230	---	530-730	---	35 L	SA	L: 100 J @ RT
				160 < t ≤ 250	---	230	---	530-730	---	30 T	SA	230 max. HBW; T: 60 J @ RT
				160 < t ≤ 250	---	230	---	530-730	---	30 T	SA	T: 60 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---
JIS G 4303:2012	Symbol SUS890L	---	---	d ≤ 180	---	215	---	490	---	35	ST	187 max. HBW; 90 max. HRBW; 200 max. HV

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X1NiCrMoCu31-27-4	---	1.4563	0.05 < d ≤ 0.10	---	---	---	1100 max.	---	20	SA	---
				0.10 < d ≤ 0.20	---	---	---	1050 max.	---	20	SA	---
				0.20 < d ≤ 0.50	---	---	---	1000 max.	---	30	SA	---
				0.50 < d ≤ 1.00	---	---	---	950 max.	---	30	SA	---
				1.00 < d ≤ 3.00	---	---	---	900 max.	---	30	SA	---
				3.00 < d ≤ 5.00	---	---	---	850 max.	---	35	SA	---
				5.00 < d ≤ 16.00	---	---	---	800 max.	---	35	SA	---
				t ≤ 160	---	220	---	500-750	---	35 L	SA	230 max. HBW; L: 100 J @ RT
				160 < t ≤ 250	---	220	---	500-750	---	30 T	SA	230 max. HBW; T: 60 J @ RT
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---
EN 10272:2007	X1NiCrMoCu31-27-4	---	1.4563	t ≤ 160	---	220	---	500-750 L	---	35 L	SA	230 max. HBW; see standard for impact data
				160 < t ≤ 250	---	220	---	500-750 T	---	30 T	SA	230 max. HBW; see standard for impact data
ISO 16143-2:2004	X1NiCrMoCu31-27-4	---	---	---	---	---	---	500-750	---	---	SA	---

8.2 Stainless Steels: Bar

8.2.4A Chemical Composition of Precipitation-Hardening Stainless Steels

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-564/SA-564M	Type 630	S17400	---	0.07	1.00	1.00	0.040	0.030	15.00-17.50	3.00-5.00	---	(Cb+Ta) 0.15 to 0.45; Cu 3.00-5.00
ASTM A564/A564M-13	Type 630	S17400	---	0.07	1.00	1.00	0.040	0.030	15.00-17.50	3.00-5.00	---	(Cb+Ta) 0.15 to 0.45; Cu 3.00-5.00
ASTM A1028-03 (2015)	Grade F, Class 1	S17400	---	0.07	1.0	1.0	0.040	0.030	15.0-17.5	3.0-5.0	---	Cb 0.15-0.45; Cu 3.0-5.0
EN 10088-3:2014	X5CrNiCuNb16-4	---	1.4542	0.07	1.50	0.70	0.040	0.030	15.0-17.0	3.0-5.0	0.60	Nb 5xC to 0.45; Cu 3.0-5.0
GB 1220-92	Grade 0Cr17Ni4Cu4Nb	---	---	0.07	1.00	1.00	0.035	0.030	15.50-17.50	3.00-5.00	---	Cu 3.00-5.00; Nb 0.15-0.45
GB 1221-92	Grade 0Cr17Ni4Cu4Nb	---	---	0.07	1.00	1.00	0.035	0.030	15.50-17.50	3.00-5.00	---	Cu 3.00-5.00; Nb 0.15-0.45
JIS G 4303:2012	Symbol SUS630	---	---	0.07	1.00	1.00	0.040	0.030	15.00-17.50	3.00-5.00	---	Cu 3.00-5.00; Nb 0.15-0.45
ASME SA-564/SA-564M	Type 631	S17700	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.50
ASTM A564/A564M-13	Type 631	S17700	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.50
EN 10088-3:2014	X7CrNiAl17-7	---	1.4568	0.09	1.00	0.70	0.040	0.015	16.0-18.0	6.5-7.8	---	Al 0.70-1.50
GB 1220-92	Grade 0Cr17Ni7Al	---	---	0.09	1.00	1.00	0.035	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.50; Cu 0.50
GB 1221-92	Grade 0Cr17Ni7Al	---	---	0.09	1.00	1.00	0.035	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.50; Cu 0.50
JIS G 4303:2012	Symbol SUS631	---	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.50
ASME SA-564/SA-564M	Type 632	S15700	---	0.09	1.00	1.00	0.040	0.030	14.00-16.00	6.50-7.75	2.00-3.00	Al 0.75-1.50
ASTM A564/A564M-13	Type 632	S15700	---	0.09	1.00	1.00	0.040	0.030	14.00-16.00	6.50-7.75	2.00-3.00	Al 0.75-1.50
GB 1220-92	Grade 0Cr15Ni7Mo2Al	---	---	0.09	1.00	1.00	0.035	0.030	14.00-16.00	6.50-7.50	2.00-3.00	Al 0.75-1.50

8.2 Stainless Steels: Bar

8.2.4B Mechanical Properties of Precipitation-Hardening Stainless Steels

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-564/SA-564M	Type 630	S17400	---	---	---	---	---	---	---	---	SA	363 max. HB; 38 max. HRC
				---	---	520	75	795	115	18	PH (H1150M)	255 min. HB; 24 min. HRC; 75 J @ RT
				---	---	725	105	860	125	16	PH (H1150D)	255-311 HB; 24-33 HRC; 41 J @ RT
				$t \leq 75$	$t \leq 3$	1170	170	1310 L	190 L	10 L	PH (H900)	388 min. HB; 40 min. HRC
				$t \leq 75$	$t \leq 3$	1070	155	1170 L	170 L	10 L	PH (H925)	375 min. HB; 38 min. HRC; L: 6.8 J @ RT
				$75 < t \leq 200$	$3 < t \leq 8$	1170	170	1310 T	190 T	10 T	PH (H900)	388 min. HB; 40 min. HRC
				$75 < t \leq 200$	$3 < t \leq 8$	1070	155	1170 T	170 T	10 T	PH (H925)	375 min. HB; 38 min. HRC; T: 6.8 J @ RT
				$t \leq 200$	$t \leq 8$	1000	145	1070 L	155 L	12 L	PH (H1025)	331 min. HB; 35 min. HRC; L: 20 J @ RT
				$t \leq 200$	$t \leq 8$	860	125	1000 L	145 L	13 L	PH (H1075)	311 min. HB; 32 min. HRC; L: 27 J @ RT
				$t \leq 200$	$t \leq 8$	795	115	965 L	140 L	14 L	PH (H1100)	302 min. HB; 31 min. HRC; L: 34 J @ RT
				$t \leq 200$	$t \leq 8$	725	105	930 L	135 L	16 L	PH (H1150)	277 min. HB; 28 min. HRC; L: 41 J @ RT

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8.2 Stainless Steels: Bar

8.2.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASTM A564/A564M-13	Type 630	S17400	---	---	---	---	---	---	---	---	SA	363 max. HB; 38 max. HRC
				---	---	520	75	795	115	18	PH (H1150M)	255 min. HB; 24 min. HRC; 75 J @ RT
				---	---	725	105	860	125	16	PH (H1150D)	255-311 HB; 24-33 HRC; 41 J @ RT
				$t \leq 75$	$t \leq 3$	1170	170	1310 L	190 L	10 L	PH (H900)	388 min. HB; 40 min. HRC
				$t \leq 75$	$t \leq 3$	1070	155	1170 L	170 L	10 L	PH (H925)	375 min. HB; 38 min. HRC; L: 6.8 J @ RT
				$75 < t \leq 200$	$3 < t \leq 8$	1170	170	1310 T	190 T	10 T	PH (H900)	388 min. HB; 40 min. HRC
				$75 < t \leq 200$	$3 < t \leq 8$	1070	155	1170 T	170 T	10 T	PH (H925)	375 min. HB; 38 min. HRC; T: 6.8 J @ RT
				$t \leq 200$	$t \leq 8$	1000	145	1070 L	155 L	12 L	PH (H1025)	331 min. HB; 35 min. HRC; L: 20 J @ RT
				$t \leq 200$	$t \leq 8$	860	125	1000 L	145 L	13 L	PH (H1075)	311 min. HB; 32 min. HRC; L: 27 J @ RT
				$t \leq 200$	$t \leq 8$	795	115	965 L	140 L	14 L	PH (H1100)	302 min. HB; 31 min. HRC; L: 34 J @ RT
				$t \leq 200$	$t \leq 8$	725	105	930 L	135 L	16 L	PH (H1150)	277 min. HB; 28 min. HRC; L: 41 J @ RT
ASTM A1028-03 (2015)	Grade F, Class 1	S17400	---	---	---	---	105	---	135	16	A+Q+G	341 max. HB;

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8.2 Stainless Steels: Bar

8.2.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X5CrNiCuNb16-4	---	1.4542	t ≤ 10	---	---	---	1200 max.	---	---	A	360 max. HB
				t ≤ 10	---	600	---	900-1100	---	10 L	PH (+P800)	---
				10 < t ≤ 16	---	---	---	1200 max.	---	---	A	360 max. HB
				10 < t ≤ 16	---	600	---	900-1100	---	10 L	PH (+P800)	---
				16 < t ≤ 40	---	---	---	1200 max.	---	---	A	360 max. HB
				16 < t ≤ 40	---	520	---	800-1050	---	12 L	PH (+P800)	L: 75 J @ RT
				40 < t ≤ 63	---	---	---	1200 max.	---	---	A	360 max. HB
				40 < t ≤ 63	---	520	---	800-1000	---	18 L	PH (+P800)	L: 75 J @ RT
				t ≤ 100	---	1000	---	1070-1270	---	10 L	PH (+P1070)	---
				t ≤ 100	---	720	---	930-1100	---	16 L	PH (+P930)	L: 40 J @ RT
				t ≤ 100	---	790	---	960-1160	---	12 L	PH (+P960)	---
				t ≤ 100	---	---	---	1200 max.	---	---	SA	360 max. HBW
				t ≤ 100	---	520	---	800-950	---	18 L	PH (+P800)	L: 75 J @ RT
				t ≤ 100	---	720	---	930-1100	---	12 L	PH (+P930)	L: 40 J @ RT
				t ≤ 100	---	790	---	960-1160	---	10 L	PH (+P960)	---
				t ≤ 100	---	1000	---	1070-1270	---	10 L	PH(+P1070)	---
				63 < t ≤ 160	---	---	---	1200 max.	---	---	A	360 max. HB
				63 < t ≤ 160	---	520	---	800-950	---	18 L	PH (+P800)	L: 75 J @ RT
GB 1220-92	Grade 0Cr17Ni4Cu4Nb	---	---	t ≤ 75	---	---	---	---	---	---	ST	363 max. HB
				t ≤ 75	---	1180	---	1310	---	10	ST	375 min. HB
				t ≤ 75	---	1000	---	1060	---	12	ST	331 min. HB
				t ≤ 75	---	865	---	1000	---	13	ST	302 min. HB
				t ≤ 75	---	725	---	930	---	16	ST	277 min. HB
GB 1221-92	Grade 0Cr17Ni4Cu4Nb	---	---	t ≤ 75	---	---	---	---	---	---	ST	363 max. HB
				t ≤ 75	---	1180	---	1310	---	10	ST	375 min. HB
				t ≤ 75	---	1000	---	1060	---	12	ST	331 min. HB
				t ≤ 75	---	865	---	1000	---	13	ST	302 min. HB
				t ≤ 75	---	725	---	930	---	16	ST	277 min. HB

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8.2 Stainless Steels: Bar

8.2.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
JIS G 4303:2012	Symbol SUS630	---	---	d ≤ 75	---	---	---	---	---	---	PH (S)	363 max. HBW; 38 max. HRC; 383 max. HV
				d ≤ 75	---	1175	---	1310	---	10	PH (H900)	375 min. HBW; 40 min. HRC; 396 min. HV
				d ≤ 75	---	1000	---	1070	---	12	PH (H1025)	331 min. HBW; 35 min. HRC; 350 min. HV
				d ≤ 75	---	860	---	1000	---	13	PH (H1075)	302 min. HBW; 31 min. HRC; 320 min. HV
				d ≤ 75	---	725	---	930	---	16	PH (H1150)	277 min. HBW; 28 min. HRC; 292 min. HV
ASME SA-564/SA-564M	Type 631	S17700	---	---	---	---	---	---	---	---	SA	229 max. HB; 98 max. HRB
				t ≤ 100	t ≤ 4	1030	150	1280 L	185 L	6 L	PH (RH950)	388 min. HB; 41 min. HRC
				t ≤ 150	t ≤ 6	965	140	1170 L	170 L	6 L	PH (TH1050)	352 min. HB; 38 min. HRC
ASTM A564/A564M-13	Type 631	S17700	---	---	---	---	---	---	---	---	SA	229 max. HB; 98 max. HRB
				t ≤ 100	t ≤ 4	1030	150	1280 L	185 L	6 L	PH (RH95)	388 min. HB; 41 min. HRC
				t ≤ 150	t ≤ 6	965	140	1170 L	170 L	6 L	PH (TH1050)	352 min. HB; 38 min. HRC

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8.2 Stainless Steels: Bar

8.2.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X7CrNiAl17-7	---	1.4568	0.50 < d ≤ 1.00	---	---	---	1100 max.	---	10	A+PH	---
				1.00 < d ≤ 3.00	---	---	---	1050 max.	---	10	A+PH	---
				3.00 < d ≤ 5.00	---	---	---	1000 max.	---	10	A+PH	---
				5.00 < d ≤ 16.00	---	---	---	950 max.	---	15	A+PH	---
				t ≤ 30	---	---	---	850 max.	---	---	SA	255 max. HBW
				d ≥ 0.05	---	---	---	500-700	---	---	---	---
				d ≥ 0.05	---	---	---	600-800	---	---	---	---
				d ≥ 0.05	---	---	---	700-900	---	---	---	---
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---
GB 1220-92	Grade 0Cr17Ni7Al	---	---	t ≤ 75	---	380 max.	---	1030 max.	---	20	ST	229 max. HB
				t ≤ 75	---	960	---	1140	---	5	ST	363 min. HB
				t ≤ 75	---	1030	---	1230	---	4	ST	388 min. HB
GB 1221-92	Grade 0Cr17Ni7Al	---	---	t ≤ 75	---	380	---	1030	---	20	ST	229 max. HB
				t ≤ 75	---	960	---	1140	---	5	ST	363 min. HB
				t ≤ 75	---	1030	---	1230	---	4	ST	388 min. HB
JIS G 4303:2012	Symbol SUS631	---	---	d ≤ 75	---	380	---	1030	---	20	PH (S)	229 max. HBW; 98 max. HRC; 241 max. HV
				d ≤ 75	---	1030	---	1230	---	4	PH (RH950)	388 min. HBW; 41 min. HRC; 410 min. HV
				d ≤ 75	---	960	---	1140	---	5	PH (TH1050)	363 min. HBW; 38 min. HRC; 383 min. HV

8.2 Stainless Steels: Bar

8.2.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-564/SA-564M	Type 632	S15700	---	---	---	---	---	---	---	---	SA	269 max. HB; 100 max. HRB
				$t \leq 100$	$t \leq 4$	1210	175	1380 L	200 L	7 L	PH (RH950)	415 min. HB
				$t \leq 150$	$t \leq 6$	1100	160	1240 L	180 L	8 L	PH (TH1050)	375 min. HB
ASTM A564/A564M-13	Type 632	S15700	---	---	---	---	---	---	---	---	SA	269 max. HB; 100 max. HRB
				$t \leq 100$	$t \leq 4$	1210	175	1380 L	200 L	7 L	PH (RH950)	415 min. HB
				$t \leq 150$	$t \leq 6$	1100	160	1240 L	180 L	8 L	PH (TH1050)	375 min. HB
GB 1220-92	Grade 0Cr15Ni7Mo2Al	---	---	$t \leq 75$	---	---	---	---	---	---	ST	269 max. HB
				$t \leq 75$	---	1100	---	1210	---	7	ST	375 min. HB
				$t \leq 75$	---	1210	---	1320	---	6	ST	388 min. HB

8.2 Stainless Steels: Bar

8.2.5A Chemical Composition of Duplex Stainless Steels

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10088-3:2014	X2CrNiMoSi18-5-3	---	1.4424	0.030	1.20-2.00	1.40-2.00	0.035	0.015	18.0-19.0	4.5-5.2	2.50-3.0	N 0.05-0.10
GB 1220-92	Grade 00Cr18Ni5Mo3Si2	---	---	0.030	1.00-2.00	1.30-2.00	0.035	0.030	18.00-19.50	4.50-5.50	2.50-3.00	---
ASME SA-276	---	S32304	---	0.030	2.50	1.00	0.040	0.030	21.50-24.50	3.00-5.50	0.05-0.60	Cu 0.05-0.60; N 0.05-0.20
ASTM A276/A276M-15	---	S32304	---	0.030	2.50	1.00	0.040	0.030	21.5-24.5	3.0-5.5	0.05-0.60	Cu 0.05-0.60; N 0.05-0.20
EN 10088-3:2014	X2CrNiN23-4	---	1.4362	0.030	2.00	1.00	0.035	0.015	22.0-24.5	3.5-5.5	0.10-0.60	Cu 0.10-0.60; N 0.05-0.20
ISO 16143-2:2004	X2CrNiN23-4	---	---	0.030	2.00	1.00	0.035	0.015	22.0-24.0	3.50-5.50	0.1-0.6	Cu 0.10-0.60; N 0.05-0.20
ASME SA-276	---	S31803	---	0.030	2.00	1.00	0.030	0.020	21.00-23.00	4.50-6.50	2.50-3.50	N 0.08-0.20
ASME SA-479/SA-479M	---	S31803	---	0.030	2.00	1.00	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
	---	S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
ASTM A276/A276M-15	---	S31803	---	0.030	2.00	1.00	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
	---	S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
ASTM A479/A479M-14	---	S31803	---	0.030	2.00	1.00	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
	---	S32205	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
ASTM A955/A955M-15	Grade 60 [420]	S31803	---	0.03	2.00	1.00	0.030	0.020	21.00-23.00	4.50-6.50	2.50-3.50	N 0.08-0.20
	Grade 75 [520]	S31803	---	0.03	2.00	1.00	0.030	0.020	21.00-23.00	4.50-6.50	2.50-3.50	N 0.08-0.20
EN 10088-3:2014	X2CrNiMoN22-5-3	---	1.4462	0.030	2.00	1.00	0.035	0.015	21.0-23.0	4.5-6.5	2.50-3.5	N 0.10-0.22
EN 10263-5:2001	X2CrNiMoN22-5-3	---	1.4462	0.030	2.00	1.00	0.035	0.015	21.00-23.00	4.50-6.50	2.50-3.50	N 0.10-0.22
EN 10294-2:2012	X2CrNiMoN22-5-3	---	1.4462	0.030	2.00	1.00	0.035	0.015	21.0-23.0	4.5-6.5	2.50-3.5	N 0.10-0.22
JIS G 4303:2012	Symbol SUS329J3L	---	---	0.030	2.00	1.00	0.040	0.030	21.00-24.00	4.50-6.50	2.50-3.50	N 0.08-0.20
ASME SA-479/SA-479M	---	S32506	---	0.030	1.00	0.90	0.040	0.015	24.0-26.0	5.5-7.2	3.0-3.5	W 0.05-0.30; N 0.08-0.20
ASTM A276/A276M-15	---	S32506	---	0.030	1.00	0.90	0.040	0.015	24.0-26.0	5.5-7.2	3.0-3.5	W 0.05-0.30; N 0.08-0.20
ASTM A479/A479M-14	---	S32506	---	0.030	1.00	0.90	0.040	0.015	24.0-26.0	5.5-7.2	3.0-3.5	W 0.05-0.30; N 0.08-0.20
JIS G 4303:2012	Symbol SUS329J4L	---	---	0.030	1.50	1.00	0.040	0.030	24.00-26.00	5.50-7.50	2.50-3.50	N 0.08-0.30
ASME SA-479/SA-479M	---	S32750	---	0.030	1.20	0.80	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	Cu 0.50; N 0.24-0.32
ASTM A479/A479M-14	---	S32750	---	0.030	1.20	0.80	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	Cu 0.50; N 0.24-0.32
EN 10088-3:2014	X2CrNiMoN25-7-4	---	1.4410	0.030	2.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.5	N 0.24-0.35
ISO 16143-2:2004	X2CrNiMoN25-7-4	---	---	0.030	2.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.5	N 0.24-0.35
ASME SA-276	---	S32760	---	0.030	1.00	1.00	0.030	0.010	24.00-26.00	6.00-8.00	3.00-4.00	[Cr+(3.3xMo)+(16xN)] 40 min.; Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30
ASME SA-479/SA-479M	---	S32760	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	[Cr+(3.3xMo)+(16xN)] 40 min.; Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30
ASTM A276/A276M-15	---	S32760	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	[Cr+(3.3xMo)+(16xN)] 40 min.; Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30
ASTM A479/A479M-14	---	S32760	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	[Cr+(3.3xMo)+(16xN)] 40 min.; Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30
EN 10088-3:2014	X2CrNiMoCuWN25-7-4	---	1.4501	0.030	1.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30
ISO 16143-2:2004	X2CrNiMoCuWN25-7-4	---	---	0.030	1.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; W 0.50-1.00; N 0.20-0.30

8.2 Stainless Steels: Bar

8.2.5A Chemical Composition of Duplex Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-479/SA-479M	---	S32550	---	0.04	1.50	1.00	0.040	0.030	24.0-27.0	4.5-6.5	2.9-3.9	Cu 1.50-2.50; N 0.10-0.25
ASTM A276/A276M-15	---	S32550	---	0.04	1.50	1.0	0.040	0.030	24.0-27.0	4.5-6.5	2.9-3.9	Cu 1.50-2.50; N 0.10-0.25
ASTM A479/A479M-14	---	S32550	---	0.04	1.50	1.00	0.040	0.030	24.0-27.0	4.5-6.5	2.9-3.9	Cu 1.50-2.50; N 0.10-0.25
EN 10088-3:2014	X2CrNiMoCuN25-6-3	---	1.4507	0.030	2.00	0.70	0.035	0.015	24.0-26.0	6.0-8.0	3.0-4.0	Cu 1.00-2.50; N 0.20-0.30
ISO 16143-2:2004	X2CrNiMoCuN25-6-3	---	---	0.030	2.00	0.70	0.035	0.015	24.0-26.0	5.0-7.5	2.5-4.0	Cu 1.00-2.50; N 0.15-0.3
EN 10294-2:2012	X3CrNiMoN27-5-2	---	1.4460	0.05	2.00	1.00	0.035	0.015	25.0-28.0	4.5-6.5	1.30-2.00	N 0.05-0.20
GB 1220-92	Grade 0Cr26Ni5Mo2	---	---	0.08	1.50	1.00	0.035	0.030	23.00-28.00	3.00-6.00	1.00-3.00	---
GB 4226-84	Grade 0Cr26Ni5Mo2	---	---	0.08	1.50	1.00	0.035	0.030	23.00-28.00	3.00-6.00	1.00-3.00	---
JIS G 4303:2012	Symbol SUS329J1	---	---	0.08	1.50	1.00	0.040	0.030	23.00-28.00	3.00-6.00	1.00-3.00	---
JIS G 4318:1998 A1:2007	Symbol SUS329J1	---	---	0.08	1.50	1.00	0.040	0.030	23.00-28.00	3.00-6.00	1.00-3.00	---
ASME SA-479/SA-479M	---	S32906	---	0.030	0.80-1.50	0.50	0.030	0.030	28.0-30.0	5.8-7.5	1.50-2.60	Cu 0.80; N 0.30-0.40
ASTM A479/A479M-14	---	S32906	---	0.030	0.80-1.50	0.50	0.030	0.030	28.0-30.0	5.8-7.5	1.50-2.60	Cu 0.80; N 0.30-0.40
EN 10088-3:2014	X2CrNiMoN29-7-2	---	1.4477	0.030	0.80-1.50	0.50	0.030	0.015	28.0-30.0	5.8-7.5	1.50-2.60	Cu 0.80; N 0.30-0.40

8.2 Stainless Steels: Bar

8.2.5B Mechanical Properties of Duplex Stainless Steels

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X2CrNiMoSi18-5-3	---	1.4424	$t \leq 50$	---	450	---	700-900	---	25 L	SA	260 max. HBW; L: 100 J @ RT
				$50 < t \leq 160$	---	400	---	680-900	---	25 L	SA	260 max. HBW; L: 100 J @ RT
GB 1220-92	Grade 00Cr18Ni5Mo3Si2	---	---	$t \leq 75$	---	390	---	590	---	20	ST	30 max. HRB
ASME SA-276	---	S32304	---	---	---	400	58	600	87	25	A and HF or A and CF	290 max. HB
ASTM A276/A276M-15	---	S32304	---	---	---	400	58	600	87	25	A+HF or A+CF	290 max. HB
EN 10088-3:2014	X2CrNiN23-4	---	1.4362	$0.5 < d \leq 1$	---	---	---	1050 max.	---	20	SA	---
				$1 < d \leq 3$	---	---	---	1000 max.	---	20	SA	---
				$3 < d \leq 5$	---	---	---	950 max.	---	25	SA	---
				$5 < d \leq 16$	---	---	---	900 max.	---	25	SA	---
				$t \leq 160$	---	400	---	600-830	---	25 L	SA	260 max. HBW; L: 100 J @ RT
				$d \geq 0.05$	---	---	---	800-1000	---	---	---	---
				$d \geq 0.05$	---	---	---	900-1100	---	---	---	---
				$d \geq 0.05$	---	---	---	1000-1250	---	---	---	---
				$d \geq 0.05$	---	---	---	1100-1350	---	---	---	---
				$d \geq 0.05$	---	---	---	1200-1450	---	---	---	---
				$d \geq 0.05$	---	---	---	1400-1700	---	---	---	---
				$d \geq 0.05$	---	---	---	1600-1900	---	---	---	---
				$d \geq 0.05$	---	---	---	1800-2100	---	---	---	---
ISO 16143-2:2004	X2CrNiN23-4	---	---	$t \leq 160$	---	400	---	600	---	25 L, 25 T	SA	260 max. HBW
ASME SA-276	---	S31803	---	---	---	448	65	620	90	25	A and HF or A and CF	290 max. HB
ASME SA-479/SA-479M	---	S31803	---	---	---	450	65	620	90	25	A	290 max. HB
		S32205	---	---	---	450	65	655	95	25	A	290 max. HB
ASTM A276/A276M-15	---	S31803	---	---	---	448	65	620	90	25	A+HF or A+CF	290 max. HB
		S32205	---	---	---	450	65	655	95	25	A+HF or A+CF	290 max. HB
ASTM A479/A479M-14	---	S31803	---	---	---	450	65	620	90	25	SA	290 max. HB
		S32205	---	---	---	450	65	655	95	25	SA	290 max. HB
ASTM A955/A955M-15	Grade 60 [420]	S31803	---	---	---	420	60	620	90	20	A, HR or SH	---
	Grade 75 [520]	S31803	---	---	---	520	75	690	100	20	A, HR or SH	---

Note: This section continued on next page

8.2 Stainless Steels: Bar

8.2.5B Mechanical Properties of Duplex Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
EN 10088-3:2014	X2CrNiMoN22-5-3	---	1.4462	0.50 < d ≤ 1.00	---	---	---	1050 max.	---	20	SA	---
				1.00 < d ≤ 3.00	---	---	---	1000 max.	---	20	SA	---
				3.00 < d ≤ 5.00	---	---	---	950 max.	---	25	SA	---
				t ≤ 10	---	650	---	850-1150	---	12 L	SA	---
				10 < t ≤ 16	---	650	---	850-1100	---	12 L	SA	---
				5.00 < d ≤ 16.00	---	---	---	900 max.	---	25	SA	---
				16 < t ≤ 40	---	450	---	650-1000	---	15 L	SA	L: 100 J @ RT
				40 < t ≤ 63	---	450	---	650-1000	---	15 L	SA	L: 100 J @ RT
				t ≤ 160	---	450	---	650-880	---	25 L	SA	270 max. HBW; L: 100 J @ RT
				63 < t ≤ 160	---	450	---	650-880	---	25 L	SA	L: 100 J @ RT
				d ≥ 0.05	---	---	---	800-1000	---	---	---	---
				d ≥ 0.05	---	---	---	900-1100	---	---	---	---
				d ≥ 0.05	---	---	---	1000-1250	---	---	---	---
				d ≥ 0.05	---	---	---	1100-1350	---	---	---	---
				d ≥ 0.05	---	---	---	1200-1450	---	---	---	---
				d ≥ 0.05	---	---	---	1400-1700	---	---	---	---
				d ≥ 0.05	---	---	---	1600-1900	---	---	---	---
				d ≥ 0.05	---	---	---	1800-2100	---	---	---	---
EN 10263-5:2001	X2CrNiMoN22-5-3	---	1.4462	2 < d ≤ 5	---	---	---	880 max. L	---	---	SA	---
				2 < d ≤ 5	---	---	---	950 max. L	---	---	CD+SA	---
				2 < d ≤ 5	---	---	---	1010 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	880 max. L	---	---	SA	---
				5 < d ≤ 10	---	---	---	1020 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	900 max. L	---	---	CD+SA	---
				5 < d ≤ 10	---	---	---	970 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	880 max. L	---	---	SA	---
				10 < d ≤ 25	---	---	---	1000 max. L	---	---	CD+SA	---
				10 < d ≤ 25	---	---	---	880 max. L	---	---	CD+SA	---
EN 10294-2:2012	X2CrNiMoN22-5-3	---	1.4462	---	---	450	---	640-880	---	22 L; 22 T	SA	---
JIS G 4303:2012	Symbol SUS329J3L	---	---	d ≤ 75	---	450	---	620	---	18	ST	302 max. HBW; 32 max. HRC; 320 max. HV
ASME SA-479/SA-479M	---	S32506	---	---	---	450	65	620	90	18	A	302 max. HB
ASTM A276/A276M-15	---	S32506	---	---	---	450	65	620	90	18	A+HF or A+CF	302 max. HB
ASTM A479/A479M-14	---	S32506	---	---	---	450	65	620	90	18	SA	302 max. HB
JIS G 4303:2012	Symbol SUS329J4L	---	---	d ≤ 75	---	450	---	620	---	18	ST	302 max. HBW; 32 max. HRC; 320 max. HV

8.2 Stainless Steels: Bar

8.2.5B Mechanical Properties of Duplex Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-479/SA-479M	---	S32750	---	---	$t \leq 2$	550	80	800	116	15	A	310 max. HB
				---	$t > 2$	515	75	760	110	15	A	310 max. HB
ASTM A479/A479M-14	---	S32750	---	---	$t \leq 2$	550	80	800	116	15	SA	310 max. HB
				---	$t > 2$	515	75	760	110	15	SA	310 max. HB
EN 10088-3:2014	X2CrNiMo25-7-4	---	1.4410	0.50 < d ≤ 1.00	---	---	---	1050 max.	---	20	SA	---
				1.00 < d ≤ 3.00	---	---	---	1000 max.	---	20	SA	---
				3.00 < d ≤ 5.00	---	---	---	950 max.	---	25	SA	---
				5.00 < d ≤ 16.00	---	---	---	900 max.	---	25	SA	---
				$t \leq 160$	---	530	---	730-930	---	25 L	SA	290 max. HBW; L: 100 J @ RT
				$d \geq 0.05$	---	---	---	800-1000	---	---	---	---
				$d \geq 0.05$	---	---	---	900-1100	---	---	---	---
				$d \geq 0.05$	---	---	---	1000-1250	---	---	---	---
				$d \geq 0.05$	---	---	---	1100-1350	---	---	---	---
				$d \geq 0.05$	---	---	---	1200-1450	---	---	---	---
				$d \geq 0.05$	---	---	---	1400-1700	---	---	---	---
				$d \geq 0.05$	---	---	---	1600-1900	---	---	---	---
				$d \geq 0.05$	---	---	---	1800-2100	---	---	---	---
ISO 16143-2:2004	X2CrNiMoN25-7-4	---	---	$t \leq 160$	---	530	---	730	---	25 L, 25 T	SA	290 max. HB
ASME SA-276	---	S32760	---	---	---	550	80	750	109	25	A and HF or A and CF	290 max. HB
				---	---	720	105	860	125	16	H+CW+CF	335 max. HB
ASME SA-479/SA-479M	---	S32760	---	---	---	550	80	750	109	25	A	300 max. HB
ASTM A276/A276M-15	---	S32760	---	---	---	550	80	750	109	25	A+HF or A+CF	290 max. HB
				---	---	720	105	860	125	16	H+CF	335 max. HB
ASTM A479/A479M-14	---	S32760	---	---	---	550	80	750	109	25	SA	300 max. HB
EN 10088-3:2014	X2CrNiMoCuWN25-7-4	---	1.4501	$t \leq 160$	---	530	---	730-930	---	25 L	SA	290 max. HBW; L: 100 J @ RT
ISO 16143-2:2004	X2CrNiMoCuWN25-7-4	---	---	$t \leq 160$	---	530	---	730	---	25 L, 25 T	SA	290 max. HBW

8.2 Stainless Steels: Bar

8.2.5B Mechanical Properties of Duplex Stainless Steels (Continued)

Specification	Designation	UNS No	Steel No	Section Thickness/Diameter		Yield Strength, min.		Tensile Strength, min.		Elongation % min	Heat Treatment	Other
				mm	in.	MPa	ksi	MPa	ksi			
ASME SA-479/SA-479M	---	S32550	---	---	---	550	80	760	110	15	A	297 max. HB
ASTM A276/A276M-15	---	S32550	---	---	---	550	80	750	109	25	A+HF or A+CF	290 max. HB
				---	---	720	105	860	125	16	H+CF	335 max. HB
ASTM A479/A479M-14	---	S32550	---	---	---	550	80	760	110	15	SA	297 max. HB
EN 10088-3:2014	X2CrNiMoCuN25-6-3	---	1.4507	t ≤ 16	---	---	---	---	---	---	SA	---
				16 < t ≤ 40	---	500	---	700-900	---	25 L	SA	L: 100 J @ RT
				40 < t ≤ 63	---	500	---	700-900	---	25 L	SA	L: 100 J @ RT
				t ≤ 160	---	500	---	700-900	---	25 L	SA	270 max. HBW; L: 100 J @ RT
				63 < t ≤ 160	---	500	---	700-900	---	25 L	SA	L: 100 J @ RT
ISO 16143-2:2004	X2CrNiMoCuN25-6-3	---	---	t ≤ 160	---	500	---	700	---	25 L, 25 T	SA	270 max. HB
EN 10294-2:2012	X3CrNiMoN27-5-2	---	1.4460	---	---	460	---	620-880	---	20 L; 20 T	SA	---
GB 1220-92	Grade 0Cr26Ni5Mo2	---	---	t ≤ 75	---	390	---	590	---	18	ST	277 max. HB; 29 max. HRB
JIS G 4303:2012	Symbol SUS329J1	---	---	d ≤ 75	---	390	---	590	---	18	ST	277 max. HBW; 29 max. HRC; 292 max. HV
ASME SA-479/SA-479M	---	S32906	---	---	---	550	80	750	109	25	A	310 max. HB
ASTM A479/A479M-14	---	S32906	---	---	---	550	80	750	109	25	SA	310 max. HB
EN 10088-3:2014	X2CrNiMoN29-7-2	---	1.4477	t ≤ 10	---	650	---	800-1050	---	25 L	SA	310 max. HBW; L: 100 J @ RT
				10 < t ≤ 160	---	550	---	750-1000	---	25 L	SA	310 max. HBW; L: 100 J @ RT

Chapter

9

STEELS FOR SPECIAL USE

Free-Machining Steels**ASME Standard**

ASME SA-29/SA-29M	Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for

ASTM Standards

ASTM A29/A29M-12e1	General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
ASTM A493-09 (2013)	Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging
ASTM A576-90b (2012)	Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A581/A581M-95b (2014)	Free-Machining Stainless Steel Wire and Wire Rods
ASTM A582/A582M-12e1	Free-Machining Stainless Steel Bars
ASTM A895-89 (2009)	Free-Machining Stainless Steel Plate, Sheet, and Strip

EN Standards

EN 10087:1998 C2:2006	Free cutting steels – Technical delivery conditions for semi-finished products, hot-rolled bars and rods
EN 10088-3:2014	Stainless steels – Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes
EN 10277-3:2008	Bright steel products – Technical delivery conditions – Part 3: Free-cutting steels

GB Standard

GB 8731-88	Free-Cutting Steel - Technical Requirements

ISO Standard

ISO 683-9-1988	Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels - Part 9: Wrought Free-Cutting Steels

JIS Standards

JIS G 4308:2013	Stainless steel wire rods
JIS G 4804:2008	Free-cutting steels

SAE Standard

SAE J403 JUN14	Chemical Compositions of SAE Carbon Steels

Spring Steels**ASTM Standards**

ASTM A313/A313M-13	Stainless Steel Spring Wire
ASTM A684/A684M-14	Steel, Strip, High-Carbon, Cold-Rolled
ASTM A713-04 (2010)	Steel Wire, High-Carbon Spring, for Heat-Treated Components
ASTM A1000/A1000M-11	Steel Wire, Carbon and Alloy Specialty Spring Quality

EN Standards

EN 10089:2002	Hot rolled steels for quenched and tempered springs – Technical delivery conditions
EN 10132-4:2000	Cold rolled narrow steel strip for heat treatment – Technical delivery conditions – Part 4: Spring steels and other applications
EN 10151:2002	Stainless steel strip for springs - Technical delivery conditions
EN 10270-2:2011	Steel wire for mechanical springs – Part 2: Oil hardened and tempered spring steel wire
EN 10270-3:2011	Steel wire for mechanical springs – Part 3: Stainless spring steel wire

GB Standards

GB/T 1222-84	Spring Steel
GB 3522-83	Cold-Rolled Quality Carbon Structural Steel Strips
GB/T 4231-93	Cold Rolled Stainless Steel Strips for Springs
GB/T 4358-1995	Carbon Spring Steel Wire for Significant Use
GB/T 18983-2003	Oil-Hardened and Tempered Steel Wire for Mechanical Springs

ISO Standards

ISO 683-14:2004	Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels - Part 14: Hot-Rolled Steels for Quenched and Tempered Springs
ISO 8458-3:2002	Steel Wire for Mechanical Springs - Part 3: Oil-Hardened and Tempered Wire

JIS Standards

JIS G 4313:2011	Cold rolled stainless steel strip for springs
JIS G 4801:2011	Spring steels
JIS G 4802:2011	Cold-rolled steel strip for springs

Tool Steels**ASTM Standards**

ASTM A600-92a (2010)	Tool Steel High Speed
ASTM A681-08	Tool Steels Alloy
ASTM A686-92 (2010)	Tool Steel, Carbon

GB Standards

GB 1298-86	Carbon Tool Steels - Technical Requirements
GB/T 1299-2000	Alloy Tool Steels
GB/T 3080-2001	High Speed Tool Steel Wire

ISO Standards

ISO 4957:1999	Tool Steels

JIS Standards

JIS G 4401:2009	Carbon tool steels
JIS G 4403:2006	High speed tool steels
JIS G 4404:2006	Alloy tool steels

SAE Standard

SAE J438b MAY70	Tool and Die Steels

Bearing Steels**ASTM Standards**

ASTM A295/A295M-14	High-Carbon Anti-Friction Bearing Steel
ASTM A485-14	High Hardenability Antifriction Bearing Steel

GB Standard

GB/T 18254-2002	High-Carbon Chromium Bearing Steel

ISO Standard

ISO 683-17:1999	Heat-Treated Steels, Alloy Steels and Free-Cutting Steels - Part 17: Ball and Roller Bearing Steels

JIS Standard

JIS G 4805:2008	High carbon chromium bearing steels

9.1 Free-Machining Steels

9.1.1 Chemical Composition of Resulfurized Carbon Steels for Free-Machining Applications

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1109	G11090	---	0.08-0.13	0.60-0.90	---	0.040	0.08-0.13	---	---	---	---
ASTM A29/A29M-12e1	Grade 1109	G11090	---	0.08-0.13	0.60-0.90	---	0.040	0.08-0.13	---	---	---	---
ASTM A576-90b (2012)	Grade 1109	G11090	---	0.08-0.13	0.60-0.90	---	0.040	0.08-0.13	---	---	---	---
EN 10087:1998 C2:2006	10S20	---	1.0721	0.07-0.13	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	---
EN 10277-3:2008	10S20	---	1.0721	0.07-0.13	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	---
GB 8731-88	Grade Y12	---	---	0.08-0.16	0.70-1.00	0.15-0.35	0.08-0.15	0.10-0.20	---	---	---	---
ISO 683-9:1988	Type 10 S 20	---	---	0.07-0.13	0.70-1.10	0.15-0.40	0.06	0.15-0.25	---	---	---	---
ASME SA-29/SA-29M	Grade 1110	G11100	---	0.08-0.13	0.30-0.60	---	0.040	0.08-0.13	---	---	---	---
ASTM A29/A29M-12e1	Grade 1110	G11100	---	0.08-0.13	0.30-0.60	---	0.040	0.08-0.13	---	---	---	---
ASTM A576-90b (2012)	Grade 1110	G11100	---	0.08-0.13	0.30-0.60	---	0.040	0.08-0.13	---	---	---	---
ASME SA-29/SA-29M	Grade 1117	G11170	---	0.14-0.20	1.00-1.30	---	0.040	0.08-0.13	---	---	---	---
	Grade 1118	G11180	---	0.14-0.20	1.30-1.60	---	0.040	0.08-0.13	---	---	---	---
ASTM A29/A29M-12e1	Grade 1117	G11170	---	0.14-0.20	1.00-1.30	---	0.040	0.08-0.13	---	---	---	---
	Grade 1118	G11180	---	0.14-0.20	1.30-1.60	---	0.040	0.08-0.13	---	---	---	---
ASTM A576-90b (2012)	Grade 1117	G11170	---	0.14-0.20	1.00-1.30	---	0.040	0.08-0.13	---	---	---	---
	Grade 1118	G11180	---	0.14-0.20	1.30-1.60	---	0.040	0.08-0.13	---	---	---	---
EN 10087:1998 C2:2006	15SMn13	---	1.0725	0.12-0.18	0.90-1.30	0.40	0.06	0.08-0.18	---	---	---	---
EN 10277-3:2008	15SMn13	---	1.0725	0.12-0.18	0.90-1.30	0.40	0.06	0.08-0.18	---	---	---	---
GB 8731-88	Grade Y20	---	---	0.17-0.25	0.70-1.00	0.15-0.35	0.06	0.08-0.15	---	---	---	---
ISO 683-9:1988	Type 17 SMn 20	---	---	0.14-0.20	1.20-1.60	0.15-0.40	0.06	0.15-0.25	---	---	---	---
JIS G 4804:2008	Grade SUM 31	---	---	0.14-0.20	1.00-1.30	---	0.040	0.08-0.13	---	---	---	---
	Grade SUM 32	---	---	0.12-0.20	0.60-1.10	---	0.040	0.10-0.20	---	---	---	---
SAE J403 JUN14	Grade 1117	G11170	---	0.14-0.20	1.00-1.30	---	0.030	0.08-0.13	---	---	---	---
	Grade 1118	G11180	---	0.14-0.20	1.30-1.60	---	0.030	0.08-0.13	---	---	---	---
ASME SA-29/SA-29M	Grade 1132	G11320	---	0.27-0.34	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
ASTM A29/A29M-12e1	Grade 1132	G11320	---	0.27-0.34	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
ASTM A576-90b (2012)	Grade 1132	G11320	---	0.27-0.34	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
GB 8731-88	Grade Y30	---	---	0.27-0.35	0.70-1.00	0.15-0.35	0.06	0.08-0.15	---	---	---	---
SAE J403 JUN14	Grade 1132	G11320	---	0.27-0.34	1.35-1.65	---	0.030	0.08-0.13	---	---	---	---

9.1 Free-Machining Steels

9.1.1 Chemical Composition of Resulfurized Carbon Steels for Free-Machining Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1137	G11370	---	0.32-0.39	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
ASTM A29/A29M-12e1	Grade 1137	G11370	---	0.32-0.39	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
ASTM A576-90b (2012)	Grade 1137	G11370	---	0.32-0.39	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
EN 10087:1998 C2:2006	35S20	---	1.0726	0.32-0.39	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	---
	36SMn14	---	1.0764	0.32-0.39	1.30-1.70	0.40	0.06	0.10-0.18	---	---	---	---
EN 10277-3:2008	35S20	---	1.0726	0.32-0.39	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	---
	36SMn14	---	1.0764	0.32-0.39	1.30-1.70	0.40	0.06	0.10-0.18	---	---	---	---
GB 8731-88	Grade Y35	---	---	0.32-0.40	0.70-1.00	0.15-0.35	0.06	0.08-0.15	---	---	---	---
ISO 683-9:1988	Type 35 S 20	---	---	0.32-0.39	0.70-1.10	0.15-0.40	0.06	0.15-0.25	---	---	---	---
	Type 35 SMn 20	---	---	0.32-0.39	0.90-1.40	0.15-0.40	0.06	0.15-0.25	---	---	---	---
JIS G 4804:2008	Grade SUM 41	---	---	0.32-0.39	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
SAE J403 JUN14	Grade 1137	G11370	---	0.32-0.39	1.35-1.65	---	0.030	0.08-0.13	---	---	---	---
ASME SA-29/SA-29M	Grade 1139	G11390	---	0.35-0.43	1.35-1.65	---	0.040	0.13-0.20	---	---	---	---
ASTM A29/A29M-12e1	Grade 1139	G11390	---	0.35-0.43	1.35-1.65	---	0.040	0.13-0.20	---	---	---	---
ASTM A576-90b (2012)	Grade 1139	G11390	---	0.35-0.43	1.35-1.65	---	0.040	0.13-0.2	---	---	---	---
EN 10087:1998 C2:2006	38SMn28	---	1.0760	0.35-0.40	1.20-1.50	0.40	0.06	0.24-0.33	---	---	---	---
EN 10277-3:2008	38SMn28	---	1.0760	0.35-0.40	1.20-1.50	0.40	0.06	0.24-0.33	---	---	---	---
SAE J403 JUN14	Grade 1138	G11380	---	0.34-0.40	0.70-1.00	---	0.030	0.08-0.13	---	---	---	---
ASME SA-29/SA-29M	Grade 1140	G11400	---	0.37-0.44	0.70-1.00	---	0.040	0.08-0.13	---	---	---	---
ASTM A29/A29M-12e1	Grade 1140	G11400	---	0.37-0.44	0.70-1.00	---	0.040	0.08-0.13	---	---	---	---
ASTM A576-90b (2012)	Grade 1140	G11400	---	0.37-0.44	0.70-1.00	---	0.040	0.08-0.13	---	---	---	---
SAE J403 JUN14	Grade 1140	G11400	---	0.37-0.44	0.70-1.00	---	0.030	0.08-0.13	---	---	---	---
ASME SA-29/SA-29M	Grade 1141	G11410	---	0.37-0.45	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
ASTM A29/A29M-12e1	Grade 1141	G11410	---	0.37-0.45	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
ASTM A576-90b (2012)	Grade 1141	G11410	---	0.37-0.45	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
GB 8731-88	Grade Y40Mn	---	---	0.37-0.45	1.20-1.55	0.15-0.35	0.05	0.20-0.30	---	---	---	---
JIS G 4804:2008	Grade SUM 42	---	---	0.37-0.45	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
SAE J403 JUN14	Grade 1141	G11410	---	0.37-0.45	1.35-1.65	---	0.030	0.08-0.13	---	---	---	---
ASME SA-29/SA-29M	Grade 1144	G11440	---	0.40-0.48	1.35-1.65	---	0.040	0.24-0.33	---	---	---	---
ASTM A29/A29M-12e1	Grade 1144	G11440	---	0.40-0.48	1.35-1.65	---	0.040	0.24-0.33	---	---	---	---
ASTM A576-90b (2012)	Grade 1144	G11440	---	0.40-0.48	1.35-1.65	---	0.040	0.24-0.33	---	---	---	---
EN 10087:1998 C2:2006	44SMn28	---	1.0762	0.40-0.48	1.30-1.70	0.40	0.06	0.24-0.33	---	---	---	---
EN 10277-3:2008	44SMn28	---	1.0762	0.40-0.48	1.30-1.70	0.40	0.06	0.24-0.33	---	---	---	---
ISO 683-9:1988	Type 44 SMn 28	---	---	0.40-0.48	1.30-1.70	0.15-0.40	0.06	0.24-0.33	---	---	---	---
JIS G 4804:2008	Grade SUM 43	---	---	0.40-0.48	1.35-1.65	---	0.040	0.24-0.33	---	---	---	---
SAE J403 JUN14	Grade 1144	G11440	---	0.40-0.48	1.35-1.65	---	0.030	0.24-0.33	---	---	---	---

9.1 Free-Machining Steels

9.1.1 Chemical Composition of Resulfurized Carbon Steels for Free-Machining Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1146	G11460	---	0.42-0.49	0.70-1.00	---	0.040	0.08-0.13	---	---	---	---
ASTM A29/A29M-12e1	Grade 1146	G11460	---	0.42-0.49	0.70-1.00	---	0.040	0.08-0.13	---	---	---	---
ASTM A576-90b (2012)	Grade 1146	G11460	---	0.42-0.49	0.70-1.00	---	0.040	0.08-0.13	---	---	---	---
GB 8731-88	Grade Y45Ca	---	---	0.42-0.50	0.60-0.90	0.20-0.40	0.04	0.04-0.08	---	---	---	Ca 0.002-0.006
SAE J403 JUN14	Grade 1146	G11460	---	0.42-0.49	0.70-1.00	---	0.030	0.08-0.13	---	---	---	---
EN 10087:1998 C2:2006	46S20	---	1.0727	0.42-0.50	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	---
EN 10277-3:2008	46S20	---	1.0727	0.42-0.50	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	---
ISO 683-9:1988	Type 46 S 20	---	---	0.42-0.50	0.70-1.10	0.15-0.40	0.06	0.15-0.25	---	---	---	---
ASME SA-29/SA-29M	Grade 1151	G11510	---	0.48-0.55	0.70-1.00	---	0.040	0.08-0.13	---	---	---	---
ASTM A29/A29M-12e1	Grade 1151	G11510	---	0.48-0.55	0.70-1.00	---	0.040	0.08-0.13	---	---	---	---
ASTM A576-90b (2012)	Grade 1151	G11510	---	0.48-0.55	0.70-1.00	---	0.040	0.08-0.13	---	---	---	---
SAE J403 JUN14	Grade 1151	G11510	---	0.48-0.55	0.70-0.90	---	0.030	0.08-0.13	---	---	---	---

9.1.2 Chemical Composition of Rephosphorized and Resulfurized Carbon Steels for Free-Machining Applications

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 1212	G12120	---	0.13	0.70-1.00	---	0.07-0.12	0.16-0.23	---	---	---	---
ASTM A29/A29M-12e1	Grade 1212	G12120	---	0.13	0.70-1.00	---	0.07-0.12	0.16-0.23	---	---	---	---
ASTM A576-90b (2012)	Grade 1212	G12120	---	0.13	0.70-1.00	---	0.07-0.12	0.16-0.23	---	---	---	---
ISO 683-9:1988	Type 9 S 20	---	---	0.13	0.60-1.20	0.05	0.11	0.15-0.25	---	---	---	---
JIS G 4804:2008	Grade SUM 21	---	---	0.13	0.70-1.00	---	0.07-0.12	0.16-0.23	---	---	---	---
SAE J403 JUN14	Grade 1212	G12120	---	0.13	0.70-1.00	---	0.07-0.12	0.16-0.23	---	---	---	---
ASME SA-29/SA-29M	Grade 1213	G12130	---	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	---
ASTM A29/A29M-12e1	Grade 1213	G12130	---	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	---
ASTM A576-90b (2012)	Grade 1213	G12130	---	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	---
EN 10087:1998 C2:2006	11SMn30	---	1.0715	0.14	0.90-1.30	0.05	0.11	0.27-0.33	---	---	---	---
EN 10277-3:2008	11SMn30	---	1.0715	0.14	0.90-1.30	0.05	0.11	0.27-0.33	---	---	---	---
GB 8731-88	Grade Y15	---	---	0.10-0.18	0.80-1.20	0.15	0.05-0.10	0.23-0.33	---	---	---	---
ISO 683-9:1988	Type 11 SMn 28	---	---	0.14	0.90-1.30	0.05	0.11	0.24-0.33	---	---	---	---
JIS G 4804:2008	Grade SUM 22	---	---	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	---
SAE J403 JUN14	Grade 1213	G12130	---	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	---
ASME SA-29/SA-29M	Grade 1215	G12150	---	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	---
ASTM A29/A29M-12e1	Grade 1215	G12150	---	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	---
ASTM A576-90b (2012)	Grade 1215	G12150	---	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	---
JIS G 4804:2008	Grade SUM 23	---	---	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	---
SAE J403 JUN14	Grade 1215	G12150	---	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	---

9.1 Free-Machining Steels

9.1.2 Chemical Composition of Rephosphorized and Resulfurized Carbon Steels for Free-Machining Applications (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10087:1998 C2:2006	11SMn37	---	1.0736	0.14	1.00-1.50	0.05	0.11	0.34-0.40	---	---	---	---
EN 10277-3:2008	11SMn37	---	1.0736	0.14	1.00-1.50	0.05	0.11	0.34-0.40	---	---	---	---
ISO 683-9:1988	Type 12 SMn 35	---	---	0.15	1.00-1.50	0.05	0.11	0.30-0.40	---	---	---	---
JIS G 4804:2008	Grade SUM 25	---	---	0.15	0.90-1.40	---	0.07-0.12	0.30-0.40	---	---	---	---

9.1.3 Chemical Composition of Resulfurized and Lead Carbon Steels for Free-Machining Applications

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10087:1998 C2:2006	10SPb20	---	1.0722	0.07-0.13	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	Pb 0.20-0.35
EN 10277-3:2008	10SPb20	---	1.0722	0.07-0.13	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	Pb 0.20-0.35
GB 8731-88	Grade Y12Pb	---	---	0.08-0.16	0.70-1.10	0.15	0.05-0.10	0.15-0.25	---	---	---	Pb 0.15-0.35
ISO 683-9:1988	Type 10 SPb 20	---	---	0.07-0.13	0.70-1.10	0.15-0.40	0.06	0.15-0.25	---	---	---	Pb 0.15-0.35

9.1.4 Chemical Composition of Rephosphorized, Resulfurized, and Lead Carbon Steels for Free-Machining Applications

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASME SA-29/SA-29M	Grade 12L13	G12134	---	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	Pb 0.15-0.35
ASTM A29/A29M-12e1	Grade 12L13	G12134	---	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	Pb 0.15-0.35
EN 10087:1998 C2:2006	11SMnPb30	---	1.0718	0.14	0.90-1.30	0.05	0.11	0.27-0.33	---	---	---	Pb 0.20-0.35
EN 10277-3:2008	11SMnPb30	---	1.0718	0.14	0.90-1.30	0.05	0.11	0.27-0.33	---	---	---	Pb 0.20-0.35
GB 8731-88	Grade Y15Pb	---	---	0.10-0.18	0.80-1.20	0.15	0.05-0.10	0.23-0.33	---	---	---	Pb 0.15-0.35
ISO 683-9:1988	Type 11 SMnPb 28	---	---	0.14	0.90-1.30	0.05	0.11	0.24-0.33	---	---	---	Pb 0.15-0.35
JIS G 4804:2008	Grade SUM 22 L	---	---	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	Pb 0.10-0.35
ASME SA-29/SA-29M	Grade 12L14	G12144	---	0.15	0.85-1.15	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
ASTM A29/A29M-12e1	Grade 12L14	G12144	---	0.15	0.85-1.15	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
ASTM A576-90b (2012)	Grade 12L14	G12144	---	0.15	0.85-1.15	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
JIS G 4804:2008	Grade SUM 24 L	---	---	0.15	0.85-1.15	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.10-0.35
SAE J403 JUN14	Grade 12L14	G12144	---	0.15	0.85-1.15	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
ASME SA-29/SA-29M	Grade 12L15	---	---	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
ASTM A29/A29M-12e1	Grade 12L15	---	---	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
JIS G 4804:2008	Grade SUM 23 L	---	---	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.10-0.35
EN 10087:1998 C2:2006	11SMnPb37	---	1.0737	0.14	1.00-1.50	0.05	0.11	0.34-0.40	---	---	---	Pb 0.20-0.35
EN 10277-3:2008	11SMnPb37	---	1.0737	0.14	1.00-1.50	0.05	0.11	0.34-0.40	---	---	---	Pb 0.20-0.35
ISO 683-9:1988	Type 12 SMnPb 35	---	---	0.15	1.00-1.50	0.05	0.11	0.30-0.40	---	---	---	Pb 0.15-0.35

9.1 Free-Machining Steels

9.1.5 Chemical Composition of Free-Machining Stainless Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A581/A581M-95b (2014)	Type 303	S30300	---	0.15	2.00	1.00	0.20	0.15 min.	17.0-19.0	8.0-10.0	---	---
ASTM A582/A582M-12e1	Type 303	S30300	---	0.15	2.00	1.00	0.20	0.15 min.	17.0-19.0	8.0-10.0	---	---
ASTM A895-89 (2009)	Type 303	S30300	---	0.15	2.00	1.00	0.20	0.15 min.	17.0-19.0	8.00-10.00	---	---
JIS G 4308:2013	Symbol SUS303	---	---	0.15	2.00	1.00	0.20	0.15 min.	17.00-19.00	8.00-10.00	0.60	---
ASTM A581/A581M-95b (2014)	Type 303Se	S30323	---	0.15	2.00	1.00	0.20	0.06	17.0-19.0	8.0-10.0	---	Se 0.15 min.
JIS G 4308:2013	Symbol SUS303Se	---	---	0.15	2.00	1.00	0.20	0.060	17.00-19.00	8.00-10.00	---	Se 0.15 min.
ASTM A581/A581M-95b (2014)	Type 430 F	S43020	---	0.12	1.25	1.00	0.06	0.15 min.	16.0-18.0	---	---	---
JIS G 4308:2013	Symbol SUS430F	---	---	0.12	1.25	1.00	0.060	0.15 min.	16.00-18.00	0.60	0.60	---
ASTM A581/A581M-95b (2014)	Type 416	S41600	---	0.15	1.25	1.00	0.06	0.15 min.	12.0-14.0	---	---	---
JIS G 4308:2013	Symbol SUS416	---	---	0.15	1.25	1.00	0.060	0.15 min.	12.00-14.00	0.60	0.60	---
EN 10088-3:2014	X12CrS13	---	1.4005	0.06-0.15	1.50	1.00	0.040	0.15-0.35	12.0-14.0	---	0.60	---

9.2 Spring Steels

9.2.1 Chemical Composition of Cold Rolled Carbon Spring Steels

9.2.1.1 Chemical Composition of Cold Rolled Carbon Wire Spring Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A713-04 (2010)	Grade 1064	G10640	---	0.60-0.70	0.50-0.80	---	0.040	0.050	---	---	---	---
	Grade 1065	G10650	---	0.60-0.70	0.60-0.90	---	0.040	0.050	---	---	---	---
GB/T 4358-1995	Grade 65Mn	---	---	0.62-0.69	0.70-1.00	0.17-0.37	0.025	0.020	0.10	0.15	---	Cu 0.20
ASTM A713-04 (2010)	Grade 1070	G10700	---	0.65-0.75	0.60-0.90	---	0.040	0.050	---	---	---	---
	Grade 70	---	---	0.67-0.74	0.30-0.60	0.17-0.37	0.025	0.020	0.10	0.15	---	Cu 0.20
EN 10270-2:2011	Grade FDC	---	---	0.60-0.75	0.50-1.20	0.10-0.35	0.030	0.025	---	---	---	Cu 0.12
	Grade TDC	---	---	0.60-0.75	0.50-1.20	0.10-0.35	0.020	0.020	---	---	---	Cu 0.10
	Grade VDC	---	---	0.60-0.75	0.50-1.00	0.15-0.30	0.020	0.020	---	---	---	Cu 0.06
GB/T 18983-2003	Grade FDC	---	---	0.60-0.75	0.50-1.20	0.10-0.35	0.030	0.030	---	---	---	Cu 0.20
	Grade TDC	---	---	0.60-0.75	0.50-1.20	0.10-0.35	0.020	0.025	---	---	---	Cu 0.12
	Grade VDC	---	---	0.60-0.75	0.50-1.20	0.10-0.35	0.020	0.025	---	---	---	Cu 0.12
ISO 8458-3:2002	Grade FDC	---	---	0.60-0.75	0.50-1.20	0.10-0.35	0.030	0.030	---	---	---	Cu 0.20
	Grade TDC	---	---	0.60-0.75	0.50-1.20	0.10-0.35	0.020	0.025	---	---	---	Cu 0.12
	Grade VDC	---	---	0.60-0.75	0.50-1.00	0.15-0.30	0.020	0.025	---	---	---	Cu 0.12

9.2 Spring Steels

9.2.1.1 Chemical Composition of Cold Rolled Carbon Wire Spring Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A713-04 (2010)	Grade 1084	G10840	---	0.80-0.93	0.60-0.90	---	0.040	0.050	---	---	---	---
GB/T 4358-1995	Grade T8MnA	---	---	0.80-0.89	0.40-0.60	0.35	0.025	0.020	0.10	0.15	---	Cu 0.20
ASTM A713-04 (2010)	Grade 1086	G10860	---	0.80-0.93	0.30-0.50	---	0.040	0.050	---	---	---	---
GB/T 4358-1995	Grade T9A	---	---	0.85-0.93	0.40	0.35	0.025	0.020	0.10	0.15	---	Cu 0.20

9.2.1.2 Chemical Composition of Cold Rolled Carbon Strip Spring Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A684/A684M-14	Grade 1040, Type 1, Limit L	G10400	---	0.37-0.44	0.60-0.90	0.15-0.30	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1040, Type 1, Limit H	G10400	---	0.37-0.44	0.60-0.90	0.15-0.30	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
	Grade 1040, Type 2, Limit L	G10400	---	0.37-0.44	0.60-0.90	0.10	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1040, Type 2, Limit H	G10400	---	0.37-0.44	0.60-0.90	0.10	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
GB 3522-83	Grade 40	---	---	0.37-0.44	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
ASTM A684/A684M-14	Grade 1050, Type 1, Limit L	G10500	---	0.48-0.55	0.60-0.90	0.15-0.30	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1050, Type 1, Limit H	G10500	---	0.48-0.55	0.60-0.90	0.15-0.30	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
	Grade 1050, Type 2, Limit L	G10500	---	0.48-0.55	0.60-0.90	0.10	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1050, Type 2, Limit H	G10500	---	0.48-0.55	0.60-0.90	0.10	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
GB 3522-83	Grade 50	---	---	0.47-0.55	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
JIS G 4802:2011	Grade S50C-CSP	---	---	0.47-0.53	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
ASTM A684/A684M-14	Grade 1055, Type 1, Limit L	G10550	---	0.50-0.60	0.60-0.90	0.15-0.30	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1055, Type 1, Limit H	G10550	---	0.50-0.60	0.60-0.90	0.15-0.30	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
	Grade 1055, Type 2, Limit L	G10550	---	0.50-0.60	0.60-0.90	0.10	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1055, Type 2, Limit H	G10550	---	0.50-0.60	0.60-0.90	0.10	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
EN 10132-4:2000	C55S	---	1.1204	0.52-0.60	0.60-0.90	0.15-0.35	0.025	0.025	0.40	0.40	0.10	---
GB 3522-83	Grade 55	---	---	0.52-0.60	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
JIS G 4802:2011	Grade S55C-CSP	---	---	0.52-0.58	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; (Ni+Cr) 0.35
ASTM A684/A684M-14	Grade 1060, Type 1, Limit L	G10600	---	0.55-0.65	0.60-0.90	0.15-0.30	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1060, Type 1, Limit H	G10600	---	0.55-0.65	0.60-0.90	0.15-0.30	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
	Grade 1060, Type 2, Limit L	G10600	---	0.55-0.65	0.60-0.90	0.10	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1060, Type 2, Limit H	G10600	---	0.55-0.65	0.60-0.90	0.10	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
EN 10132-4:2000	C60S	---	1.1211	0.57-0.65	0.60-0.90	0.15-0.35	0.025	0.025	0.40	0.40	0.10	---
GB 3522-83	Grade 60	---	---	0.57-0.65	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
JIS G 4802:2011	Grade S60C-CSP	---	---	0.55-0.65	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30

9.2 Spring Steels

9.2.1.2 Chemical Composition of Cold Rolled Carbon Strip Spring Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A684/A684M-14	Grade 1064, Type 1, Limit L	G10640	---	0.59-0.70	0.50-0.80	0.15-0.30	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1064, Type 1, Limit H	G10640	---	0.59-0.70	0.50-0.80	0.15-0.30	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
	Grade 1064, Type 2, Limit L	G10640	---	0.59-0.70	0.50-0.80	0.10	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1064, Type 2, Limit H	G10640	---	0.59-0.70	0.50-0.80	0.10	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
	Grade 1065, Type 1, Limit L	G10650	---	0.60-0.70	0.60-0.90	0.15-0.30	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1065, Type 1, Limit H	G10650	---	0.60-0.70	0.60-0.90	0.15-0.30	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
	Grade 1065, Type 2, Limit L	G10650	---	0.60-0.70	0.60-0.90	0.10	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1065, Type 2, Limit H	G10650	---	0.60-0.70	0.60-0.90	0.10	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
GB 3522-83	Grade 65	---	---	0.62-0.70	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
JIS G 4802:2011	Grade S65C-CSP	---	---	0.60-0.70	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30
ASTM A684/A684M-14	Grade 1070, Type 1, Limit L	G10700	---	0.65-0.75	0.60-0.90	0.15-0.30	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1070, Type 1, Limit H	G10700	---	0.65-0.75	0.60-0.90	0.15-0.30	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
	Grade 1070, Type 2, Limit L	G10700	---	0.65-0.75	0.60-0.90	0.10	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1070, Type 2, Limit H	G10700	---	0.65-0.75	0.60-0.90	0.10	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
EN 10132-4:2000	C67S	---	1.1231	0.65-0.73	0.60-0.90	0.15-0.35	0.025	0.025	0.40	0.40	0.10	---
GB 3522-83	Grade 70	---	---	0.67-0.75	0.50-0.80	0.17-0.37	---	---	0.25	0.30	---	Cu 0.25
JIS G 4802:2011	Grade S70C-CSP	---	---	0.65-0.75	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30
ASTM A684/A684M-14	Grade 1074, Type 1, Limit L	G10740	---	0.70-0.80	0.50-0.80	0.15-0.30	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1074, Type 1, Limit H	G10740	---	0.70-0.80	0.50-0.80	0.15-0.30	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
	Grade 1074, Type 2, Limit L	G10740	---	0.70-0.80	0.50-0.80	0.10	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1074, Type 2, Limit H	G10740	---	0.70-0.80	0.50-0.80	0.10	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
EN 10132-4:2000	C75S	---	1.1248	0.70-0.80	0.60-0.90	0.15-0.35	0.025	0.025	0.40	0.40	0.10	---
ASTM A684/A684M-14	Grade 1080, Type 1, Limit L	G10800	---	0.75-0.88	0.60-0.90	0.15-0.30	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1080, Type 1, Limit H	G10800	---	0.75-0.88	0.60-0.90	0.15-0.30	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
	Grade 1080, Type 2, Limit L	G10800	---	0.75-0.88	0.60-0.90	0.10	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1080, Type 2, Limit H	G10800	---	0.75-0.88	0.60-0.90	0.10	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
	Grade 1085, Type 1, Limit L	G10850	---	0.80-0.93	0.70-1.00	0.15-0.30	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1085, Type 1, Limit H	G10850	---	0.80-0.93	0.70-1.00	0.15-0.30	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
	Grade 1085, Type 2, Limit L	G10850	---	0.80-0.93	0.70-1.00	0.10	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1085, Type 2, Limit H	G10850	---	0.80-0.93	0.70-1.00	0.10	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
EN 10132-4:2000	C85S	---	1.1269	0.80-0.90	0.40-0.70	0.15-0.35	0.025	0.025	0.40	0.40	0.10	---
JIS G 4802:2011	Grade SK85-CSP	---	---	0.80-0.90	0.50	0.35	0.030	0.030	0.30	0.25	---	Cu 0.25

9.2 Spring Steels

9.2.1.2 Chemical Composition of Cold Rolled Carbon Strip Spring Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A684/A684M-14	Grade 1086, Type 1, Limit L	G10860	---	0.80-0.93	0.30-0.50	0.15-0.30	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1086, Type 1, Limit H	G10860	---	0.80-0.93	0.30-0.50	0.15-0.30	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
	Grade 1086, Type 2, Limit L	G10860	---	0.80-0.93	0.30-0.50	0.10	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1086, Type 2, Limit H	G10860	---	0.80-0.93	0.30-0.50	0.10	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
EN 10132-4:2000	C90S	---	1.1217	0.85-0.95	0.40-0.70	0.15-0.35	0.025	0.025	0.40	0.40	0.10	---
ASTM A684/A684M-14	Grade 1095, Type 1, Limit L	G10950	---	0.90-1.03	0.30-0.50	0.15-0.30	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1095, Type 1, Limit H	G10950	---	0.90-1.03	0.30-0.50	0.15-0.30	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
	Grade 1095, Type 2, Limit L	G10950	---	0.90-1.03	0.30-0.50	0.10	0.030	0.035	0.25	0.30	0.10	Cu 0.30; (Cu+Ni+Cr+Mo) 0.80
	Grade 1095, Type 2, Limit H	G10950	---	0.90-1.03	0.30-0.50	0.10	0.030	0.035	0.30	0.30	0.16	Cu 0.50; (Cu+Ni+Cr+Mo) 0.80
EN 10132-4:2000	C100S	---	1.1274	0.95-1.05	0.30-0.60	0.15-0.35	0.025	0.025	0.40	0.40	0.10	---
JIS G 4802:2011	Grade SK95-CSP	---	---	0.90-1.00	0.50	0.35	0.030	0.030	0.30	0.25	---	Cu 0.25

9.2.2 Chemical Composition of Hot Rolled Alloy Spring Steels

9.2.2.1 Chemical Composition of Hot Rolled Si Alloy Spring Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB/T 18983-2003	Grade FDSiMn	---	---	0.56-0.64	0.60-0.90	1.50-2.00	0.035	0.035	---	---	---	Cu 0.25
	Grade TDSiMn	---	---	0.56-0.64	0.60-0.90	1.50-2.00	0.035	0.035	---	---	---	Cu 0.25
JIS G 4801:2011	Grade SUP6	---	---	0.56-0.64	0.70-1.00	1.50-1.80	0.030	0.030	---	---	---	Cu 0.30

9.2.2.2 Chemical Composition of Hot Rolled Cr Alloy Spring Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10089:2002	55Cr3	---	1.7176	0.52-0.59	0.70-1.00	0.40	0.025	0.025	0.70-1.00	---	---	(Cu+10xSn)±0.60
ISO 683-14:2004	Type 55Cr3	---	---	0.52-0.59	0.70-1.00	0.40	0.030	0.030	0.70-1.00	---	---	(Cu+10xSn) 0.60
JIS G 4801:2011	Grade SUP9	---	---	0.52-0.60	0.65-0.95	0.15-0.35	0.030	0.030	0.65-0.95	---	---	Cu 0.30
EN 10089:2002	60Cr3	---	1.7177	0.55-0.65	0.70-1.00	0.40	0.025	0.025	0.60-0.90	---	---	(Cu+10xSn)±0.60
JIS G 4801:2011	Grade SUP9A	---	---	0.56-0.64	0.70-1.00	0.15-0.35	0.030	0.030	0.70-1.00	---	---	Cu 0.30

9.2 Spring Steels

9.2.2 Chemical Composition of Hot Rolled Alloy Spring Steels

9.2.2.3 Chemical Composition of Hot Rolled Cr-Si Alloy Spring Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A1000/A1000M-11	Grade A	---	---	0.51-0.59	0.50-0.80	1.20-1.60	0.025	0.025	0.60-0.80	---	---	---
	Grade D	---	---	0.55-0.68	0.50-0.90	1.20-1.65	0.025	0.025	0.50-0.80	---	---	V 0.08-0.25
EN 10089:2002	54SiCr6	---	1.7102	0.51-0.59	0.50-0.80	1.20-1.60	0.025	0.025	0.50-0.80	---	---	(Cu+10xSn)±0.60
EN 10270-2:2011	Grade FDSiCr	---	---	0.50-0.60	0.50-0.90	1.20-1.60	0.030	0.025	0.50-0.80	---	---	Cu 0.12
	Grade TDSiCr	---	---	0.50-0.60	0.50-0.90	1.20-1.60	0.025	0.020	0.50-0.80	---	---	Cu 0.10
	Grade VDSiCr	---	---	0.50-0.60	0.50-0.90	1.20-1.60	0.025	0.020	0.50-0.80	---	---	Cu 0.06
GB/T 18983-2003	Grade FDCrSi	---	---	0.50-0.60	0.50-0.90	1.20-1.60	0.030	0.030	0.50-0.80	---	---	Cu 0.20
	Grade TDCrSi	---	---	0.50-0.60	0.50-0.90	1.20-1.60	0.025	0.025	0.50-0.80	---	---	Cu 0.12
	Grade VDCrSi	---	---	0.50-0.60	0.50-0.90	1.20-1.60	0.025	0.025	0.50-0.80	---	---	Cu 0.12
ISO 683-14:2004	Type 55SiCr6-3	---	---	0.51-0.59	0.50-0.80	1.20-1.60	0.030	0.030	0.50-0.80	---	---	(Cu+10xSn) 0.60
ISO 8458-3:2002	Grade FDSiCr	---	---	0.50-0.60	0.50-0.90	1.20-1.60	0.030	0.030	0.50-0.80	---	---	Cu 0.20
	Grade TDSiCr	---	---	0.50-0.60	0.50-0.90	1.20-1.60	0.025	0.025	0.50-0.80	---	---	Cu 0.12
	Grade VDSiCr	---	---	0.50-0.60	0.50-0.90	1.20-1.60	0.025	0.025	0.50-0.80	---	---	Cu 0.12
JIS G 4801:2011	Grade SUP12	---	---	0.51-0.59	0.60-0.90	1.20-1.60	0.030	0.030	0.60-0.90	---	---	Cu 0.30

9.2.2.4 Chemical Composition of Hot Rolled Cr-Mo Alloy Spring Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10089:2002	60CrMo3-1	---	1.7239	0.56-0.64	0.70-1.00	0.40	0.025	0.025	0.70-1.00	---	0.06-0.15	(Cu+10xSn)±0.60
	60CrMo3-2	---	1.7240	0.56-0.64	0.70-1.00	0.40	0.025	0.025	0.70-1.00	---	0.15-0.25	(Cu+10xSn)±0.60
	60CrMo3-3	---	1.7241	0.56-0.64	0.70-1.00	0.40	0.025	0.025	0.70-1.00	---	0.25-0.35	(Cu+10xSn)±0.60
ISO 683-14:2004	Type 60CrMo3-3	---	---	0.56-0.64	0.70-1.00	0.40	0.030	0.030	0.70-1.00	---	0.25-0.35	(Cu+10xSn) 0.60
JIS G 4801:2011	Grade SUP13	---	---	0.56-0.64	0.70-1.00	0.15-0.35	0.030	0.030	0.70-0.90	---	0.25-0.35	Cu 0.30

9.2 Spring Steels

9.2.2 Chemical Composition of Hot Rolled Alloy Spring Steels

9.2.2.5 Chemical Composition of Hot Rolled Cr-V Alloy Spring Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10089:2002	54SiCrV6	---	1.8152	0.51-0.59	0.50-0.80	1.20-1.60	0.025	0.025	0.50-0.80	---	---	V 0.10-0.20; (Cu+10xSn)±0.60
	51CrV4	---	1.8159	0.47-0.55	0.70-1.10	0.40	0.025	0.025	0.90-1.20	---	---	V 0.10-0.25; (Cu+10xSn)±0.60
EN 10132-4:2000	51CrV4	---	1.8159	0.47-0.55	0.70-1.10	0.40	0.025	0.025	0.90-1.20	0.40	0.10	V 0.10-0.25
GB/T 18983-2003	Grade FDCrV-A	---	---	0.47-0.55	0.60-1.20	0.10-0.40	0.030	0.030	0.80-1.10	---	---	V 0.15-0.25; Cu 0.20
	Grade TDCrV-A	---	---	0.47-0.55	0.60-1.20	0.10-0.40	0.025	0.025	0.80-1.10	---	---	V 0.15-0.25; Cu 0.12
	Grade VDCrV-A	---	---	0.47-0.55	0.60-1.20	0.10-0.40	0.025	0.025	0.80-1.10	---	---	V 0.15-0.25; Cu 0.12
ISO 683-14:2004	Type 51CrV4	---	---	0.47-0.55	0.70-1.10	0.40	0.030	0.030	0.90-1.20	---	---	V 0.10-0.25; (Cu+10xSn) 0.60
ISO 8458-3:2002	Grade FDCrV-A	---	---	0.47-0.55	0.60-1.20	0.10-0.40	0.030	0.030	0.80-1.10	---	---	V 0.15-0.25; Cu 0.20
	Grade TDCrV-A	---	---	0.47-0.55	0.60-1.20	0.10-0.40	0.025	0.025	0.80-1.10	---	---	V 0.15-0.25; Cu 0.12
	Grade VDCrV-A	---	---	0.47-0.55	0.60-1.20	0.10-0.40	0.025	0.025	0.80-1.10	---	---	V 0.15-0.25; Cu 0.12
JIS G 4801:2011	Grade SUP10	---	---	0.47-0.55	0.65-0.95	0.15-0.35	0.030	0.030	0.80-1.10	---	---	V 0.15-0.25; Cu 0.30
JIS G 4802:2011	Grade SUP10-CSP	---	---	0.47-0.55	0.65-0.95	0.15-0.35	0.035	0.035	0.80-1.00	---	---	V 0.15-0.25; Cu 0.30
ASTM A1000/A1000M-11	Grade C	---	---	0.60-0.70	0.50-0.90	0.15-0.30	0.025	0.025	0.35-0.60	---	---	V 0.10-0.25
EN 10270-2:2011	Grade FDCrV	---	---	0.62-0.72	0.50-0.90	0.15-0.30	0.030	0.025	0.40-0.60	---	---	V 0.15-0.25; Cu 0.12
	Grade TDCrV	---	---	0.62-0.72	0.50-0.90	0.15-0.30	0.025	0.020	0.40-0.60	---	---	V 0.15-0.25; Cu 0.10
	Grade VDCrV	---	---	0.62-0.72	0.50-0.90	0.15-0.30	0.025	0.020	0.40-0.60	---	---	V 0.15-0.25; Cu 0.06
GB/T 18983-2003	Grade FDCrV-B	---	---	0.62-0.72	0.50-0.90	0.15-0.30	0.030	0.030	0.40-0.60	---	---	V 0.15-0.25; Cu 0.20
	Grade TDCrV-B	---	---	0.62-0.72	0.50-0.90	0.15-0.30	0.025	0.025	0.40-0.60	---	---	V 0.15-0.25; Cu 0.12
	Grade VDCrV-B	---	---	0.62-0.72	0.50-0.90	0.15-0.30	0.025	0.025	0.40-0.60	---	---	V 0.15-0.25; Cu 0.12
ISO 8458-3:2002	Grade FDCrV-B	---	---	0.62-0.72	0.50-0.90	0.15-0.30	0.030	0.030	0.40-0.60	---	---	V 0.15-0.25; Cu 0.20
	Grade TDCrV-B	---	---	0.62-0.72	0.50-0.90	0.15-0.30	0.025	0.025	0.40-0.60	---	---	V 0.15-0.25; Cu 0.12
	Grade VDCrV-B	---	---	0.62-0.72	0.50-0.90	0.15-0.30	0.025	0.025	0.40-0.60	---	---	V 0.15-0.25; Cu 0.12

9.2 Spring Steels

9.2.2 Chemical Composition of Hot Rolled Alloy Spring Steels

9.2.2.6 Chemical Composition of Hot Rolled Cr-B Alloy Spring Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB/T 1222-84	Grade 60CrMnBA	---	---	0.56-0.64	0.70-1.00	0.17-0.37	0.030	0.030	0.70-1.00	0.35	---	B 0.0005-0.004
JIS G 4801:2011	Grade SUP11A	---	---	0.56-0.64	0.70-1.00	0.15-0.35	0.030	0.030	0.70-1.00	---	---	B 0.0005 min.; Cu 0.30

9.2.3 Chemical Composition of Stainless Spring Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10151:2002	X30Cr13	---	1.4028	0.26-0.35	1.50	1.00	0.040	0.015	12.0-14.0	---	---	---
	X39Cr13	---	1.4031	0.36-0.42	1.00	1.00	0.040	0.015	12.5-14.5	---	---	---
GB/T 4231-93	Grade 3Cr13	---	---	0.26-0.40	1.00	1.00	0.035	0.030	12.00-14.00	0.60	---	---
JIS G 4313:2011	Symbol SUS 420J2-CSP	---	---	0.26-0.40	1.00	1.00	0.040	0.030	12.00-14.00	0.60	---	---
ASTM A313/A313M-13	Type 302, Class 1	S30200	---	0.12	2.00	1.00	0.045	0.030	17.0-19.0	8.00-10.00	---	N 0.10
	Type 302, Class 2	S30200	---	0.12	2.00	1.00	0.045	0.030	17.0-19.0	8.00-10.00	---	N 0.10
EN 10151:2002	X10CrNi18-8	---	1.4310	0.05-0.15	2.00	2.00	0.045	0.015	16.0-19.0	6.0-9.5	0.80	N 0.11
EN 10270-3:2011	X10CrNi18-8	---	1.4310	0.05-0.15	2.00	2.00	0.045	0.015	16.0-19.0	6.0-9.5	0.80	N 0.11
GB/T 4231-93	Grade 1Cr17Ni7	---	---	---	---	---	---	---	---	---	---	---
JIS G 4313:2011	Symbol SUS 301-CSP	---	---	0.15	2.00	1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	---
ASTM A313/A313M-13	Type 304	S30400	---	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10
EN 10151:2002	X5CrNi18-10	---	1.4301	0.07	2.00	1.00	0.045	0.015	17.5-19.5	8.0-10.5	---	N 0.11
GB/T 4231-93	Grade 0Cr19Ni9	---	---	0.08	2.50	1.00	0.035	0.030	18.00-20.00	7.00-10.50	---	N 0.10-0.25
JIS G 4313:2011	Symbol SUS 304-CSP	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
ASTM A313/A313M-13	Type 316	S31600	---	0.07	2.00	1.00	0.045	0.030	16.5-18.0	10.5-13.5	2.00-2.50	N 0.10
EN 10151:2002	X5CrNiMo17-12-2	---	1.4401	0.07	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-2.50	N 0.11
EN 10270-3:2011	X5CrNiMo17-12-2	---	1.4401	0.07	2.00	1.00	0.045	0.015	16.5-18.5	10.0-13.0	2.00-2.50	N 0.11
ASTM A313/A313M-13	Type 631	S17700	---	0.09	1.00	1.00	0.040	0.030	16.0-18.0	6.5-7.8	---	Al 0.75-1.50
EN 10151:2002	X7CrNiAl17-7	---	1.4568	0.09	1.00	0.70	0.040	0.015	16.0-18.0	6.5-7.8	---	Al 0.70-1.50
EN 10270-3:2011	X7CrNiAl17-7	---	1.4568	0.09	1.00	0.70	0.040	0.015	16.0-18.0	6.5-7.8	---	Al 0.70-1.50
GB/T 4231-93	Grade 0Cr17Ni7Al	---	---	0.09	1.00	1.00	0.035	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.00
JIS G 4313:2011	Symbol SUS 631-CSP	---	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.50

9.3 Tools Steels

9.3.1 Chemical Composition of Carbon Tool Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
GB 1298-86	Grade T7	---	---	0.65-0.74	0.40	0.35	0.035	0.030	---	---	---	---
ISO 4957:1999	C70U	---	---	0.65-0.75	0.10-0.40	0.10-0.30	0.030	0.030	---	---	---	---
JIS G 4401:2009	Grade SK65	---	---	0.60-0.70	0.10-0.50	0.10-0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
GB 1298-86	Grade T8	---	---	0.75-0.84	0.40	0.35	0.035	0.030	---	---	---	---
ISO 4957:1999	C80U	---	---	0.75-0.85	0.10-0.40	0.10-0.30	0.030	0.030	---	---	---	---
JIS G 4401:2009	Grade SK75	---	---	0.70-0.80	0.10-0.50	0.10-0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
SAE J438b MAY70	Grade W108	T72301	---	0.70-0.85	---	---	---	---	---	---	---	---
ASTM A686-92 (2010)	Type W1, Grade A-8	T72301	---	0.80-0.90	0.10-0.40	0.10-0.40	0.030	0.030	0.15	0.20	0.10	V 0.10; Cu 0.20; W 0.15
GB 1298-86	Grade T8Mn	---	---	0.80-0.90	0.40-0.60	0.35	0.035	0.030	---	---	---	---
JIS G 4401:2009	Grade SK85	---	---	0.80-0.90	0.10-0.50	0.10-0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
ASTM A686-92 (2010)	Type W1, Grade A-8.5	T72301	---	0.85-0.95	0.10-0.40	0.10-0.40	0.030	0.030	0.15	0.20	0.10	V 0.10; Cu 0.20; W 0.15
GB 1298-86	Grade T9	---	---	0.85-0.94	0.40	0.35	0.035	0.030	---	---	---	---
ISO 4957:1999	C90U	---	---	0.85-0.95	0.10-0.40	0.10-0.30	0.030	0.030	---	---	---	---
SAE J438b MAY70	Grade W109	T72301	---	0.85-0.95	---	---	---	---	---	---	---	---
ASTM A686-92 (2010)	Type W1, Grade A-9	T72301	---	0.90-1.00	0.10-0.40	0.10-0.40	0.030	0.030	0.15	0.20	0.10	V 0.10; Cu 0.20; W 0.15
JIS G 4401:2009	Grade SK95	---	---	0.90-1.00	0.10-0.50	0.10-0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
ASTM A686-92 (2010)	Type W1, Grade A-10	T72301	---	1.00-1.10	0.10-0.40	0.10-0.40	0.030	0.030	0.15	0.20	0.10	V 0.10; Cu 0.20; W 0.15
GB 1298-86	Grade T10	---	---	0.95-1.04	0.40	0.35	0.035	0.030	---	---	---	---
ISO 4957:1999	C105U	---	---	1.00-1.10	0.10-0.40	0.10-0.30	0.030	0.030	---	---	---	---
JIS G 4401:2009	Grade SK105	---	---	1.00-1.10	0.10-0.50	0.10-0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
SAE J438b MAY70	Grade W110	T72301	---	0.95-1.10	---	---	---	---	---	---	---	---
ASTM A686-92 (2010)	Type W1, Grade A-11.5	T72301	---	1.15-1.25	0.10-0.40	0.10-0.40	0.030	0.030	0.15	0.20	0.10	V 0.10; Cu 0.20; W 0.15
GB 1298-86	Grade T12	---	---	1.15-1.24	0.40	0.35	0.035	0.030	---	---	---	---
ISO 4957:1999	C120U	---	---	1.15-1.25	0.10-0.40	0.10-0.30	0.030	0.030	---	---	---	---
JIS G 4401:2009	Grade SK120	---	---	1.15-1.25	0.10-0.50	0.10-0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
SAE J438b MAY70	Grade W112	T72301	---	1.10-1.30	---	---	---	---	---	---	---	---
ASTM A686-92 (2010)	Type W2, Grade A-9.5	T72302	---	0.95-1.10	0.10-0.40	0.10-0.40	0.030	0.030	0.15	0.20	0.10	V 0.15-0.35; Cu 0.20; W 0.15
ISO 4957:1999	105V	---	---	1.00-1.10	0.10-0.40	0.10-0.30	0.030	0.030	---	---	---	V 0.10-0.20
JIS G 4404:2006	Grade SKS 43	---	---	1.00-1.10	0.10-0.40	0.10-0.30	0.030	0.030	0.20	---	---	V 0.10-0.20
ASTM A686-92 (2010)	Type W2, Grade A-8.5	T72302	---	0.85-0.95	0.10-0.40	0.10-0.40	0.030	0.030	0.15	0.20	0.10	V 0.15-0.35; Cu 0.20; W 0.15
JIS G 4404:2006	Grade SKS 44	---	---	0.80-0.90	0.30	0.25	0.030	0.030	0.20	---	---	V 0.10-0.25

9.3 Tools Steels

9.3.2 Chemical Composition of High Speed Tools Steels

9.3.2.1 Chemical Composition of Tungsten Type High Speed Tools Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A600-92a (2010)	Type T1	T12001	---	0.65-0.80	0.10-0.40	0.20-0.40	0.03	0.03	3.75-4.50	---	---	V 0.90-1.30; W 17.25-18.75; (Ni+Cu) 0.75
ISO 4957:1999	HS18-0-1	---	---	0.73-0.83	0.40	0.45	0.030	0.03	3.80-4.50	---	---	V 1.00-1.20; W 17.20-18.70
JIS G 4403:2006	Grade SKH2	---	---	0.73-0.83	0.40	0.45	0.030	0.030	3.80-4.50	---	---	V 1.00-1.20; W 17.20-18.70; Cu 0.25
SAE J438b MAY70	Grade T1	T12001	---	0.65-0.75	0.20-0.40	0.20-0.40	---	---	3.75-4.50	---	---	V 0.90-1.30; W 17.25-18.75
ASTM A600-92a (2010)	Type T4	T12004	---	0.70-0.80	0.10-0.40	0.20-0.40	0.03	0.03	3.75-4.50	---	0.40-1.00	V 0.80-1.20; W 17.50-19.00; Co 4.25-5.75; (Ni+Cu) 0.75
GB/T 3080-2001	Grade W18Cr4V	---	---	0.70-0.80	0.10-0.40	0.20-0.40	0.030	0.030	3.80-4.40	---	0.30	V 1.00-1.40; W 17.50-19.00
JIS G 4403:2006	Grade SKH3	---	---	0.73-0.83	0.40	0.45	0.030	0.030	3.80-4.50	---	---	V 0.80-1.20; W 17.00-19.00; Co 4.50-5.50; Cu 0.25
SAE J438b MAY70	Grade T4	T12004	---	0.70-0.80	0.20-0.40	0.20-0.40	---	---	3.75-4.50	---	0.70-1.00	V 0.80-1.20; W 17.25-18.75; Co 4.25-5.75
ASTM A600-92a (2010)	Type T5	T12005	---	0.75-0.85	0.20-0.40	0.20-0.40	0.03	0.03	3.75-5.00	---	0.50-1.25	V 1.80-2.40; W 17.50-19.00; Co 7.00-9.50; (Ni+Cu) 0.75
JIS G 4403:2006	Grade SKH4	---	---	0.73-0.83	0.40	0.45	0.030	0.030	3.80-4.50	---	---	V 1.00-1.50; W 17.00-19.00; Co 9.00-11.00; Cu 0.25
SAE J438b MAY70	Grade T5	T12005	---	0.75-0.85	0.20-0.40	0.20-0.40	---	---	3.75-4.50	---	0.70-1.00	V 1.80-2.40; W 17.50-19.00; Co 7.00-9.00
ASTM A600-92a (2010)	Type T15	T12015	---	1.50-1.60	0.15-0.40	0.15-0.40	0.03	0.03	3.75-5.00	---	1.00	V 4.50-5.25; W 11.75-13.00; Co 4.75-5.25; (Ni+Cu) 0.75
JIS G 4403:2006	Grade SKH10	---	---	1.45-1.60	0.40	0.45	0.030	0.030	3.80-4.50	---	---	V 4.20-5.20; W 11.50-13.50; Co 4.20-5.20; Cu 0.25
ASTM A600-92a (2010)	Type M1	T11301	---	0.78-0.88	0.15-0.40	0.20-0.50	0.03	0.03	3.50-4.00	---	8.20-9.20	V 1.00-1.35; W 1.40-2.10; (Ni+Cu) 0.75
GB/T 3080-2001	Grade W6Mo5Cr4V2	---	---	0.80-0.90	0.15-0.45	0.20-0.45	0.030	0.030	3.80-4.40	---	4.50-5.50	V 1.75-2.20; W 5.50-6.75
ISO 4957:1999	HS1-8-1	---	---	0.77-0.87	0.40	0.70	0.030	0.03	3.50-4.50	---	8.00-9.00	V 1.00-1.40; W 1.40-2.00
JIS G 4403:2006	Grade SKH50	---	---	0.77-0.87	0.45	0.70	0.030	0.030	3.50-4.50	---	8.00-9.00	V 1.00-1.40; W 1.40-2.00; Cu 0.25

9.3 Tools Steels

9.3.2 Chemical Composition of High Speed Tools Steels

9.3.2.2 Chemical Composition of Molybdenum Type High Speed Tools Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A600-92a (2010)	Type M2 (regular C)	T11302	---	0.78-0.88	0.15-0.40	0.20-0.45	0.03	0.03	3.75-4.50	---	4.50-5.50	V 1.75-2.20; W 5.50-6.75; (Ni+Cu) 0.75
	Type M2 (high C)	T11302	---	0.95-1.05	0.15-0.40	0.20-0.45	0.03	0.03	3.75-4.50	---	4.50-5.50	V 1.75-2.20; W 5.50-6.75; (Ni+Cu) 0.75
ISO 4957:1999	HS6-5-2	---	---	0.80-0.88	0.40	0.45	0.030	0.03	3.80-4.50	---	4.70-5.20	V 1.70-2.10; W 5.90-6.70
JIS G 4403:2006	Grade SKH51	---	---	0.80-0.88	0.40	0.45	0.030	0.030	3.80-4.50	---	4.70-5.20	V 1.70-2.10; W 5.90-6.70; Cu 0.25
SAE J438b MAY70	Grade M2	T11302	---	0.78-0.88	0.20-0.40	0.20-0.40	---	---	3.75-4.50	---	4.50-5.50	V 1.60-2.20; W 5.50-6.75
ASTM A600-92a (2010)	Type M3, Class 1	T11313	---	1.00-1.10	0.15-0.40	0.20-0.45	0.03	0.03	3.75-4.50	---	4.75-6.50	V 2.25-2.75; W 5.00-6.75; (Ni+Cu) 0.75
ISO 4957:1999	HS6-6-2	---	---	1.00-1.10	0.40	0.45	0.030	0.03	3.80-4.50	---	5.50-6.50	V 2.30-2.60; W 5.90-6.70
JIS G 4403:2006	Grade SKH52	---	---	1.00-1.10	0.40	0.45	0.030	0.030	3.80-4.50	---	5.50-6.50	V 2.30-2.60; W 5.90-6.70; Cu 0.25
SAE J438b MAY70	Grade M3	T11313	---	1.00-1.25	0.20-0.40	0.20-0.40	---	---	3.75-4.50	---	4.75-6.25	V 2.25-3.25; W 5.50-6.75
ASTM A600-92a (2010)	Type M3, Class 2	T11323	---	1.15-1.25	0.15-0.40	0.20-0.45	0.03	0.03	3.75-4.50	---	4.75-6.50	V 2.75-3.25; W 5.00-6.75; (Ni+Cu) 0.75
ISO 4957:1999	HS6-5-3	---	---	1.15-1.25	0.40	0.45	0.030	0.03	3.80-4.50	---	4.70-5.20	V 2.70-3.20; W 5.90-6.70
JIS G 4403:2006	Grade SKH53	---	---	1.15-1.25	0.40	0.45	0.030	0.030	3.80-4.50	---	4.70-5.20	V 2.70-3.20; W 5.90-6.70; Cu 0.25
ASTM A600-92a (2010)	Type M4	T11304	---	1.25-1.40	0.15-0.40	0.20-0.45	0.03	0.03	3.75-4.75	---	4.25-5.50	V 3.75-4.50; W 5.25-6.50; (Ni+Cu) 0.75
ISO 4957:1999	HS6-5-4	---	---	1.25-1.40	0.40	0.45	0.030	0.03	3.80-4.50	---	4.20-5.00	V 3.70-4.20; W 5.20-6.00
JIS G 4403:2006	Grade SKH54	---	---	1.25-1.40	0.40	0.45	0.030	0.030	3.80-4.50	---	4.20-5.00	V 3.70-4.20; W 5.20-6.00; Cu 0.25
SAE J438b MAY70	Grade M4	T11304	---	1.25-1.40	0.20-0.40	0.20-0.40	---	---	4.00-4.75	---	4.50-5.50	V 3.90-4.50; W 5.25-6.50
ASTM A600-92a (2010)	Type M7	T11307	---	0.97-1.05	0.15-0.40	0.20-0.55	0.03	0.03	3.50-4.00	---	8.20-9.20	V 1.75-2.25; W 1.40-2.10; (Ni+Cu) 0.75
ISO 4957:1999	HS2-9-2	---	---	0.95-1.05	0.40	0.70	0.030	0.03	3.50-4.50	---	8.20-9.20	V 1.70-2.20; W 1.50-2.10
JIS G 4403:2006	Grade SKH58	---	---	0.95-1.05	0.40	0.70	0.030	0.030	3.50-4.50	---	8.20-9.20	V 1.70-2.20; W 1.50-2.10; Cu 0.25
ASTM A600-92a (2010)	Type M36	T11336	---	0.80-0.90	0.15-0.40	0.20-0.45	0.03	0.03	3.75-4.50	---	4.50-5.50	V 1.75-2.25; W 5.50-6.50; Co 7.75-8.75; (Ni+Cu) 0.75
JIS G 4403:2006	Grade SKH56	---	---	0.85-0.95	0.40	0.45	0.030	0.030	3.80-4.50	---	4.70-5.20	V 1.70-2.10; W 5.90-6.70; Co 7.00-9.00; Cu 0.25

9.3 Tools Steels

9.3.2 Chemical Composition of High Speed Tools Steels

9.3.2.2 Chemical Composition of Molybdenum Type High Speed Tools Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A600-92a (2010)	Type M42	T11342	---	1.05-1.15	0.15-0.40	0.15-0.65	0.03	0.03	3.50-4.25	---	9.00-10.00	V 0.95-1.35; W 1.15-1.85; Co 7.75-8.75; (Ni+Cu) 0.75
ISO 4957:1999	HS2-9-1-8	---	---	1.05-1.15	0.40	0.70	0.030	0.03	3.50-4.50	---	9.00-10.00	V 0.90-1.30; W 1.20-1.90; Co 7.50-8.50
JIS G 4403:2006	Grade SKH59	---	---	1.05-1.15	0.40	0.70	0.030	0.030	3.50-4.50	---	9.00-10.00	V 0.90-1.30; W 1.20-1.90; Co 7.50-8.50; Cu 0.25
ISO 4957:1999	HS6-5-2-5	---	---	0.87-0.95	0.40	0.45	0.030	0.03	3.80-4.50	---	4.70-5.20	V 1.70-2.10; W 5.90-6.70; Co 4.50-5.00
JIS G 4403:2006	Grade SKH55	---	---	0.87-0.95	0.40	0.45	0.030	0.030	3.80-4.50	---	4.70-5.20	V 1.70-2.10; W 5.90-6.70; Co 4.50-5.00; Cu 0.25
ISO 4957:1999	HS10-4-3-10	---	---	1.20-1.35	0.40	0.45	0.030	0.03	3.80-4.50	---	3.20-3.90	V 3.00-3.50; W 9.00-10.00; Co 9.50-10.50
JIS G 4403:2006	Grade SKH57	---	---	1.20-1.35	0.40	0.45	0.030	0.030	3.80-4.50	---	3.20-3.90	V 3.00-3.50; W 9.00-10.00; Co 9.50-10.50; Cu 0.25

9.3.3 Chemical Composition of Cold Work Tool Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A681-08	Type A2	T30102	---	0.95-1.05	0.40-1.00	0.10-0.50	0.030	0.030	4.75-5.50	---	0.90-1.40	V 0.15-0.50; (Ni+Cu) 0.75
GB/T 1299-2000	Grade Cr5Mo1V	---	---	0.95-1.05	1.00	0.50	0.030	0.030	4.75-5.50	---	0.90-1.40	V 0.15-0.50; Co 1.00; (Cu+Ni) 0.55
ISO 4957:1999	X100CrMoV5	---	---	0.95-1.05	0.40-0.80	0.10-0.40	0.030	0.030	4.80-5.50	---	0.90-1.20	V 0.15-0.35
JIS G 4404:2006	Grade SKD 12	---	---	0.95-1.05	0.40-0.80	0.10-0.40	0.030	0.030	4.80-5.50	---	0.90-1.20	V 0.15-0.35
SAE J438b MAY70	Grade A2	T30102	---	0.95-1.05	0.45-0.75	0.20-0.40	---	---	4.75-5.50	---	0.90-1.40	V 0.40
ASTM A681-08	Type D2	T30402	---	1.40-1.60	0.10-0.60	0.10-0.60	0.030	0.030	11.00-13.00	---	0.70-1.20	V 0.50-1.10; (Ni+Cu) 0.75
GB/T 1299-2000	Grade Cr12Mo1V1	---	---	1.40-1.60	0.60	0.60	0.030	0.030	11.00-13.00	---	0.70-1.20	V 0.5-1.10; Co 1.00; (Cu+Ni) 0.55
JIS G 4404:2006	Grade SKD 11	---	---	1.40-1.60	0.60	0.40	0.030	0.030	11.00-13.00	---	0.80-1.20	V 0.20-0.50
SAE J438b MAY70	Grade D2	T30402	---	1.40-1.60	0.30-0.50	0.30-0.50	---	---	11.00-13.00	---	0.70-1.20	V 0.80; Co 0.60
ASTM A681-08	Type D3	T30403	---	2.00-2.35	0.10-0.60	0.10-0.60	0.030	0.030	11.00-13.50	---	---	V 1.00; W 1.00; (Ni+Cu) 0.75
GB/T 1299-2000	Grade Cr12	---	---	2.00-2.30	0.40	0.40	0.030	0.030	11.50-13.00	---	---	Co 1.00; (Cu+Ni) 0.55
ISO 4957:1999	X210Cr12	---	---	1.90-2.20	0.20-0.60	0.10-0.60	0.030	0.030	11.0-13.0	---	---	---
JIS G 4404:2006	Grade SKD 1	---	---	1.90-2.20	0.20-0.60	0.10-0.60	0.030	0.030	11.00-13.00	---	---	V 0.30
SAE J438b MAY70	Grade D3	T30403	---	2.00-2.35	0.24-0.45	0.25-0.45	---	---	11.00-13.00	---	0.80	V 0.80; W 0.75
ASTM A686-92 (2010)	Type W1, Grade A-10.5	T72301	---	1.05-1.15	0.10-0.40	0.10-0.40	0.030	0.030	0.15	0.20	0.10	V 0.10; Cu 0.20; W 0.15
GB 1298-86	Grade T11	---	---	1.05-1.14	0.40	0.35	0.035	0.030	0.25	0.20	---	Cu 0.30

9.3 Tools Steels

9.3.3 Chemical Composition of Cold Work Tool Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A681-08	Type A6	T30106	---	0.65-0.75	1.80-2.50	0.10-0.70	0.030	0.030	0.90-1.40	---	0.90-1.40	(Ni+Cu) 0.75
ISO 4957:1999	70MnMoCr8	---	---	0.65-0.75	1.80-2.50	0.10-0.50	0.030	0.030	0.90-1.20	---	0.90-1.40	---
ASTM A681-08	Type O1	T31501	---	0.85-1.00	1.00-1.40	0.10-0.50	0.030	0.030	0.40-0.70	---	---	V 0.30; W 0.40-0.60; (Ni+Cu) 0.75
GB/T 1299-2000	Grade 9CrWMn	---	---	0.85-0.95	0.90-1.20	0.40	0.030	0.030	0.50-0.80	---	---	W 0.50-0.80; Nb 0.20-0.35; (Cu+Ni) 0.55
ISO 4957:1999	95MnWCr5	---	---	0.90-1.00	1.05-1.35	0.10-0.40	0.030	0.030	0.40-0.65	---	---	V 0.05-0.20; W 0.40-0.70
JIS G 4404:2006	Grade SKS 3	---	---	0.90-1.00	0.90-1.20	0.35	0.030	0.030	0.50-1.00	---	---	W 0.50-1.00
ASTM A681-08	Type O2	T31502	---	0.85-0.95	1.40-1.80	0.50	0.030	0.030	0.50	---	0.30	V 0.30; (Ni+Cu) 0.75
SAE J438b MAY70	Grade O2	T31502	---	0.85-0.95	1.40-1.80	0.20-0.40	---	---	0.35	---	0.30	V 0.20
GB/T 1299-2000	Grade CrWMn	---	---	0.90-1.05	0.80-1.10	0.40	0.030	0.030	0.90-1.20	---	---	W 1.20-1.60; Nb 0.20-0.35; (Cu+Ni) 0.55
JIS G 4404:2006	Grade SKS 31	---	---	0.95-1.05	0.90-1.20	0.35	0.030	0.030	0.80-1.20	---	---	W 1.00-1.50

9.3.4 Chemical Composition of Hot Work Tool Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A681-08	Type H10	T20810	---	0.35-0.45	0.20-0.70	0.80-1.25	0.030	0.030	3.00-3.75	---	2.00-3.00	V 0.25-0.75; (Ni+Cu) 0.75
ISO 4957:1999	32CrMoV12-28	---	---	0.28-0.35	0.15-0.45	0.10-0.40	0.030	0.020	2.70-3.20	---	2.50-3.00	V 0.40-0.70
JIS G 4404:2006	Grade SKD 7	---	---	0.28-0.35	0.15-0.45	0.10-0.40	0.030	0.020	2.70-3.20	---	2.50-3.00	V 0.40-0.70
ASTM A681-08	Type H11	T20811	---	0.33-0.43	0.20-0.60	0.80-1.25	0.030	0.030	4.75-5.50	---	1.10-1.60	V 0.30-0.60; (Ni+Cu) 0.75
ISO 4957:1999	X37CrMoV5-1	---	---	0.33-0.41	0.25-0.50	0.80-1.20	0.030	0.020	4.80-5.50	---	1.10-1.50	V 0.30-0.50
JIS G 4404:2006	Grade SKD 6	---	---	0.32-0.42	0.50	0.80-1.20	0.030	0.020	4.50-5.50	---	1.00-1.50	V 0.30-0.50
SAE J438b MAY70	Grade H11	T20811	---	0.30-0.40	0.20-0.40	0.80-1.20	---	---	4.75-5.50	---	1.25-1.75	V 0.30-0.50
ASTM A681-08	Type H12	T20812	---	0.30-0.40	0.20-0.60	0.80-1.25	0.030	0.030	4.75-5.50	---	1.25-1.75	V 0.20-0.50; W 1.00-1.70; (Ni+Cu) 0.75
ISO 4957:1999	X35CrWMoV5	---	---	0.32-0.40	0.20-0.50	0.80-1.20	0.030	0.020	4.75-5.50	---	1.25-1.60	V 0.20-0.50; W 1.10-1.60
JIS G 4404:2006	Grade SKD 62	---	---	0.32-0.40	0.20-0.50	0.80-1.20	0.030	0.020	4.75-5.50	---	1.00-1.60	V 0.20-0.50; W 1.00-1.60
SAE J438b MAY70	Grade H12	T20812	---	0.30-0.40	0.20-0.40	0.80-1.20	---	---	4.75-5.50	---	1.25-1.75	V 0.10-0.50; W 1.00-1.70
ASTM A681-08	Type H13	T20813	---	0.32-0.45	0.20-0.60	0.80-1.25	0.030	0.030	4.75-5.50	---	1.10-1.75	V 0.80-1.20; (Ni+Cu) 0.75
ISO 4957:1999	X40CrMoV5-1	---	---	0.35-0.42	0.25-0.50	0.80-1.20	0.030	0.020	4.80-5.50	---	1.20-1.50	V 0.85-1.15
JIS G 4404:2006	Grade SKD 61	---	---	0.35-0.42	0.25-0.50	0.80-1.20	0.030	0.020	4.80-5.50	---	1.00-1.50	V 0.80-1.15
SAE J438b MAY70	Grade H13	T20813	---	0.30-0.40	0.20-0.40	0.80-1.20	---	---	4.75-5.50	---	1.25-1.75	V 0.80-1.20

9.3 Tools Steels

9.3.4 Chemical Composition of Hot Work Tool Steels (Continued)

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A681-08	Type H19	T20819	---	0.32-0.45	0.20-0.50	0.15-0.50	0.030	0.030	4.00-4.75	---	0.30-0.55	V 1.75-2.20; W 3.75-4.50; Co 4.00-4.50; (Ni+Cu) 0.75
ISO 4957:1999	38CrCoWV18-17-17	---	---	0.35-0.45	0.20-0.50	0.15-0.50	0.030	0.020	4.00-4.70	---	0.30-0.50	V 1.70-2.10; W 3.80-4.50; Co 4.00-4.50
JIS G 4404:2006	Grade SKD 8	---	---	0.35-0.45	0.20-0.50	0.15-0.50	0.030	0.020	4.00-4.70	---	0.30-0.50	V 1.70-2.10; W 3.80-4.50; Co 4.00-4.50
ASTM A681-08	Type H21	T20821	---	0.26-0.36	0.15-0.40	0.15-0.50	0.030	0.030	3.00-3.75	---	---	V 0.30-0.60; W 8.50-10.00; (Ni+Cu) 0.75
ISO 4957:1999	X30WCrV9-3	---	---	0.25-0.35	0.15-0.45	0.10-0.40	0.030	0.020	2.50-3.20	---	---	V 0.30-0.50; W 8.50-9.50
JIS G 4404:2006	Grade SKD 5	---	---	0.25-0.35	0.15-0.45	0.10-0.40	0.030	0.020	2.50-3.20	---	---	V 0.30-0.50; W 8.50-9.50
SAE J438b MAY70	Grade H21	T20821	---	0.30-0.40	0.20-0.40	0.15-0.30	---	---	3.00-3.75	---	---	V 0.30-0.50; W 8.75-10.00
ISO 4957:1999	55NiCrMoV7	---	---	0.50-0.60	0.60-0.90	0.10-0.40	0.030	0.030	0.80-1.20	1.50-1.80	0.35-0.55	V 0.05-0.15
JIS G 4404:2006	Grade SKT 4	---	---	0.50-0.60	0.60-0.90	0.10-0.40	0.030	0.020	0.80-1.20	1.50-1.80	0.35-0.55	V 0.05-0.15

9.3.5 Chemical Composition of Special Purpose Tool Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A681-08	Type L6	T61206	---	0.65-0.75	0.25-0.80	0.10-0.50	0.030	0.030	0.60-1.20	1.25-2.00	0.50	---
JIS G 4404:2006	Grade SKS 51	---	---	0.75-0.85	0.50	0.35	0.030	0.030	0.20-0.50	1.30-2.00	---	---
SAE J438b MAY70	Grade L6	T61206	---	0.65-0.75	0.55-0.85	0.20-0.40	---	---	0.65-0.85	1.25-1.75	0.25	V 0.25
ASTM A681-08	Type F2	T60602	---	1.20-1.40	0.10-0.50	0.10-0.50	0.030	0.030	0.20-0.40	---	---	W 3.00-4.50
JIS G 4404:2006	Grade SKS 11	---	---	1.20-1.30	0.50	0.35	0.030	0.030	0.20-0.50	---	---	V 0.10-0.30; W 3.00-4.00
ASTM A681-08	Type L3	T61203	---	0.95-1.10	0.25-0.80	0.10-0.50	0.030	0.030	1.30-1.70	---	---	V 0.10-0.30; (Ni+Cu) 0.75
GB/T 1299-2000	Grade Cr2	---	---	0.95-1.10	0.40	0.40	0.030	0.030	1.30-1.65	---	---	Co 1.00; (Cu+Ni) 0.55
ISO 4957:1999	102Cr6	---	---	0.95-1.10	0.25-0.45	0.15-0.35	0.030	0.030	1.35-1.65	---	---	---
SAE J438b MAY70	Grade L7	---	---	0.95-1.05	0.25-0.45	0.20-0.40	---	---	1.25-1.75	---	0.30-0.50	---
ASTM A681-08	Type S1	T41901	---	0.40-0.55	0.10-0.40	0.15-1.20	0.030	0.030	1.00-1.80	---	0.50	V 0.15-0.30; W 1.50-3.00; (Ni+Cu) 0.75
GB/T 1299-2000	Grade 5CrW2Si	---	---	0.45-0.55	0.40	0.50-0.80	0.030	0.030	1.00-1.30	---	---	W 2.00-2.50; Co 1.00; (Cu+Ni) 0.55
ASTM A681-08	Type S5	T41905	---	0.50-0.65	0.60-1.00	1.75-2.25	0.030	0.030	0.10-0.50	---	0.20-1.35	V 0.15-0.35; (Ni+Cu) 0.75
GB/T 1299-2000	Grade 6CrMnSi2Mo1	---	---	0.50-0.65	0.60-1.00	1.75-2.25	0.030	0.030	0.10-0.50	---	0.20-1.35	V 0.15-0.35; Co 1.00; (Cu+Ni) 0.55
SAE J438b MAY70	Grade S5	T41905	---	0.50-0.60	0.60-0.90	1.80-2.20	---	---	0.30	---	0.30-0.50	V 0.25
ASTM A681-08	Type S7	T41907	---	0.45-0.55	0.20-0.90	0.20-1.00	0.030	0.030	3.00-3.50	---	1.30-1.80	V 0.35; (Ni+Cu) 0.75
GB/T 1299-2000	Grade 5Cr3Mn1SiMo1V	---	---	0.45-0.55	0.20-0.90	0.20-1.00	0.030	0.030	3.00-3.50	---	1.30-1.80	V 0.35; Co 1.00; (Cu+Ni) 0.55
ISO 4957:1999	50CrMoV13-15	---	---	0.45-0.55	0.50-0.90	0.20-0.80	0.030	0.020	3.00-3.50	---	1.30-1.70	V 0.15-0.35

9.4 Bearing Steels

9.4.1 Chemical Composition of Bearing Steels

Specification	Designation	UNS No.	Steel No.	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A295/A295M-14	Grade 52100	G52986	---	0.93-1.05	0.25-0.45	0.15-0.35	0.025	0.015	1.35-1.60	0.25	0.10	Al 0.050; Cu 0.30; O 0.0015
GB/T 18254-2002	Grade GCr15	---	---	0.95-1.05	0.25-0.45	0.15-0.35	0.025	0.025	1.40-1.65	0.30	0.10	Cu 0.25; (Ni+Cu) 0.50
ISO 683-17:1999	100Cr6	---	---	0.93-1.05	0.25-0.45	0.15-0.35	0.025	0.015	1.35-1.60	---	0.10	Al 0.050
JIS G 4805:2008	Grade SUJ2	---	---	0.95-1.10	0.50	0.15-0.35	0.025	0.025	1.30-1.60	0.25	0.08	Cu 0.25
ASTM A485-14	Grade 1	K19667	---	0.90-1.05	0.90-1.20	0.45-0.75	0.025	0.015	0.90-1.20	0.25	0.10	Al 0.050; Cu 0.30; Ti 0.0050; O 0.0015
	Grade B2, 100CrMnSi4-4	---	---	0.93-1.05	0.90-1.20	0.45-0.75	0.025	0.015	0.90-1.20	---	0.10	Al 0.050; Cu 0.30; O 0.0015
ISO 683-17:1999	100CrMnSi4-4	---	---	0.93-1.05	0.90-1.20	0.45-0.75	0.025	0.015	0.90-1.20	---	0.10	---
JIS G 4805:2008	Grade SUJ3	---	---	0.95-1.10	0.90-1.15	0.40-0.70	0.025	0.025	0.90-1.20	0.25	0.08	Cu 0.25
ASTM A485-14	Grade B3, 100CrMnSi6-4	---	---	0.93-1.05	1.00-1.20	0.45-0.75	0.025	0.015	1.40-1.65	---	0.10	Al 0.050; Cu 0.30; O 0.0015
GB/T 18254-2002	Grade GCr15SiMn	---	---	0.95-1.05	0.95-1.25	0.45-0.75	0.025	0.025	1.40-1.65	0.30	0.10	Cu 0.25; (Ni+Cu) 0.50
ISO 683-17:1999	100CrMnSi6-4	---	---	0.93-1.05	1.00-1.20	0.45-0.75	0.025	0.015	1.40-1.65	---	0.10	---
ASTM A485-14	Grade B4, 100CrMnSi6-6	---	---	0.93-1.05	1.40-1.70	0.45-0.75	0.025	0.015	1.40-1.65	---	0.10	Al 0.050; Cu 0.30; O 0.0015
ISO 683-17:1999	100CrMnSi6-6	---	---	0.93-1.05	1.40-1.70	0.45-0.75	0.025	0.015	1.40-1.65	---	0.10	Cu 0.30
ASTM A485-14	Grade B5, 100CrMo7	---	---	0.93-1.05	0.25-0.45	0.15-0.35	0.025	0.015	1.65-1.95	---	0.15-0.30	Al 0.050; Cu 0.30; O 0.0015
GB/T 18254-2002	Grade GCr18Mo	---	---	0.95-1.05	0.25-0.40	0.20-0.40	0.025	0.020	1.65-1.95	0.25	0.15-0.25	Cu 0.25
ISO 683-17:1999	100CrMo7	---	---	0.93-1.05	0.25-0.45	0.15-0.35	0.025	0.015	1.65-1.95	---	0.15-0.30	---
ASTM A485-14	Grade B6, 100CrMo7-3	---	---	0.93-1.05	0.60-0.80	0.15-0.35	0.025	0.015	1.65-1.95	---	0.20-0.35	Al 0.050; Cu 0.30; O 0.0015
ISO 683-17:1999	100CrMo7-3	---	---	0.93-1.05	0.60-0.80	0.15-0.35	0.025	0.015	1.65-1.95	---	0.20-0.35	---
ASTM A485-14	Grade B7, 100CrMo7-4	---	---	0.93-1.05	0.60-0.80	0.15-0.35	0.025	0.015	1.65-1.95	---	0.40-0.50	Al 0.050; Cu 0.30; O 0.0015
ISO 683-17:1999	100CrMo7-4	---	---	0.93-1.05	0.60-0.80	0.15-0.35	0.025	0.015	1.65-1.95	---	0.40-0.50	O 0.0015
ASTM A485-14	Grade B8, 100CrMnMoSi8-4-6	---	---	0.93-1.05	0.80-1.10	0.40-0.60	0.025	0.015	1.80-2.05	---	0.50-0.60	Al 0.050; Cu 0.30; O 0.0015
ISO 683-17:1999	100CrMnMoSi8-4-6	---	---	0.93-1.05	0.80-1.10	0.40-0.60	0.025	0.015	1.80-2.05	---	0.50-0.60	---

Appendix

1

ASTM FERROUS METAL STANDARDS

Standard	Title
ASTM A1-00 (2010)	Standard Specification for Carbon Steel Tee Rails
ASTM A2-02 (2014)	Standard Specification for Carbon Steel Girder Rails of Plain, Grooved, and Guard Types
ASTM A3-01 (2012)	Standard Specification for Steel Joint Bars, Low, Medium, and High Carbon (Non-Heat-Treated)
ASTM A6/A6M-14	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A20/A20M-14	Standard Specification for General Requirements for Steel Plates for Pressure Vessels
ASTM A27/A27M-13	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A29/A29M-12	Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
ASTM A31-14	Standard Specification for Steel Rivets and Bars for Rivets, Pressure Vessels
ASTM A34/A34M-06 (2012)	Standard Practice for Sampling and Procurement Testing of Magnetic Materials
ASTM A36/A36M-14	Standard Specification for Carbon Structural Steel
ASTM A47/A47M-99 (2014)	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48/A48M-03 (2012)	Standard Specification for Gray Iron Castings
ASTM A49-12	Standard Specification for Heat-Treated Carbon Steel Joint Bars, Microalloyed Joint Bars, and Forged Carbon Steel Compromise Joint Bars
ASTM A53/A53M-12	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A65-07 (2013)	Standard Specification for Steel Track Spikes
ASTM A66-07 (2013)	Standard Specification for Steel Screw Spikes
ASTM A67-00 (2010)	Standard Specification for Steel Tie Plates, Low-Carbon and High-Carbon-Hot-Worked
ASTM A74-13a	Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A90/A90M-13	Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM A99-03 (2014)	Standard Specification for Ferromanganese
ASTM A100-07 (2012)	Standard Specification for Ferrosilicon
ASTM A101-04 (2014)	Standard Specification for Ferrochromium
ASTM A102-04 (2014)	Standard Specification for Ferrovandium
ASTM A105/A105M-14	Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A106/A106M-14	Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A108-13	Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A109/A109M-14	Standard Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled
ASTM A111-99a (2014)	Standard Specification for Zinc-Coated (Galvanized) "Iron" Telephone and Telegraph Line Wire
ASTM A116-11	Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A121-13	Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
ASTM A123/A123M-13	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A125-96 (2013)	Standard Specification for Steel Springs, Helical, Heat-Treated
ASTM A126-04 (2014)	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A128/A128M-93 (2012)	Standard Specification for Steel Castings, Austenitic Manganese
ASTM A131/A131M-14	Standard Specification for Structural Steel for Ships
ASTM A132-04 (2014)	Standard Specification for Ferromolybdenum
ASTM A134-96 (2012)	Standard Specification for Pipe, Steel, Electric-Fusion (Arc)-Welded (Sizes NPS 16 and Over)
ASTM A135/A135M-09 (2014)	Standard Specification for Electric-Resistance-Welded Steel Pipe
ASTM A139/A139M-04 (2010)	Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
ASTM A143/A143M-07 (2014)	Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A144-04 (2014)	Specification for Ferrotungsten
ASTM A146-04 (2014)	Standard Specification for Molybdenum Oxide Products
ASTM A148/A148M-14	Standard Specification for Steel Castings, High Strength, for Structural Purposes
ASTM A153/A153M-09	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A159-83 (2011)	Standard Specification for Automotive Gray Iron Castings
ASTM A178/A178M-02 (2012)	Standard Specification for Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes
ASTM A179/A179M-90a (2012)	Standard Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes
ASTM A181/A181M-14	Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
ASTM A182/A182M-15	Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A183-14	Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A184/A184M-06 (2011)	Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A192/A192M-02 (2012)	Standard Specification for Seamless Carbon Steel Boiler Tubes for High-Pressure Service
ASTM A193/A193M-15	Standard Specification for Alloy-Steel and Stainless Steel Bolting for High-Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194/A194M-15	Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A197/A197M-00 (2011)	Standard Specification for Cupola Malleable Iron
ASTM A203/A203M-12	Standard Specification for Pressure Vessel Plates, Alloy Steel, Nickel

Standard	Title
ASTM A204/A204M-12	Standard Specification for Pressure Vessel Plates, Alloy Steel, Molybdenum
ASTM A209/A209M-03 (2012)	Standard Specification for Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes
ASTM A210/A210M-02 (2012)	Standard Specification for Seamless Medium-Carbon Steel Boiler and Superheater Tubes
ASTM A213/A213M-15a	Standard Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
ASTM A214/A214M-96 (2012)	Standard Specification for Electric-Resistance-Welded Carbon Steel Heat-Exchanger and Condenser Tubes
ASTM A216/A216M-14	Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High- Temperature Service
ASTM A217/A217M-14	Standard Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure- Containing Parts, Suitable for High-Temperature Service
ASTM A220/A220M-99 (2014)	Standard Specification for Pearlitic Malleable Iron
ASTM A225/A225M-12	Standard Specification for Pressure Vessel Plates, Alloy Steel, Manganese-Vanadium-Nickel
ASTM A227/A227M-06 (2011)	Standard Specification for Steel Wire, Cold-Drawn for Mechanical Springs
ASTM A228/A228M-14	Standard Specification for Steel Wire, Music Spring Quality
ASTM A229/A229M-12	Standard Specification for Steel Wire, Quenched and Tempered for Mechanical Springs
ASTM A230/A230M-05 (2011)	Standard Specification for Steel Wire, Oil-Tempered Carbon Valve Spring Quality
ASTM A231/A231M-10	Standard Specification for Chromium-Vanadium Alloy Steel Spring Wire
ASTM A232/A232M-05 (2011)	Standard Specification for Chromium-Vanadium Alloy Steel Valve Spring Quality Wire
ASTM A234/A234M-14	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A239-14	Standard Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles
ASTM A240/A240M-15a	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A242/A242M-13	Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A247-10	Standard Test Method for Evaluating the Microstructure of Graphite in Iron Castings
ASTM A249/A249M-14a	Standard Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes
ASTM A250/A250M-05 (2014)	Standard Specification for Electric-Resistance-Welded Ferritic Alloy-Steel Boiler and Superheater Tubes
ASTM A252-10	Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM A254/A254M-12	Standard Specification for Copper-Brazed Steel Tubing
ASTM A255-10 (2014)	Standard Test Methods for Determining Hardenability of Steel
ASTM A262-14	Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
ASTM A263-12	Standard Specification for Stainless Chromium Steel-Clad Plate
ASTM A264-12	Standard Specification for Stainless Chromium-Nickel Steel-Clad Plate
ASTM A265-12	Standard Specification for Nickel and Nickel-Base Alloy-Clad Steel Plate
ASTM A266/A266M-13	Standard Specification for Carbon Steel Forgings for Pressure Vessel Components
ASTM A268/A268M-10	Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
ASTM A269/A269M-14	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A270/A270M-15	Standard Specification for Seamless and Welded Austenitic and Ferritic/Austenitic Stainless Steel Sanitary Tubing
ASTM A275/A275M-15	Standard Practice for Magnetic Particle Examination of Steel Forgings
ASTM A276/A276M-15	Standard Specification for Stainless Steel Bars and Shapes
ASTM A278/A278M-01 (2011)	Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650°F (350°C)
ASTM A283/A283M-13	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A285/A285M-12	Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength
ASTM A288-91 (2013)	Standard Specification for Carbon and Alloy Steel Forgings for Magnetic Retaining Rings for Turbine Generators
ASTM A289/A289M-97 (2013)	Standard Specification for Alloy Steel Forgings for Nonmagnetic Retaining Rings for Generators
ASTM A290/A290M-05 (2015)	Standard Specification for Carbon and Alloy Steel Forgings for Rings for Reduction Gears
ASTM A291/A291M-05 (2015)	Standard Specification for Steel Forgings, Carbon and Alloy, for Pinions, Gears and Shafts for Reduction Gears
ASTM A295/A295M-14	Standard Specification for High-Carbon Anti-Friction Bearing Steel
ASTM A297/A297M-14	Standard Specification for Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for General Application
ASTM A299/A299M-09 (2014)	Standard Specification for Pressure Vessel Plates, Carbon Steel, Manganese-Silicon
ASTM A302/A302M-12	Standard Specification for Pressure Vessel Plates, Alloy Steel, Manganese-Molybdenum and Manganese-Molybdenum-Nickel
ASTM A304-11	Standard Specification for Carbon and Alloy Steel Bars Subject to End-Quench Hardenability Requirements

Standard	Title
ASTM A307-14	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A308/A308M-10	Standard Specification for Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot-Dip Process
ASTM A309-01 (2012)	Standard Test Method for Weight and Composition of Coating on Terne Sheet by the Triple-Spot Test
ASTM A311/A311M-04 (2015)	Standard Specification for Cold-Drawn, Stress-Relieved Carbon Steel Bars Subject to Mechanical Property Requirements
ASTM A312/A312M-15	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A313/A313M-13	Standard Specification for Stainless Steel Spring Wire
ASTM A314-13a	Standard Specification for Stainless Steel Billets and Bars for Forging
ASTM A319-71 (2011)	Standard Specification for Gray Iron Castings for Elevated Temperatures for Non-Pressure Containing Parts
ASTM A320/A320M-15	Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
ASTM A322-13	Standard Specification for Steel Bars, Alloy, Standard Grades
ASTM A323-05 (2010)	Standard Specification for Ferroboron
ASTM A324-08 (2013)	Standard Specification for Ferrotitanium
ASTM A325-14	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A325M-14	Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric)
ASTM A327/A327M-11	Standard Test Methods for Impact Testing of Cast Irons
ASTM A328/A328M-13a	Standard Specification for Steel Sheet Piling
ASTM A333/A333M-13	Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service and Other Applications with Required Notch Toughness
ASTM A334/A334M-04a (2010)	Standard Specification for Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service
ASTM A335/A335M-15	Standard Specification for Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
ASTM A336/A336M-10a	Standard Specification for Alloy Steel Forgings for Pressure and High-Temperature Parts
ASTM A338-84 (2014)	Standard Specification for Malleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service at Temperatures Up to 650°F (345°C)
ASTM A340-14	Standard Terminology of Symbols and Definitions Relating to Magnetic Testing
ASTM A341/A341M-00 (2011)	Standard Test Method for Direct Current Magnetic Properties of Materials Using D-C Permeameters and the Ballistic Test Methods
ASTM A342/A342M-14	Standard Test Methods for Permeability of Weakly Magnetic Materials
ASTM A343/ A 343M-14	Standard Test Method for Alternating-Current Magnetic Properties of Materials at Power Frequencies Using Wattmeter-Ammeter-Voltmeter Method and 25-cm Epstein Test Frame
ASTM A345-14	Standard Specification for Flat-Rolled Electrical Steels for Magnetic Applications
ASTM A348/A348M-05 (2011)	Standard Test Method for Alternating Current Magnetic Properties of Materials Using the Wattmeter-Ammeter-Voltmeter Method, 100 to 10 000 Hz and 25-cm Epstein Frame
ASTM A350/A350M-15	Standard Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components
ASTM A351/A351M-14	Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
ASTM A352/A352M-06 (2012)	Standard Specification for Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service
ASTM A353/A353M-09 (2014)	Standard Specification for Pressure Vessel Plates, Alloy Steel, Double-Normalized and Tempered 9% Nickel
ASTM A354-11	Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
ASTM A355-89 (2012)	Standard Specification for Steel Bars, Alloys, for Nitriding
ASTM A356/A356M-11	Standard Specification for Steel Castings, Carbon, Low Alloy, and Stainless Steel, Heavy-Walled for Steam Turbines
ASTM A358/A358M-14a	Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications
ASTM A363-03 (2014)	Standard Specification for Zinc-Coated (Galvanized) Steel Overhead Ground Wire Strand
ASTM A367-11	Standard Test Methods of Chill Testing of Cast Iron
ASTM A368-95a (2013)	Standard Specification for Stainless Steel Wire Strand
ASTM A369/A369M-11	Standard Specification for Carbon and Ferritic Alloy Steel Forged and Bored Pipe for High-Temperature Service
ASTM A370-14	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A372/A372M-15	Standard Specification for Carbon and Alloy Steel Forgings for Thin-Walled Pressure Vessels
ASTM A376/A376M-14	Standard Specification for Seamless Austenitic Steel Pipe for High-Temperature Service
ASTM A377-03 (2014)	Standard Index of Specifications for Ductile-Iron Pressure Pipe
ASTM A380/A380M-13	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A381-96 (2012)	Standard Specification for Metal-Arc-Welded Steel Pipe for Use With High-Pressure Transmission Systems
ASTM A384/ A 384M-07 (2013)	Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies

Standard	Title
ASTM A385/A385M-11	Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A387/A387M-11	Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
ASTM A388/A388M-15	Standard Practice for Ultrasonic Examination of Steel Forgings
ASTM A389/A389M-13	Standard Specification for Steel Castings, Alloy, Specially Heat-Treated, for Pressure-Containing Parts, Suitable for High-Temperature Service
ASTM A390-06 (2011)	Standard Specification for Zinc-Coated (Galvanized) Steel Poultry Fence Fabric (Hexagonal and Straight Line)
ASTM A391/A391M-07 (2012)	Standard Specification for Grade 80 Alloy Steel Chain
ASTM A392-11a	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A394-08 (2015)	Standard Specification for Steel Transmission Tower Bolts, Zinc-Coated and Bare
ASTM A395/A395M-99 (2014)	Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
ASTM A400-69 (2012)	Standard Practice for Steel Bars, Selection Guide, Composition, and Mechanical Properties
ASTM A401/A401M-10	Standard Specification for Steel Wire, Chromium-Silicon Alloy
ASTM A403/A403M-15	Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
ASTM A407-07 (2013)	Standard Specification for Steel Wire, Cold-Drawn, for Coiled-Type Springs
ASTM A409/A409M-15	Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service
ASTM A411-08 (2013)	Standard Specification for Zinc-Coated (Galvanized) Low-Carbon Steel Armor Wire
ASTM A413/A413M-07 (2012)	Standard Specification for Carbon Steel Chain
ASTM A414/A414M-14	Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy for Pressure Vessels
ASTM A416/A416M-12a	Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM A418/A418M-15	Standard Practice for Ultrasonic Examination of Turbine and Generator Steel Rotor Forgings
ASTM A420/A420M-14	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service
ASTM A421/A421M-10	Standard Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete
ASTM A423/A423M-09 (2014)	Standard Specification for Seamless and Electric-Welded Low-Alloy Steel Tubes
ASTM A424/A424M-09a	Standard Specification for Steel, Sheet, for Porcelain Enameling
ASTM A426/A426M-13	Standard Specification for Centrifugally Cast Ferritic Alloy Steel Pipe for High-Temperature Service
ASTM A427/A427M-10 (2015)	Standard Specification for Wrought Alloy Steel Rolls for Cold and Hot Reduction
ASTM A428/A428M-10 (2014)	Standard Test Method for Weight [Mass] of Coating on Aluminum-Coated Iron or Steel Articles
ASTM A434-06 (2012)	Standard Specification for Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered
ASTM A435/A435M-90 (2012)	Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates
ASTM A436-84 (2011)	Standard Specification for Austenitic Gray Iron Castings
ASTM A437/A437M-12	Standard Specification for Stainless and Alloy-Steel Turbine-Type Bolting Specially Heat Treated for High-Temperature Service
ASTM A439-83 (2009)	Standard Specification for Austenitic Ductile Iron Castings
ASTM A447/A447M-11	Standard Specification for Steel Castings, Chromium-Nickel-Iron Alloy (25-12 Class), for High-Temperature Service
ASTM A449-14	Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A450/A450M-15	Standard Specification for General Requirements for Carbon and Low Alloy Steel Tubes
ASTM A451/A451M-14	Standard Specification for Centrifugally Cast Austenitic Steel Pipe for High-Temperature Service
ASTM A453/A453M-12	Standard Specification for High-Temperature Bolting, with Expansion Coefficients Comparable to Austenitic Stainless Steels
ASTM A455/A455M-12a	Standard Specification for Pressure Vessel Plates, Carbon Steel, High-Strength Manganese
ASTM A456/A456M-08 (2013)	Standard Specification for Magnetic Particle Examination of Large Crankshaft Forgings
ASTM A459-08 (2013)	Standard Specification for Zinc-Coated Flat Steel Armoring Tape
ASTM A460-11	Standard Specification for Copper-Clad Steel Wire Strand
ASTM A463/A463M-10 (2015)	Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A466/A466M-07 (2012)	Standard Specification for Weldless Chain
ASTM A467/A467M-07 (2012)	Standard Specification for Machine and Coil Chain
ASTM A469/A469M-07 (2012)	Standard Specification for Vacuum-Treated Steel Forgings for Generator Rotors
ASTM A470/A470M-05 (2015)	Standard Specification for Vacuum-Treated Carbon and Alloy Steel Forgings for Turbine Rotors and Shafts
ASTM A471/A471M-09 (2014)	Standard Specification for Vacuum-Treated Alloy Steel Forgings for Turbine Rotor Disks and Wheels
ASTM A472/A472M-07 (2012)	Standard Specification for Heat Stability of Steam Turbine Shafts and Rotor Forgings
ASTM A473-15	Standard Specification for Stainless Steel Forgings
ASTM A474-03 (2013)	Standard Specification for Aluminum-Coated Steel Wire Strand
ASTM A475-03 (2014)	Standard Specification for Zinc-Coated Steel Wire Strand
ASTM A476/A476M-00 (2014)	Standard Specification for Ductile Iron Castings for Paper Mill Dryer Rolls
ASTM A478-97 (2013)	Standard Specification for Chromium-Nickel Stainless Steel Weaving and Knitting Wire
ASTM A479/A479M-14	Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

Standard	Title
ASTM A480/A480M-14b	Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A481-05 (2010)	Standard Specification for Chromium Metal
ASTM A482/A482M-11	Standard Specification for Ferchromium-Silicon
ASTM A483/A483M-10	Standard Specification for Silicomanganese
ASTM A484/A484M-15	Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings
ASTM A485-14	Standard Specification for High Hardenability Antifriction Bearing Steel
ASTM A487/A487M-14	Standard Specification for Steel Castings Suitable for Pressure Service
ASTM A488/A488M-12	Standard Practice for Steel Castings, Welding, Qualifications of Procedures and Personnel
ASTM A489-12	Standard Specification for Carbon Steel Lifting Eyes
ASTM A490-14a	Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A490M-14a	Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A491-11	Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A492-95 (2013)	Standard Specification for Stainless Steel Rope Wire
ASTM A493-09 (2013)	Standard Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging
ASTM A494/A494M-15	Standard Specification for Castings, Nickel and Nickel Alloy
ASTM A495-06 (2010)	Standard Specification for Calcium-Silicon Alloys
ASTM A498/A498M-14	Standard Specification for Seamless and Welded Carbon Steel Heat-Exchanger Tubes with Integral Fins
ASTM A499-15	Standard Specification for Steel Bars and Shapes, Carbon Rolled from "T" Rails
ASTM A500/A500M-13	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A501/A501M-14	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A502-03 (2015)	Standard Specification for Rivets, Steel, Structural
ASTM A503/A503M-15	Standard Specification for Ultrasonic Examination of Forged Crankshafts
ASTM A504/A504-14	Standard Specification for Wrought Carbon Steel Wheels
ASTM A505-12	Standard Specification for Steel, Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A506-12	Standard Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled
ASTM A507-12	Standard Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled
ASTM A508/A508M-14	Standard Specification for Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels
ASTM A510/A510M-13	Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel
ASTM A511/A511M-15a	Standard Specification for Seamless Stainless Steel Mechanical Tubing
ASTM A512-06 (2012)	Standard Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing
ASTM A513/A513M-15	Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
ASTM A514/A514M-14	Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A515/A515M-10	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A516/A516M-10	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A517/A517M-10	Standard Specification for Pressure Vessel Plates, Alloy Steel, High-Strength, Quenched and Tempered
ASTM A518/A518M-99 (2012)	Standard Specification for Corrosion-Resistant High-Silicon Iron Castings
ASTM A519-06 (2012)	Standard Specification for Seamless Carbon and Alloy Steel Mechanical Tubing
ASTM A521/A521M-06 (2011)	Standard Specification for Steel, Closed-Impression Die Forgings for General Industrial Use
ASTM A522/A522M-14	Standard Specification for Forged or Rolled 8 and 9% Nickel Alloy Steel Flanges, Fittings, Valves, and Parts for Low-Temperature Service
ASTM A523-96 (2012)	Standard Specification for Plain End Seamless and Electric-Resistance-Welded Steel Pipe for High-Pressure Pipe-Type Cable Circuits
ASTM A524-96 (2012)	Standard Specification for Seamless Carbon Steel Pipe for Atmospheric and Lower Temperatures
ASTM A529/A529M-14	Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A530/A530M-12	Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe
ASTM A531/A531M-13	Standard Practice for Ultrasonic Examination of Turbine-Generator Steel Retaining Rings
ASTM A532/A532M-10 (2014)	Standard Specification for Abrasion-Resistant Cast Irons
ASTM A533/A533M-09 (2014)	Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered, Manganese-Molybdenum and Manganese-Molybdenum-Nickel
ASTM A534-14	Standard Specification for Carburizing Steels for Anti-Friction Bearings
ASTM A536-84 (2014)	Standard Specification for Ductile Iron Castings
ASTM A537/A537M-13	Standard Specification for Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel
ASTM A540/A540M-11	Standard Specification for Alloy-Steel Bolting for Special Applications

Standard	Title
ASTM A541/A541M-05 (2015)	Standard Specification for Quenched and Tempered Carbon and Alloy Steel Forgings for Pressure Vessel Components
ASTM A542/A542M-13	Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched-and-Tempered, Chromium-Molybdenum, and Chromium-Molybdenum-Vanadium
ASTM A543/A543M-09 (2013)	Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered Nickel-Chromium-Molybdenum
ASTM A550-06 (2010)	Standard Specification for Ferrocolumbium
ASTM A551/A551M-08 (2013)	Standard Specification for Carbon Steel Tires for Railway and Rapid Transit Applications
ASTM A553/A553M-14	Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered 7, 8, and 9% Nickel
ASTM A554-15	Standard Specification for Welded Stainless Steel Mechanical Tubing
ASTM A555/A555M-05 (2014)	Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods
ASTM A556/A556M-96 (2012)	Standard Specification for Seamless Cold-Drawn Carbon Steel Feedwater Heater Tubes
ASTM A560/A560M-12	Standard Specification for Castings, Chromium-Nickel Alloy
ASTM A561-08 (2014)	Standard Practice for Macroetch Testing of Tool Steel Bars
ASTM A562/A562M-10	Standard Specification for Pressure Vessel Plates, Carbon Steel, Manganese-Titanium for Glass or Diffused Metallic Coatings
ASTM A563-15	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A564/A564M-13	Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A565/A565M-10	Standard Specification for Martensitic Stainless Steel Bars for High-Temperature Service
ASTM A568/A568M-14	Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A571/A571M-01 (2011)	Standard Specification for Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low-Temperature Service
ASTM A572/A572M-15	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A573/A573M-13	Standard Specification for Structural Carbon Steel Plates of Improved Toughness
ASTM A574-13	Standard Specification for Alloy Steel Socket-Head Cap Screws
ASTM A574M-12	Standard Specification for Alloy Steel Socket-Head Cap Screws (Metric)
ASTM A575-96 (2013)	Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A576-90b (2012)	Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A577/A577M-90 (2012)	Standard Specification for Ultrasonic Angle-Beam Examination of Steel Plates
ASTM A578/A578M-07 (2012)	Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications
ASTM A579/A579M-04a (2014)	Standard Specification for Superstrength Alloy Steel Forgings
ASTM A580/A580M-15	Standard Specification for Stainless Steel Wire
ASTM A581/A581M-95b (2014)	Standard Specification for Free-Machining Stainless Steel Wire and Wire Rods
ASTM A582/A582M-12	Standard Specification for Free-Machining Stainless Steel Bars
ASTM A586-04a (2014)	Standard Specification for Zinc-Coated Parallel and Helical Steel Wire Structural Strand
ASTM A587-96 (2012)	Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry
ASTM A588/A588M-15	Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A589/A589M-06 (2012)	Standard Specification for Seamless and Welded Carbon Steel Water-Well Pipe
ASTM A592/A592M-10 (2015)	Standard Specification for High-Strength Quenched and Tempered Low-Alloy Steel Forged Parts for Pressure Vessels
ASTM A595/A595M-14	Standard Specification for Steel Tubes, Low-Carbon or High Strength Low-Alloy, Tapered for Structural Use
ASTM A596/A596M-14	Standard Test Method for Direct-Current Magnetic Properties of Materials Using the Ballistic Method and Ring Specimens
ASTM A597/A597M-14	Standard Specification for Cast Tool Steel
ASTM A598/A598M-02 (2015)	Standard Test Method for Magnetic Properties of Magnetic Amplifier Cores
ASTM A599/A599M-07 (2012)	Standard Specification for Tin Mill Products, Electrolytic Tin-Coated, Cold-Rolled Sheet
ASTM A600-92a (2010)	Standard Specification for Tool Steel High Speed
ASTM A601/A601M-10	Standard Specification for Electrolytic Manganese Metal
ASTM A602-94 (2014)	Standard Specification for Automotive Malleable Iron Castings
ASTM A603-98 (2014)	Standard Specification for Zinc-Coated Steel Structural Wire Rope
ASTM A604/A604M-07 (2012)	Standard Practice for Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets
ASTM A606/A606M-09a	Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A608/A608M-14	Standard Specification for Centrifugally Cast Iron-Chromium-Nickel High-Alloy Tubing for Pressure Application at High Temperatures
ASTM A609/A609M-12	Standard Practice for Castings, Carbon, Low-Alloy, and Martensitic Stainless Steel, Ultrasonic Examination Thereof
ASTM A610-79 (2014)	Standard Test Methods for Sampling and Testing Ferroalloys for Determination of Size

Standard	Title
ASTM A612/A612M-12	Standard Specification for Pressure Vessel Plates, Carbon Steel, High Strength, for Moderate and Lower Temperature Service
ASTM A615/A615M-15a	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A618/A618M-04 (2010)	Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A623-11	Standard Specification for Tin Mill Products, General Requirements
ASTM A623M-11	Standard Specification for Tin Mill Products, General Requirements [Metric]
ASTM A624/A624M-13	Standard Specification for Tin Mill Products, Electrolytic Tin Plate, Single Reduced
ASTM A625/A625M-13	Standard Specification for Tin Mill Products, Black Plate, Single Reduced
ASTM A626/A626M-13	Standard Specification for Tin Mill Products, Electrolytic Tin Plate, Double Reduced
ASTM A627-03 (2011)	Standard Test Methods for Tool-Resisting Steel Bars, Flats, and Shapes for Detention and Correctional Facilities
ASTM A630-03 (2014)	Standard Test Methods for Determination of Tin Coating Weights for Electrolytic Tin Plate
ASTM A632-04 (2014)	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service
ASTM A633/A633M-13	Standard Specification for Normalized High-Strength Low-Alloy Structural Steel Plates
ASTM A635/A635M-14	Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for
ASTM A636-08 (2013)	Standard Specification for Nickel Oxide Sinter
ASTM A638/A638M-10	Standard Specification for Precipitation Hardening Iron Base Superalloy Bars, Forgings, and Forging Stock for High-Temperature Service
ASTM A640-97 (2014)	Standard Specification for Zinc-Coated Steel Strand for Messenger Support of Figure 8 Cable
ASTM A641/A641M-09a (2014)	Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A644-14	Standard Terminology Relating to Iron Castings
ASTM A645/A645M-10	Standard Specification for Pressure Vessel Plates, 5% and 5½% Nickel Alloy Steels, Specially Heat Treated
ASTM A646/A646M-06 (2011)	Standard Specification for Premium Quality Alloy Steel Blooms and Billets for Aircraft and Aerospace Forgings
ASTM A648-12	Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Pipe
ASTM A649/A649M-10 (2015)	Standard Specification for Forged Steel Rolls Used for Corrugating Paper Machinery
ASTM A650/A650M-13	Standard Specification for Tin Mill Products, Black Plate, Double Reduced
ASTM A653/A653M-13	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A656/A656M-13	Standard Specification for Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability
ASTM A657/A657M-13	Standard Specification for Tin Mill Products, Black Plate Electrolytic Chromium-Coated, Single and Double Reduced
ASTM A659/A659M-12	Standard Specification for Commercial Steel (CS), Sheet and Strip, Carbon (0.16 Maximum to 0.25 Maximum Percent), Hot-Rolled
ASTM A660/A660M-11	Standard Specification for Centrifugally Cast Carbon Steel Pipe for High-Temperature Service
ASTM A662/A662M-12	Standard Specification for Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service
ASTM A663/A663M-12	Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties
ASTM A664-15	Standard Practice for Identification of Standard Electrical Steel Grades in ASTM Specifications
ASTM A666-15	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A667/A667M-87 (2012)	Standard Specification for Centrifugally Cast Dual Metal (Gray and White Cast Iron) Cylinders
ASTM A668/A668M-15	Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A671/A671M-14	Standard Specification for Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures
ASTM A672/A672M-14	Standard Specification for Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures
ASTM A673/A673M-07 (2012)	Standard Specification for Sampling Procedure for Impact Testing of Structural Steel
ASTM A674-10 (2014)	Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids
ASTM A675/A675M-14	Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A677-12	Standard Specification for Nonoriented Electrical Steel Fully Processed Types
ASTM A679/A679M-06 (2012)	Standard Specification for Steel Wire, High Tensile Strength, Cold Drawn
ASTM A681-08	Standard Specification for Tool Steels Alloy
ASTM A683-05 (2010)	Standard Specification for Nonoriented Electrical Steel, Semiprocessed Types
ASTM A684/A684M-14	Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled
ASTM A686-92 (2010)	Standard Specification for Tool Steel, Carbon
ASTM A688/A688M-15	Standard Specification for Seamless and Welded Austenitic Stainless Steel Feedwater Heater Tubes
ASTM A689-97 (2013)	Standard Specification for Carbon and Alloy Steel Bars for Springs
ASTM A690/A690M-13a	Standard Specification for High-Strength Low-Alloy Nickel, Copper, Phosphorus Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments

Standard	Title
ASTM A691/A691M-09 (2014)	Standard Specification for Carbon and Alloy Steel Pipe, Electric-Fusion-Welded for High-Pressure Service at High Temperatures
ASTM A693-13	Standard Specification for Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A694/A694M-14	Standard Specification for Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service
ASTM A696-90a (2012)	Standard Specification for Steel Bars, Carbon, Hot-Wrought or Cold-Finished, Special Quality, for Pressure Piping Components
ASTM A697/A697M-13	Standard Test Method for Alternating Current Magnetic Properties of Laminated Core Specimen Using Voltmeter-Ammeter-Wattmeter Methods
ASTM A698/A698M-15	Standard Test Method for Magnetic Shield Efficiency in Attenuating Alternating Magnetic Fields
ASTM A700-14	Standard Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment
ASTM A701/A701M-10	Standard Specification for Ferromanganese-Silicon
ASTM A702-13	Standard Specification for Steel Fence Posts, Hot Wrought
ASTM A703/A703M-15	Standard Specification for Steel Castings, General Requirements, for Pressure-Containing Parts
ASTM A704/A704M-06 (2011)	Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
ASTM A705/A705M-13	Standard Specification for Age-Hardening Stainless Steel Forgings
ASTM A706/A706M-14	Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
ASTM A707/A707M-14	Standard Specification for Forged Carbon and Alloy Steel Flanges for Low-Temperature Service
ASTM A709/A709M-13a	Standard Specification for Structural Steel for Bridges
ASTM A710/A710M-02 (2013)	Standard Specification for Precipitation-Strengthened Low-Carbon Nickel-Copper-Chromium-Molybdenum-Columbium Alloy Structural Steel Plates
ASTM A711/A711M-07 (2012)	Standard Specification for Steel Forging Stock
ASTM A712-14	Standard Test Method for Electrical Resistivity of Soft Magnetic Alloys
ASTM A713-04 (2010)	Standard Specification for Steel Wire, High-Carbon Spring, for Heat-Treated Components
ASTM A716-08 (2014)	Standard Specification for Ductile Iron Culvert Pipe
ASTM A717/A717M-12	Standard Test Method for Surface Insulation Resistivity of Single-Strip Specimens
ASTM A719/A719M-14	Standard Test Method for Lamination Factor of Magnetic Materials
ASTM A720/A720M-02 (2011)	Standard Test Method for Ductility of Nonoriented Electrical Steel
ASTM A721/A721M-02 (2011)	Standard Test Method for Ductility of Oriented Electrical Steel
ASTM A722/A722M-15	Standard Specification for High-Strength Steel Bar for Prestressing Concrete
ASTM A723/A723M-10 (2015)	Standard Specification for Alloy Steel Forgings for High-Strength Pressure Component Application
ASTM A724/A724M-09 (2013)	Standard Specification for Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, Quenched and Tempered, for Welded Pressure Vessels
ASTM A726-05 (2010)	Standard Specification for Cold-Rolled Magnetic Lamination Quality Steel, Semiprocessed Types
ASTM A727/A727M-14	Standard Specification for Carbon Steel Forgings for Piping Components with Inherent Notch Toughness
ASTM A729/A729M-15	Standard Specification for Carbon and Alloy Steel Axles, Heat-Treated, for Mass Transit and Electric Railway Service
ASTM A732/A732M-14	Standard Specification for Castings, Investment, Carbon and Low Alloy Steel for General Application, and Cobalt Alloy for High Strength at Elevated Temperatures
ASTM A733-13	Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A734/A734M-12	Standard Specification for Pressure Vessel Plates, Alloy Steel and High-Strength Low-Alloy Steel, Quenched-and-Tempered
ASTM A735/A735M-12	Standard Specification for Pressure Vessel Plates, Low-Carbon Manganese-Molybdenum-Columbium Alloy Steel, for Moderate and Lower Temperature Service
ASTM A736/A736M-12	Standard Specification for Pressure Vessel Plates, Low-Carbon Age-Hardening Nickel-Copper-Chromium-Molybdenum-Columbium Alloy Steel
ASTM A737/A737M-09 (2013)	Standard Specification for Pressure Vessel Plates, High-Strength, Low-Alloy Steel
ASTM A738/A738M-12a	Standard Specification for Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service
ASTM A739-90a (2012)	Standard Specification for Steel Bars, Alloy, Hot-Wrought, for Elevated Temperature or Pressure-Containing Parts, or Both
ASTM A740-98 (2014)	Standard Specification for Hardware Cloth (Woven or Welded Galvanized Steel Wire Fabric)
ASTM A741-11	Standard Specification for Metallic-Coated Steel Wire Rope and Fittings for Highway Guardrail
ASTM A742/A742M-13	Standard Specification for Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe
ASTM A743/A743M-13a	Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM A744/A744M-13	Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service
ASTM A745/A745M-15	Standard Practice for Ultrasonic Examination of Austenitic Steel Forgings
ASTM A746-09 (2014)	Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM A747/A747M-12	Standard Specification for Steel Castings, Stainless, Precipitation Hardening

Standard	Title
ASTM A748/A748M-87 (2012)	Standard Specification for Statically Cast Chilled White Iron-Gray Iron Dual Metal Rolls for Pressure Vessel Use
ASTM A749/A749M-14	Standard Specification for Steel, Strip, Carbon and High-Strength, Low-Alloy, Hot-Rolled, General Requirements for
ASTM A751-14a	Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
ASTM A753-08 (2013)	Standard Specification for Wrought Nickel-Iron Soft Magnetic Alloys (UNS K94490, K94840, N14076, N14080)
ASTM A754/A754M-11	Standard Test Method for Coating Weight (Mass) of Metallic Coatings on Steel by X-Ray Fluorescence
ASTM A755/A755M-15	Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A756-09 (2014)	Standard Specification for Stainless Anti-Friction Bearing Steel
ASTM A757/A757M-15	Standard Specification for Steel Castings, Ferritic and Martensitic, for Pressure-Containing and Other Applications, for Low-Temperature Service
ASTM A758/A758M-14	Standard Specification for Wrought-Carbon Steel Butt-Welding Piping Fittings with Improved Notch Toughness
ASTM A759-10	Standard Specification for Carbon Steel Crane Rails
ASTM A760/A760M-15	Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
ASTM A761/A761M-15	Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
ASTM A762/A762M-15	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A763-15	Standard Practices for Detecting Susceptibility to Intergranular Attack in Ferritic Stainless Steels
ASTM A764-07 (2012)	Standard Specification for Metallic Coated Carbon Steel Wire, Coated at Size and Drawn to Size for Mechanical Springs
ASTM A765/A765M-07 (2012)	Standard Specification for Carbon Steel and Low-Alloy Steel Pressure-Vessel-Component Forgings with Mandatory Toughness Requirements
ASTM A767/A767M-09	Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A768/A768M-05 (2015)	Standard Specification for Vacuum-Treated 12% Chromium Alloy Steel Forgings for Turbine Rotors and Shafts
ASTM A769/A769M-05 (2010)	Standard Specification for Carbon and High-Strength Electric Resistance Forge-Welded Steel Structural Shapes
ASTM A770/A770M-03 (2012)	Standard Specification for Through-Thickness Tension Testing of Steel Plates for Special Applications
ASTM A772/A772M-00 (2011)	Standard Test Method for AC Magnetic Permeability of Materials Using Sinusoidal Current
ASTM A773/A773M-14	Standard Test Method for Direct Current Magnetic Properties of Low Coercivity Magnetic Materials Using Hysteresisgraphs
ASTM A774/A774M-14	Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures
ASTM A775/A775M-07b (2014)	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A778-01 (2009)	Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products
ASTM A779/A779M-12	Standard Specification for Steel Strand, Seven-Wire, Uncoated, Compacted for Prestressed Concrete
ASTM A780/A780M-09 (2015)	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A781/A781M-14b	Standard Specification for Castings, Steel and Alloy, Common Requirements, for General Industrial Use
ASTM A786/A786M-05 (2009)	Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM A787/A787M-15	Standard Specification for Electric-Resistance-Welded Metallic-Coated Carbon Steel Mechanical Tubing
ASTM A788/A788M-15	Standard Specification for Steel Forgings, General Requirements
ASTM A789/A789M-14	Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service
ASTM A790/A790M-14a	Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe
ASTM A792/A792M-10	Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM A793-96 (2014)	Standard Specification for Rolled Floor Plate, Stainless Steel
ASTM A794/A794M-12	Standard Specification for Commercial Steel (CS), Sheet, Carbon (0.16% Maximum to 0.25% Maximum), Cold-Rolled
ASTM A795/A795M-13	Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM A796/A796M-15	Standard Practice for Structural Design of Corrugated Steel Pipe, Pipe-Arches, and Arches for Storm and Sanitary Sewers and Other Buried Applications
ASTM A798/A798M-13	Standard Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
ASTM A799/A799M-10	Standard Practice for Steel Castings, Stainless, Instrument Calibration, for Estimating Ferrite Content
ASTM A800/A800M-14	Standard Practice for Steel Casting, Austenitic Alloy, Estimating Ferrite Content Thereof
ASTM A801-14	Standard Specification for Wrought Iron-Cobalt High Magnetic Saturation Alloys (UNS R30005 and K92650)
ASTM A802-95 (2010)	Standard Practice for Steel Castings, Surface Acceptance Standards, Visual Examination
ASTM A803/A803M-12	Standard Specification for Seamless and Welded Ferritic Stainless Steel Feedwater Heater Tubes

Standard	Title
ASTM A804/A804M-04 (2009)	Standard Test Methods for Alternating-Current Magnetic Properties of Materials at Power Frequencies Using Sheet-Type Test Specimens
ASTM A805/A805M-09	Standard Specification for Steel, Flat Wire, Carbon, Cold-Rolled
ASTM A807/A807M-13	Standard Practice for Installing Corrugated Steel Structural Plate Pipe for Sewers and Other Applications
ASTM A809-08 (2013)	Standard Specification for Aluminum-Coated (Aluminized) Carbon Steel Wire
ASTM A810-01 (2014)	Standard Specification for Zinc-Coated (Galvanized) Steel Pipe Winding Mesh
ASTM A811-15	Standard Specification for Soft Magnetic Iron Parts Fabricated by Powder Metallurgy Techniques
ASTM A813/A813M-14	Standard Specification for Single- or Double-Welded Austenitic Stainless Steel Pipe
ASTM A814/A814M-15	Standard Specification for Cold-Worked Welded Austenitic Stainless Steel Pipe
ASTM A815/A815M-14	Standard Specification for Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings
ASTM A817-12	Standard Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcellled Tension Wire
ASTM A818-06 (2010)	Standard Specification for Coppered Carbon Steel Wire
ASTM A820/A820M-11	Standard Specification for Steel Fibers for Fiber-Reinforced Concrete
ASTM A821/A821M-15	Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks
ASTM A822/A822M-04 (2010)	Standard Specification for Seamless Cold-Drawn Carbon Steel Tubing for Hydraulic System Service
ASTM A823-99 (2012)	Standard Specification for Statically Cast Permanent Mold Gray Iron Castings
ASTM A824-01 (2012)	Standard Specification for Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence
ASTM A827/A827M-14	Standard Specification for Plates, Carbon Steel, for Forging and Similar Applications
ASTM A829/A829M-14	Standard Specification for Alloy Structural Steel Plates
ASTM A830/A830M-14	Standard Specification for Plates, Carbon Steel, Structural Quality, Furnished to Chemical Composition Requirements
ASTM A832/A832M-10	Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum-Vanadium
ASTM A833-08a (2014)	Standard Practice for Indentation Hardness of Metallic Materials by Comparison Hardness Testers
ASTM A834-95 (2011)	Standard Specification for Common Requirements for Iron Castings for General Industrial Use
ASTM A835/A835M-10	Standard Specification for Sizes of Ferroalloys and Alloy Additives
ASTM A836/A836M-14	Standard Specification for Titanium-Stabilized Carbon Steel Forgings for Glass-Lined Piping and Pressure Vessel Service
ASTM A837/A837M-06 (2011)	Standard Specification for Steel Forgings, Alloy, for Carburizing Applications
ASTM A838-02 (2013)	Standard Specification for Free-Machining Ferritic Stainless Soft Magnetic Alloy Bar for Relay Applications
ASTM A839-15	Standard Specification for Iron-Phosphorus Powder Metallurgy Parts for Soft Magnetic Applications
ASTM A841/A841M-13	Standard Specification for Steel Plates for Pressure Vessels, Produced by Thermo-Mechanical Control Process (TMCP)
ASTM A842-11a	Standard Specification for Compacted Graphite Iron Castings
ASTM A844/A844M-09	Standard Specification for Steel Plates, 9% Nickel Alloy, for Pressure Vessels, Produced by the Direct-Quenching Process
ASTM A847/A847M-14	Standard Specification for Cold-Formed Welded and Seamless High-Strength, Low Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance
ASTM A848-01 (2011)	Standard Specification for Low-Carbon Magnetic Iron
ASTM A849-15	Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
ASTM A853-04 (2010)	Standard Specification for Steel Wire, Carbon, for General Use
ASTM A854/A854M-08 (2013)	Standard Specification for Metallic-Coated Steel Smooth High-Tensile Fence and Trellis Wire
ASTM A855/A855M-03 (2014)	Standard Specification for Zinc-5% Aluminum-Mischmetal Alloy-Coated Steel Wire Strand
ASTM A856/A856M-03 (2014)	Standard Specification for Zinc-5% Aluminum-Mischmetal Alloy-Coated Carbon Steel Wire
ASTM A857/A857M-07 (2013)	Standard Specification for Steel Sheet Piling, Cold Formed, Light Gage
ASTM A858/A858M-14	Standard Specification for Heat-Treated Carbon Steel Fittings for Low-Temperature and Corrosive Service
ASTM A859/A859M-04 (2014)	Standard Specification for Age-Hardening Alloy Steel Forgings for Pressure Vessel Components
ASTM A860/A860M-14	Standard Specification for Wrought High-Strength Ferritic Steel Butt-Welding Fittings
ASTM A861-04 (2013)	Standard Specification for High-Silicon Iron Pipe and Fittings
ASTM A862/A862M-98 (2014)	Standard Practice for Application of Asphalt Coatings to Corrugated Steel Sewer and Drainage Pipe
ASTM A865/A865M-06 (2012)	Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints
ASTM A866-14	Standard Specification for Medium Carbon Anti-Friction Bearing Steel
ASTM A867-03 (2013)	Standard Specification for Iron-Silicon Relay Steels
ASTM A871/A871M-14	Standard Specification for High-Strength Low-Alloy Structural Steel Plate With Atmospheric Corrosion Resistance
ASTM A872/A872M-14	Standard Specification for Centrifugally Cast Ferritic/Austenitic Stainless Steel Pipe for Corrosive Environments
ASTM A874/A874M-98 (2014)	Standard Specification for Ferritic Ductile Iron Castings Suitable for Low-Temperature Service
ASTM A875/A875M-13	Standard Specification for Steel Sheet, Zinc-5% Aluminum Alloy-Coated by the Hot-Dip Process

Standard	Title
ASTM A876-12	Standard Specification for Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types
ASTM A877/A877M-10	Standard Specification for Steel Wire, Chromium-Silicon Alloy, Chrome-Silicon-Vanadium Alloy Valve Spring Quality
ASTM A878/A878M-05 (2011)	Standard Specification for Steel Wire, Modified Chromium Vanadium Valve Spring Quality
ASTM A879/A879M-12	Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
ASTM A881/A881M-10	Standard Specification for Steel Wire, Indented, Low-Relaxation for Prestressed Concrete Railroad Ties
ASTM A882/A882M-04a (2010)	Standard Specification for Filled Epoxy-Coated Seven-Wire Prestressing Steel Strand
ASTM A884/A884M-14	Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A886/A886M-12	Standard Specification for Steel Strand, Indented, Seven-Wire Stress-Relieved for Prestressed Concrete
ASTM A887-89 (2014)	Standard Specification for Borated Stainless Steel Plate, Sheet, and Strip for Nuclear Application
ASTM A888-13a	Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM A889/A889M-14	Standard Test Method for Alternating-Current Magnetic Properties of Materials at Low Magnetic Flux Density Using the Voltmeter-Ammeter-Wattmeter-Varmeter Method and 25-cm Epstein Frame
ASTM A890/A890M-13	Standard Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Application
ASTM A891/A891M-10 (2015)	Standard Specification for Precipitation Hardening Iron Base Superalloy Forgings for Turbine Rotor Disks and Wheels
ASTM A892-09 (2014)	Standard Guide for Defining and Rating the Microstructure of High Carbon Bearing Steels
ASTM A893/A893M-03 (2015)	Standard Test Method for Complex Dielectric Constant of Nonmetallic Magnetic Materials at Microwave Frequencies
ASTM A894/A894M-00 (2011)	Standard Test Method for Saturation Magnetization or Induction of Nonmetallic Magnetic Materials
ASTM A895-89 (2009)	Standard Specification for Free-Machining Stainless Steel Plate, Sheet, and Strip
ASTM A896/A896M-09 (2014)	Standard Practice for Conducting Case Studies on Galvanized Structures
ASTM A897/A897M-15	Standard Specification for Austempered Ductile Iron Castings
ASTM A898/A898M-07 (2012)	Standard Specification for Straight Beam Ultrasonic Examination of Rolled Steel Structural Shapes
ASTM A899-91 (2014)	Standard Specification for Steel Wire, Epoxy-Coated
ASTM A900/A900M-01 (2012)	Standard Test Method for Lamination Factor of Amorphous Magnetic Strip
ASTM A901-12	Standard Specification for Amorphous Magnetic Core Alloys, Semi-Processed Types
ASTM A902-15	Standard Terminology Relating to Metallic Coated Steel Products
ASTM A903/A903M-99 (2012)	Standard Specification for Steel Castings, Surface Acceptance Standards, Magnetic Particle and Liquid Penetrant Inspection
ASTM A904-14	Standard Specification for 50 Nickel-50 Iron Powder Metallurgy Soft Magnetic Parts
ASTM A905-04 (2010)	Standard Specification for Steel Wire, Pressure Vessel Winding
ASTM A906/A906M-02 (2010)	Standard Specification for Grade 80 and Grade 100 Alloy Steel Chain Slings for Overhead Lifting
ASTM A908-03 (2013)	Standard Specification for Stainless Steel Needle Tubing
ASTM A909/A909M-06 (2011)	Standard Specification for Steel Forgings, Microalloy, for General Industrial Use
ASTM A910/A910M-12	Standard Specification for Uncoated, Weldless, 2-Wire and 3-Wire Steel Strand for Prestressed Concrete
ASTM A911/A911M-11	Standard Specification for Uncoated, Stress-Relieved Steel Bars for Prestressed Concrete Railroad Ties
ASTM A912/A912M-11	Standard Test Method for Alternating-Current Magnetic Properties of Amorphous Materials at Power Frequencies Using Wattmeter-Ammeter-Voltmeter Method with Toroidal Specimens
ASTM A913/A913M-15	Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST)
ASTM A914/A914M-92 (2011)	Standard Specification for Steel Bars Subject to Restricted End-Quench Hardenability Requirements
ASTM A915/A915M-08 (2013)	Standard Specification for Steel Castings, Carbon, and Alloy, Chemical Requirements Similar to Standard Wrought Grades
ASTM A917-08 (2015)	Standard Specification for Steel Sheet, Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface (General Requirements)
ASTM A918-06 (2011)	Standard Specification for Steel Sheet, Zinc-Nickel Alloy Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
ASTM A920/A920M-14	Standard Specification for Steel Bars, Microalloy, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A921/A921M-93 (2011)	Standard Specification for Steel Bars, Microalloy, Hot-Wrought, Special Quality, for Subsequent Hot Forging
ASTM A922-05 (2010)	Standard Specification for Silicon Metal
ASTM A923-14	Standard Test Methods for Detecting Detrimental Intermetallic Phase in Duplex Austenitic/Ferritic Stainless Steels
ASTM A924/A924M-14	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM A925-03 (2014)	Standard Specification for Zinc-5% Aluminum-Mischmetal Alloy-Coated Steel Overhead Ground Wire Strand

Standard	Title
ASTM A926-03 (2014)	Standard Test Method for Comparing the Abrasion Resistance of Coating Materials for Corrugated Metal Pipe
ASTM A927/A927M-11	Standard Test Method for Alternating-Current Magnetic Properties of Toroidal Core Specimens Using the Voltmeter-Ammeter-Wattmeter Method
ASTM A928/A928M-14	Standard Specification for Ferritic/Austenitic (Duplex) Stainless Steel Pipe Electric Fusion Welded with Addition of Filler Metal
ASTM A929/A929M-01 (2013)	Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
ASTM A930-09 (2014)	Standard Practice for Life-Cycle Cost Analysis of Corrugated Metal Pipe Used for Culverts, Storm Sewers, and Other Buried Conduits
ASTM A931-08 (2013)	Standard Test Method for Tension Testing of Wire Ropes and Strand
ASTM A932/A932M-01 (2012)	Standard Test Method for Alternating-Current Magnetic Properties of Amorphous Materials at Power Frequencies Using Wattmeter-Ammeter-Voltmeter Method with Sheet Specimens
ASTM A933/A933M-14	Standard Specification for Vinyl-Coated Steel Wire and Welded Wire Reinforcement
ASTM A934/A934M-13	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A937/A937M-12	Standard Test Method for Determining Interlaminar Resistance of Insulating Coatings Using Two Adjacent Test Surfaces
ASTM A938-07 (2013)	Standard Test Method for Torsion Testing of Wire
ASTM A939/A939M-15	Standard Practice for Ultrasonic Examination from Bored Surfaces of Cylindrical Forgings
ASTM A940/A940M-06 (2011)	Standard Specification for Vacuum Treated Steel Forgings, Alloy, Differentially Heat Treated, for Turbine Rotors
ASTM A941-13b	Standard Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys
ASTM A942/A942M-95 (2012)	Standard Specification for Centrifugally Cast White Iron/Gray Iron Dual Metal Abrasion-Resistant Roll Shells
ASTM A943/A943M-01 (2014)	Standard Specification for Spray-Formed Seamless Austenitic Stainless Steel Pipes
ASTM A944-10	Standard Test Method for Comparing Bond Strength of Steel Reinforcing Bars to Concrete Using Beam-End Specimens
ASTM A945/A945M-06 (2011)	Standard Specification for High-Strength Low-Alloy Structural Steel Plate with Low Carbon and Restricted Sulfur for Improved Weldability, Formability, and Toughness
ASTM A947M-13	Standard Specification for Textured Stainless Steel Sheet [Metric]
ASTM A949/A949M-01 (2014)	Standard Specification for Spray-Formed Seamless Ferritic/Austenitic Stainless Steel Pipe
ASTM A950/A950M-11	Standard Specification for Fusion Bonded Epoxy-Coated Structural Steel H-Piles and Sheet Piling
ASTM A951/A951M-14	Standard Specification for Steel Wire for Masonry Joint Reinforcement
ASTM A952/A952M-02 (2010)	Standard Specification for Forged Grade 80 and Grade 100 Steel Lifting Components and Welded Attachment Links
ASTM A955M/ A 955M-15	Standard Specification for Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement
ASTM A956-12	Standard Test Method for Leeb Hardness Testing of Steel Products
ASTM A957/A957M-15	Standard Specification for Investment Castings, Steel and Alloy, Common Requirements, for General Industrial Use
ASTM A958/A958M-14	Standard Specification for Steel Castings, Carbon, and Alloy, with Tensile Requirements, Chemical Requirements Similar to Standard Wrought Grades
ASTM A959-11	Standard Guide for Specifying Harmonized Standard Grade Compositions for Wrought Stainless Steels
ASTM A960/A960M-14a	Standard Specification for Common Requirements for Wrought Steel Piping Fittings
ASTM A961/A961M-14	Standard Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications
ASTM A962/A962M-14a	Standard Specification for Common Requirements for Bolting Intended for Use at Any Temperature from Cryogenic to the Creep Range
ASTM A964/A964M-03 (2011)	Standard Specification for Corrugated Steel Box Culverts
ASTM A965/A965M-14	Standard Specification for Steel Forgings, Austenitic, for Pressure and High Temperature Parts
ASTM A966/A966M-15	Standard Practice for Magnetic Particle Examination of Steel Forgings Using Alternating Current
ASTM A967/A967M-13	Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts
ASTM A968/A968M-96 (2014)	Standard Specification for Chromium, Chromium-Nickel, and Silicon Alloy Steel Bars and Shapes for Corrosion and Heat-Resisting Service
ASTM A970/A970M-15	Standard Specification for Headed Steel Bars for Concrete Reinforcement
ASTM A971/A971M-10	Standard Test Method for Measuring Edge Taper and Crown of Flat-Rolled Electrical Steel Coils
ASTM A972/A972M-00 (2010)	Standard Specification for Fusion Bonded Epoxy-Coated Pipe Piles
ASTM A973/A973M-07 (2012)	Standard Specification for Grade 100 Alloy Steel Chain
ASTM A974-97 (2011)	Standard Specification for Welded Wire Fabric Gabions and Gabion Mattresses (Metallic Coated or Polyvinyl Chloride (PVC) Coated)
ASTM A975-11	Standard Specification for Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire With Poly(Vinyl Chloride) (PVC) Coating)
ASTM A976-13	Standard Classification of Insulating Coatings for Electrical Steels by Composition, Relative Insulating Ability and Application
ASTM A977/A977M-07 (2013)	Standard Test Method for Magnetic Properties of High-Coercivity Permanent Magnet Materials Using Hysteresigraphs

Standard	Title
ASTM A978/A978M-08 (2013)	Standard Specification for Composite Ribbed Steel Pipe, Precoated and Polyethylene Lined for Gravity Flow Sanitary Sewers, Storm Sewers, and Other Special Applications
ASTM A979/A979M-03 (2014)	Standard Specification for Concrete Pavements and Linings Installed in Corrugated Steel Structures in the Field
ASTM A980/A980M-11	Standard Specification for Steel, Sheet, Carbon, Ultra High Strength Cold Rolled
ASTM A981/A981M-11	Standard Test Method for Evaluating Bond Strength for 0.600-in. [15.24-mm] Diameter Steel Prestressing Strand, Grade 270 [1860], Uncoated, Used in Prestressed Ground Anchors
ASTM A982/A982M-10 (2015)	Standard Specification for Steel Forgings, Stainless, for Compressor and Turbine Airfoils
ASTM A983/A983M-06 (2011)	Standard Specification for Continuous Grain Flow Forged Carbon and Alloy Steel Crankshafts for Medium Speed Diesel Engines
ASTM A985/A985M-14	Standard Specification for Steel Investment Castings General Requirements, for Pressure-Containing Parts
ASTM A986/A986M-01 (2011)	Standard Specification for Magnetic Particle Examination of Continuous Grain Flow Crankshaft Forgings
ASTM A987/A987M-09 (2014)	Standard Practice for Measuring Shape Characteristics of Tin Mill Products
ASTM A988/A988M-15	Standard Specification for Hot Isostatically-Pressed Stainless Steel Flanges, Fittings, Valves, and Parts for High Temperature Service
ASTM A989/A989M-15	Standard Specification for Hot Isostatically-Pressed Alloy Steel Flanges, Fittings, Valves, and Parts for High Temperature Service
ASTM A990/A990M-14a	Standard Specification for Castings, Iron-Nickel-Chromium and Nickel Alloys, Specially Controlled for Pressure Retaining Parts for Corrosion Service
ASTM A991/A991M-10 (2015)	Standard Test Method for Conducting Temperature Uniformity Surveys of Furnaces Used to Heat Treat Steel Products
ASTM A992/A992M-11	Standard Specification for Structural Steel Shapes
ASTM A994-13	Standard Guide for Editorial Procedures and Form of Product Specifications for Steel, Stainless Steel, and Related Alloys
ASTM A995/A995M-13	Standard Specification for Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts
ASTM A996/A996M-15	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM A997-08 (2012)	Standard Practice for Investment Castings, Surface Acceptance Standards, Visual Examination
ASTM A998/A998M-12	Standard Practice for Structural Design of Reinforcements for Fittings in Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
ASTM A999/A999M-14	Standard Specification for General Requirements for Alloy and Stainless Steel Pipe
ASTM A1000/A1000M-11	Standard Specification for Steel Wire, Carbon and Alloy Specialty Spring Quality
ASTM A1001-01 (2010)	Standard Specification for High Strength Steel Castings in Heavy Sections
ASTM A1002-10	Standard Specification for Castings, Nickel-Aluminum Ordered Alloy
ASTM A1003/A1003M-15	Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members
ASTM A1004/A1004M-99 (2014)	Standard Practice for Establishing Conformance to the Minimum Expected Corrosion Characteristics of Metallic, Painted-Metallic, and Nonmetallic-Coated Steel Sheet Intended for Use as Cold Formed Framing Members
ASTM A1007-15	Standard Specification for Carbon Steel Wire for Wire Rope
ASTM A1008/A1008M-15	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A1009-05 (2010)	Standard Specification for Soft Magnetic MnZn Ferrite Core Materials for High Frequency (10 kHz-1 MHz) Power Transformer and Filter Inductor Applications
ASTM A1010/ A 1010M-13	Standard Specification for Higher-Strength Martensitic Stainless Steel Plate, Sheet, and Strip
ASTM A1011/A1011M-14	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM A1012-10	Standard Specification for Seamless and Welded Ferritic, Austenitic and Duplex Alloy Steel Condenser and Heat Exchanger Tubes With Integral Fins
ASTM A1013-00 (2013)	Standard Test Method for High-Frequency (10 kHz-1 MHz) Core Loss of Soft Magnetic Core Components at Controlled Temperatures Using the Voltmeter-Ammeter-Wattmeter Method
ASTM A1014/A1014M-10	Standard Specification for Precipitation-Hardening Bolting (UNS N07718) for High Temperature Service
ASTM A1015-01 (2014)	Standard Guide for Videoborecopying of Tubular Products for Sanitary Applications
ASTM A1016/A1016M-14	Standard Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes
ASTM A1017/A1017M-11	Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum-Tungsten
ASTM A1018/A1018M-10	Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM A1020/A1020M-02 (2012)	Standard Specification for Steel Tubes, Carbon and Carbon Manganese, Fusion Welded, for Boiler, Superheater, Heat Exchanger and Condenser Applications
ASTM A1021/A1021M-05 (2015)	Standard Specification for Martensitic Stainless Steel Forgings and Forging Stock for High-Temperature Service

Standard	Title
ASTM A1022/A1022M-15	Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement
ASTM A1023/A1023M-15	Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes
ASTM A1024/A1024M-02 (2012)	Standard Specification for Steel Line Pipe, Black, Plain-End, Seamless
ASTM A1025/A1025M-10	Standard Specification for Ferrous Alloys and Other Alloying Materials, General Requirements
ASTM A1028-03 (2015)	Standard Specification for Stainless Steel Bars for Compressor and Turbine Airfoils
ASTM A1030/A1030M-11	Standard Practice for Measuring Flatness Characteristics of Steel Sheet Products
ASTM A1031/A1031M-12	Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Alloy, Drawing Steel and Structural Steel, Hot-Rolled
ASTM A1032-15	Standard Test Method for Hydrogen Embrittlement Resistance for Steel Wire Hard Drawn Used for Prestressed Concrete Pipe
ASTM A1033-10 (2015)	Standard Practice for Quantitative Measurement and Reporting of Hypoeutectoid Carbon and Low-Alloy Steel Phase Transformations
ASTM A1034/A1034M-10a	Standard Test Methods for Testing Mechanical Splices for Steel Reinforcing Bars
ASTM A1035/A1035M-15	Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement
ASTM A1036-04 (2009)	Standard Guide for Measuring Power Frequency Magnetic Properties of Flat-Rolled Electrical Steels Using Small Single Sheet Testers
ASTM A1037/A1037M-05 (2012)	Standard Specification for Steel Line Pipe, Black, Furnace-Butt-Welded
ASTM A1038-13	Standard Test Method for Portable Hardness Testing by the Ultrasonic Contact Impedance Method
ASTM A1039/A1039M-13	Standard Specification for Steel, Sheet, Hot Rolled, Carbon, Commercial, Structural, and High-Strength Low-Alloy, Produced by the Twin-Roll Casting Process
ASTM A1040-10	Standard Guide for Specifying Harmonized Standard Grade Compositions for Wrought Carbon, Low-Alloy, and Alloy Steels
ASTM A1043/A1043M-14	Standard Specification for Structural Steel with Low Yield to Tensile Ratio for Use in Buildings
ASTM A1044/A1044M-15	Standard Specification for Steel Stud Assemblies for Shear Reinforcement of Concrete
ASTM A1045-10 (2014)	Standard Specification for Flexible Poly (Vinyl Chloride) (PVC) Gaskets used in Connection of Vitreous China Plumbing Fixtures to Sanitary Drainage System
ASTM A1046/A1046M-14	Standard Specification for Steel Sheet, Zinc-Aluminum-Magnesium Alloy-Coated by the Hot-Dip Process
ASTM A1047/A1047M-05 (2014)	Standard Test Method for Pneumatic Leak Testing of Tubing
ASTM A1048/A1048M-06 (2011)	Standard Specification for Pressure Vessel Forgings, Alloy Steel, Higher Strength Chromium-Molybdenum-Tungsten for Elevated Temperature Service
ASTM A1049/A1049M-10 (2015)	Standard Specification for Stainless Steel Forgings, Ferritic/Austenitic (Duplex), for Pressure Vessels and Related Components
ASTM A1053/A1053M-12	Standard Specification for Welded Ferritic-Martensitic Stainless Steel Pipe
ASTM A1054-14	Standard Specification for Sintered Ceramic Ferrite Permanent Magnets
ASTM A1055/A1055M-10	Standard Specification for Zinc and Epoxy Dual-Coated Steel Reinforcing Bars
ASTM A1056-12	Standard Specification for Cast Iron Couplings Used for Joining Hubless Cast Iron Soil Pipe and Fittings
ASTM A1057/A1057-08 (2014)	Standard Specification for Steel, Structural Tubing, Cold Formed, Welded, Carbon, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A1058-14	Standard Test Methods for Mechanical Testing of Steel Products-Metric
ASTM A1059/A1059M-08 (2013)	Standard Specification for Zinc Alloy Thermo-Diffusion Coatings (TDC) on Steel Fasteners, Hardware, and Other Products
ASTM A1060/A1060M-14	Standard Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A1061/A1061M-09	Standard Test Methods for Testing Multi-Wire Steel Strand
ASTM A1062-10	Standard Specification for Steel Castings Sampling
ASTM A1063/A1063M-11a	Standard Specification for Steel Sheet, Twin-Rolled Cast, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A1064/A1064M-15	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A1065/A1065M-15	Standard Specification for Cold-Formed Electric-Fusion (Arc) Welded High-Strength Low-Alloy Structural Tubing in Shapes, with 50 ksi [345 MPa] Minimum Yield Point
ASTM A1066/A1066M-11	Standard Specification for High-Strength Low-Alloy Structural Steel Plate Produced by Thermo-Mechanical Controlled Process (TMCP)
ASTM A1067/A1067M-12a	Standard Specification for Test Coupons for Steel Castings
ASTM A1068-10 (2015)	Standard Practice for Life-Cycle Cost Analysis of Corrosion Protection Systems on Iron and Steel Products
ASTM A1069/A1069M-11	Standard Specifications for Laser-Fused Stainless Steel Bars, Plates, and Shapes
ASTM A1071/A1071M-11	Standard Test Method for Evaluating Hygrothermal Corrosion Resistance of Permanent Magnet Alloys
ASTM A1072/A1072M-11	Standard Specification for Zinc-5% Aluminum (Hot-Dip) Coatings on Iron and Steel Products
ASTM A1073/A1073M-14	Standard Practice for Using Hand Micrometers to Measure the Thickness of Nonmetallic-Coated Steel Sheet
ASTM A1074-11	Standard Specification for Hot Tin and Hot Tin/Lead Dip on Ferrous and Non-Ferrous Metals

Standard	Title
ASTM A1075-12	Standard Specification for Flanged Steel U-Channel Posts
ASTM A1076/A1076M-13	Standard Specification for Cold Formed Carbon Structural Steel Tubing Made from Metallic Precoated Sheet Steel
ASTM A1077/A1077M-14	Standard Specification for Structural Steel with Improved Yield Strength at High Temperature for Use in Buildings
ASTM A1078/A1078M-12	Standard Specification for Epoxy-Coated Steel Dowels for Concrete Pavement
ASTM A1079-13	Standard Specification for Steel Sheet, Complex Phase (CP), Dual Phase (DP) and Transformation Induced Plasticity (TRIP), Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A1080-15	Standard Practice for Hot Isostatic Pressing of Steel, Stainless Steel, and Related Alloy Castings
ASTM A1081/A1081M-12	Standard Test Method for Evaluating Bond of Seven-Wire Steel Prestressing Strand
ASTM A1082/A1082M-15	Standard Specification for High Strength Precipitation Hardening and Duplex Stainless Steel Bolting for Special Purpose Applications
ASTM A1083/A1083M-12	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, Produced by Twin-Roll Casting Process
ASTM A1084-15	Standard Test Method for Detecting Detrimental Phases in Lean Duplex Austenitic/Ferritic Stainless Steels
ASTM A1085-13	Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
ASTM A1086-13	Standard Specification for Thin-Gauge Nonoriented Electrical Steel Fully Processed Types
ASTM A1087/A1087M-13	Standard Practice for Using Hand Calipers to Measure the Width of Steel Sheet
ASTM A1088-13	Standard Specification for Steel, Sheet, Cold-Rolled, Complex Phase (CP), Dual Phase (DP) and Transformation Induced Plasticity (TRIP)
ASTM A1089/A1089M-14	Standard Specification for Highly Loaded Anti-Friction Bearing Steel
ASTM A1090/A1090M-14	Standard Specification for Forged Rings and Hollows Produced from Steels with Atmospheric Corrosion Resistance
ASTM A1092-15	Standard Specification for Steel Sheet, as Cold-Reduced, for Conversion to Annealed Cold-Rolled Steel Sheet, and Hot Dip Metallic-Coated Steel Sheet
ASTM A1094/A1094M-15	Standard Specification for Continuous Hot-Dip Galvanized Steel Bars for Concrete Reinforcement

Appendix

2

***DISCONTINUED
FERROUS METAL STANDARDS***

ASTM STANDARDS

Discontinued	Replaced By
A4 (1965)	A3 – Steel Joint Bars, Low, Medium and High Carbon (Non-Heat-Treated)
A5 (1979)	A3 – Steel Joint Bars, Low, Medium and High Carbon (Non-Heat-Treated)
A7 (1967)	A36/A36M – Carbon Structural Steel A283/A283M – Low and Intermediate Tensile Strength Carbon Steel Plates A306 – Discontinued 1975; Replaced by A663/A663M – Steel Bars, Carbon, Merchant Quality, Mechanical Properties, and A675/A675M – Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
A8 (1963)	No Replacement
A9 (1940)	No Replacement
A10 (1970)	A283/A283M – Low and Intermediate Tensile Strength Carbon Steel Plates
A11 (1930)	A113 – Discontinued 1979; No Replacement
A12 (1934)	A131/A131M – Structural Steel for Ships
A13 (1934)	A131/A131M – Structural Steel for Ships
A14 (1950)	A68 – Discontinued 1975; Replaced by A689 – Carbon and Alloy Steel Bars for Springs
A15 (1969)	A615/A615M – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A16 (1969)	A616 – Discontinued 1999; Replaced by A996/A996M – Magnetic Particle Examination of Steel Forgings Using Alternating Current
A17 (1945)	A273 – Discontinued 1975; Replaced by A711/A711M – Steel Forging Stock A274 – Discontinued 1975; Replaced by A711/A711M – Steel Forging Stock
A18 (1940)	A236 – Discontinued 1981; No Replacement
A19 (1936)	A236 – Discontinued 1981; No Replacement
A21 (2003)	No Replacement
A22 (1934)	A57 – Discontinued 1966; Replaced by A504/A504M – Wrought Carbon Steel Wheels
A23 (1917)	A57 – Discontinued 1966; Replaced by A504/A504M – Wrought Carbon Steel Wheels
A24 (1917)	A57 – Discontinued 1966; Replaced by A504/A504M – Wrought Carbon Steel Wheels
A25 (1993)	A504/A504M – Wrought Carbon Steel Wheels
A26 (1966)	A551/A551M – Carbon Steel Tires for Railway and Rapid Transit Applications
A28 (1925)	A83 – Discontinued 1967; Replaced by A192/A192M – Seamless Carbon Steel Boiler Tubes for High-Pressure Service
A30 (1964)	No Replacement
A32 (1927)	A107 – Discontinued 1968; Replaced by A575 – Steel Bars, Carbon, Merchant Quality, M-Grades, and A576 – Steel Bars, Carbon, Hot-Wrought, Special Quality A108 – Steel Bars, Carbon, Cold Finished, Standard Quality
A33 (1937)	E30 – Discontinued 1995; No Replacement
A35 (1937)	No Replacement
A37 (1936)	No Replacement
A38 (1924)	A83 – Discontinued 1967; Replaced by A192/A192M – Seamless Carbon Steel Boiler Tubes for High-Pressure Service
A39 (1920)	A84 – Discontinued 1972; No Replacement
A40 (1920)	A84 – Discontinued 1972; No Replacement
A41 (1956)	No Replacement
A42 (1972)	No Replacement
A43 (1992)	No Replacement
A44 (1955)	A377 – Index of Specifications for Ductile-Iron Pressure Pipe
A45 (1943)	A377 – Index of Specifications for Ductile-Iron Pressure Pipe
A46 (1943)	No Replacement
A47M (1998)	A47/A47M – Ferritic Malleable Iron Castings
A48M (2000)	A48/A48M – Gray Iron Castings
A50 (1937)	A183 – Carbon Steel Track Bolts and Nuts
A51 (1937)	A183 – Carbon Steel Track Bolts and Nuts
A52 (1925)	A83 – Discontinued 1967; Replaced by A192/A192M – Seamless Carbon Steel Boiler Tubes for High-Pressure Service
A54 (1927)	A107 – Discontinued 1968; Replaced by A575 – Steel Bars, Carbon, Merchant Quality, M-Grades, and A576 – Steel Bars, Carbon, Hot-Wrought, Special Quality A108 – Steel Bars, Carbon, Cold Finished, Standard Quality
A55 (1937)	E30 – Discontinued 1995; No Replacement
A56 (1972)	No Replacement
A57 (1966)	A504/A504M – Wrought Carbon Steel Wheels

Discontinued	Replaced By
A58 (1943)	A689 – Carbon and Alloy Steel Bars for Springs
A59 (1966)	A689 – Carbon and Alloy Steel Bars for Springs
A60 (1966)	A689 – Carbon and Alloy Steel Bars for Springs
A61 (1969)	A616 – Discontinued 1999; Replaced by A996/A996M – Magnetic Particle Examination of Steel Forgings Using Alternating Current
A62 (1949)	No Replacement
A63 (1941)	A237 – Discontinued 1975; Replaced by A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use A238 – Discontinued 1989; Replaced by A730 – Discontinued 2004; Replaced by A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use
A64 (1937)	E30 – Discontinued 1995; No Replacement
A68 (1975)	A689 – Carbon and Alloy Steel Bars for Springs
A69 (1927)	No Replacement
A70 (1947)	A285/A285M – Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength
A71 (1937)	No Replacement
A72 (1972)	No Replacement
A73 (1972)	No Replacement
A75 (1921)	A47/A47M – Ferritic Malleable Iron Castings
A76 (1981)	A183 – Carbon Steel Track Bolts and Nuts
A77 (1935)	No Replacement
A78 (1947)	A283/A283M – Low and Intermediate Tensile Strength Carbon Steel Plates
A79 (1921)	A84 – Discontinued 1972; No Replacement
A80 (1927)	A107 – Discontinued 1968; Replaced by A575 – Steel Bars, Carbon, Merchant Quality, M-Grades, and A576 – Steel Bars, Carbon, Hot-Wrought, Special Quality A108 – Steel Bars, Carbon, Cold Finished, Standard Quality
A81 (1972)	No Replacement
A82/A82M (2013)	A1064/A1064M – Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
A83 (1967)	A192/A192M – Seamless Carbon Steel Boiler Tubes for High-Pressure Service
A84 (1972)	No Replacement
A85 (1953)	No Replacement
A86 (1963)	No Replacement
A87 (1947)	A27/A27M – Steel Castings, Carbon, for General Application
A88 (1933)	A48/A48M – Gray Iron Castings
A89 (1947)	A285/A285M – Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength
A91 (1940)	No Replacement
A92 (1937)	No Replacement
A93 (1965)	A525/A525M – Discontinued 1994; Replaced by A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, and A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A94 (1966)	No Replacement
A95 (1957)	A216/A216M – Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
A96 (1965)	A193/A193M – Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
A97 (1935)	No Replacement
A98 (1992)	No Replacement
A103 (1939)	E32 – Discontinued 2015; No Replacement
A104 (1939)	E31 – Discontinued 1995; No Replacement
A107 (1968)	A575 – Steel Bars, Carbon, Merchant Quality, M-Grades A576 – Steel Bars, Carbon, Hot-Wrought, Special Quality
A109M (1998)	A109/A109M – Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled
A110 (1936)	A90/A90M – Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
A112 (1990)	No Replacement
A113 (1979)	No Replacement
A114 (1940)	No Replacement
A115 (1937)	No Replacement
A117 (1956)	A392 – Zinc-Coated Steel Chain-Link Fence Fabric
A118 (1933)	No Replacement

Discontinued	Replaced By
A119 (1942)	E44 – Discontinued 1993; Replaced by A919 – Discontinued 1999; Replaced by A941 – Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys
A120 (1987)	A53/A53M – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A122 (1963)	A475 – Zinc-Coated Steel Wire Strand
A124 (1940)	No Replacement
A127 (1949)	Redesignated A340 – Terminology of Symbols and Definitions Relating to Magnetic Testing
A129 (1969)	No Replacement
A130 (1937)	E30 – Discontinued 1995; No Replacement
A133 (1941)	A237 – Discontinued 1975; Replaced by A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use A238 – Discontinued 1989; Replaced by A730 – Discontinued 2004; Replaced by A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use
A136 (1945)	No Replacement
A137 (1943)	No Replacement
A138 (1945)	No Replacement
A140 (1935)	No Replacement
A141 (1967)	A502 – Rivets, Steel, Structural
A142 (1977)	A716 – Ductile Iron Culvert Pipe
A145 (1940)	A132 – Ferromolybdenum
A147 (1984)	No Replacement
A149 (1940)	A212 – Discontinued 1967; Replaced by A515/A515M – Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service, and A516/A516M – Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
A150 (1940)	A212 – Discontinued 1967; Replaced by A515/A515M – Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service, and A516/A516M – Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
A151 (1938)	No Replacement
A152 (1972)	No Replacement
A154 (1936)	A180 – Discontinued 1937; Replaced by A27/A27M – Steel Castings, Carbon, for General Application
A155 (1978)	A671/A671M – Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures A672/A672M – Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures A691/A691M – Carbon and Alloy Steel Pipe, Electric Fusion-Welded for High-Pressure Service at High Temperatures
A156 (1936)	A146 – Molybdenum Oxide Products
A157 (1953)	A217/A217M – Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service A351/A351 – Castings, Austenitic, for Pressure-Containing Parts
A158 (1953)	A335/A335M – Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
A160 (1969)	A617 – Discontinued 1999; Replaced by A996/A996M – Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
A161 (1999)	A192/A192M – Seamless Carbon Steel Boiler Tubes for High Pressure Service A209/A209M – Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes
A162 (1973)	No Replacement
A163 (1972)	No Replacement
A164 (1981)	B663 – Silver-Tungsten Carbide Electrical Contact Material
A165 (1988)	B766 – Electrodeposited Coatings of Cadmium
A166 (1968)	B456 – Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
A167 (2014)	No Replacement
A168 (1947)	A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A169 (1947)	A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application

Discontinued	Replaced By
A170 (1947)	A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A171 (1947)	A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A172 (1947)	A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A173 (1954)	A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A174 (1940)	A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A175 (1947)	A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A176 (2015)	A240/A240M – Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
A177 (1989)	A666 – Annealed or Cold-Worked Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar
A180 (1937)	A27/A27M – Steel Castings, Carbon, for General Application
A185/A185M (2013)	A1064/A1064M – Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
A186 (1966)	A504/A504M – Wrought Carbon Steel Wheels
A187 (1943)	No Replacement
A188 (1943)	No Replacement
A189 (1972)	No Replacement
A190 (1962)	No Replacement
A191 (1942)	A239 – Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles1, 2
A195 (1966)	A502 – Rivets, Steel, Structural
A196 (1962)	No Replacement
A197M (1999)	A197/A197M – Cupola Malleable Iron
A198 (1947)	A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A199/A199M (1995)	A200 – Discontinued 1999; Replaced by A213/A213M – Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
A200 (1999)	A213/A213M – Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
A201 (1967)	A515/A515M – Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service A516/A516M – Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
A202/A202M (2004)	No Replacement
A205 (1967)	A233 – Discontinued 1970; No Replacement A251 – Discontinued 1970; No Replacement
A206 (1953)	A335/A335M – Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
A207 (1972)	No Replacement
A208 (1941)	A239 – Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles
A211 (1993)	No Replacement
A212 (1967)	A515/A515M – Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service A516/A516M – Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

Discontinued	Replaced By
A215 (1947)	A27/A27M – Steel Castings, Carbon, for General Application
A218 (1963)	A475 – Zinc-Coated Steel Wire Strand
A219 (1972)	B487 – Test Method for Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section B499 – Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals B504 – Test Method for Measurement of Thickness of Metallic Coatings by the Coulometric Method B529 – Discontinued 1979; Replaced by B244 – Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments B530 – Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Electrodeposited Nickel Coatings on Magnetic and Nonmagnetic Substrates
A220M (1999)	A220/A220M – Pearlitic Malleable Iron
A221 (1947)	A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A222 (1947)	A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A223 (1947)	A296 – Discontinued 1980; Replaced by A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A224 (1969)	G4 – Guide for Conducting Corrosion Tests in Field Applications
A226/A226M (1997)	No Replacement
A233 (1970)	No Replacement
A235 (1975)	A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use
A236 (1981)	No Replacement
A237 (1975)	A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use
A238 (1989)	A730 – Discontinued 2004; Replaced by A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use
A241 (1979)	A67 – Steel Tie Plates, Low-Carbon and High-Carbon Hot-Worked
A243 (1975)	A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use
A244 (1947)	A504/A504M – Wrought Carbon Steel Wheels
A245 (1972)	A570 – Discontinued 2000; Replaced by A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength A611 – Discontinued 2000; Replaced by A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
A246 (1958)	A245 – Discontinued 1972; Replaced by A570 – Discontinued 2000; Replaced by A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength A611 – Discontinued 2000; Replaced by A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
A248 (1972)	A273 – Discontinued 1975; Replaced by A711/A711M – Steel Forging Stock A274 – Discontinued 1975; Replaced by A711/A711M – Steel Forging Stock
A251 (1970)	No Replacement
A253 (1962)	No Replacement
A256 (1990)	No Replacement
A257 (1945)	A34/A34M – Practice for Sampling and Procurement Testing of Magnetic Materials
A258 (1945)	A34/A34M – Practice for Sampling and Procurement Testing of Magnetic Materials
A259 (1945)	A34/A34M – Practice for Sampling and Procurement Testing of Magnetic Materials
A260 (1966)	No Replacement
A261 (1959)	No Replacement
A267 (1954)	No Replacement
A271 (1999)	A213/A213M – Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes

Discontinued	Replaced By
A272 (1945)	E109 – Discontinued 1981; Replaced by E709 – Guide for Magnetic Particle Testing
A273 (1975)	A711/A711M – Steel Forging Stock
A274 (1975)	A711/A711M – Steel Forging Stock
A277 (1952)	A338 – Malleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service at Temperatures Up to 650°F (345°C)
A278M (2001)	A278/A278M – Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650oF (350oC)
A279 (1945)	G31 – Guide for Laboratory Immersion Corrosion Testing of Metals
A280 (1953)	A335/A335M – Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
A281 (1947)	A27/A27M – Steel Castings, Carbon, for General Application
A282 (1945)	A148/A148M – Steel Castings, High Strength, for Structural Purposes
A284/A284M (1992)	A283/A283M – Low and Intermediate Tensile Strength Carbon Steel Plates
A286 (1960)	A434 – Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered
A287 (1955)	No Replacement
A292 (1968)	A469/A469M – Vacuum-Treated Steel Forgings for Generator Rotors
A293 (1984)	A470/A470M – Vacuum-Treated Carbon and Alloy Steel Forgings for Turbine Rotors and Shafts
A294 (1988)	A471/A471M – Vacuum-Treated Alloy Steel Forgings for Turbine Rotor Disks and Wheels
A296 (1980)	A743/A743M – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application A744/A744M – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service
A298 (1970)	No Replacement
A300 (1975)	No Replacement
A301 (1956)	A387/A387M – Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
A303 (1970)	A570 – Discontinued 2000; Replaced by A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
A305 (1968)	A615/A615M – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement A616 – Discontinued 1999; Replaced by A996/A996M – Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement A617 – Discontinued 1999; Replaced by A996/A996M – Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
A306 (1975)	A663/A663M – Steel Bars, Carbon, Merchant Quality, Mechanical Properties A675/A675M – Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
A310 (1949)	Redesignated A345 – Flat-Rolled Electrical Steels for Magnetic Applications
A315 (1952)	A335/A335M – Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
A316 (1969)	No Replacement
A317 (1975)	E381 – Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings
A318 (1976)	A370 – Test Methods and Definitions for Mechanical Testing of Steel Products
A321 (2007)	No Replacement
A326 (1990)	No Replacement
A327M (2011)	A327/A327M – Test Methods for Impact Testing of Cast Irons
A329 (1965)	A551/A551M – Carbon Steel Tires for Railway and Rapid Transit Applications
A330 (1954)	A370 – Test Methods and Definitions for Mechanical Testing of Steel Products
A331 (2004)	A108 – Steel Bar, Carbon and Alloy, Cold-Finished
A332 (1965)	A689 – Carbon and Alloy Steel Bars for Springs
A337 (1955)	A392 – Zinc-Coated Steel Chain-Link Fence Fabric
A339 (1965)	A536 – Ductile Iron Castings
A344 (1977)	A370 – Test Methods and Definitions for Mechanical Testing of Steel Products A712 – Test Method for Electrical Resistivity of Soft Magnetic Alloys A717/A717M – Test Method for Surface Insulation Resistivity of Single-Strip Specimens A718 – Discontinued 1996; No Replacement A719/A719M – Test Method for Lamination Factor of Magnetic Materials A720/A720M – Test Method for Ductility of Nonoriented Electrical Steel
A346 (1998)	No Replacement
A347 (1996)	No Replacement
A349 (1984)	No Replacement
A357 (1973)	A387/A387M – Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
A359 (1954)	A370 – Test Methods and Definitions for Mechanical Testing of Steel Products
A360 (1993)	No Replacement
A360M (1993)	No Replacement
A361/A361M (1995)	No Replacement

Discontinued	Replaced By
A362 (1977)	No Replacement
A364 (1959)	A434 – Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered
A365 (1968)	A619/A619M – Discontinued 1997; No Replacement A620/A620M – Discontinued 2000; Replaced by A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
A366/A366M (2000)	A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
A371 (1969)	No Replacement
A373 (1966)	Combined with A36/A36M – Carbon Structural Steel
A374 (1971)	A606/A606M – Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance A607 – Discontinued 2000; Replaced by A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable, and A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
A375 (1971)	A606/A606M – Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance A607 – Discontinued 2000; Replaced by A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable, and A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
A378 (1955)	A345 – Flat-Rolled Electrical Steels for Magnetic Applications
A379 (1955)	A345 – Flat-Rolled Electrical Steels for Magnetic Applications
A382 (1971)	No Replacement
A383 (1996)	No Replacement
A386 (1984)	A123/A123M – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A393 (1974)	A262 – Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
A395M (1998)	A395/A395M – Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
A396 (1965)	A536 – Ductile Iron Castings
A397 (1958)	No Replacement
A398 (1969)	No Replacement
A399 (1969)	No Replacement
A402 (1958)	No Replacement
A404 (1974)	No Replacement
A405 (1995)	No Replacement
A406 (1965)	No Replacement
A407M (1989)	No Replacement
A408 (1968)	A615/A615M – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A410 (1976)	No Replacement
A412 (1988)	No Replacement
A415 (1970)	A569/A569M – Discontinued 2000; Replaced by A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
A417 (2008)	No Replacement
A417M (1989)	No Replacement
A419 (1971)	No Replacement
A422 (1994)	No Replacement
A425 (1970)	A569/A569M – Discontinued 2000; Replaced by A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
A429 (1976)	A276 – Stainless Steel Bars and Shapes
A430/A430M (1995)	A312/A312M – Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
A431 (1968)	A615/A615M – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A432 (1968)	A615/A615M – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A433 (1972)	No Replacement
A438 (2003)	No Replacement
A440 (1979)	No Replacement
A441/A441M (1988)	A572/A572M – High-Strength Low-Alloy Columbium-Vanadium Structural Steel
A442/A442M (1991)	No Replacement

Discontinued	Replaced By
A443 (1966)	Combined with A370 – Test Methods and Definitions for Mechanical Testing of Steel Products
A444/A444M (1995)	A929/A929M – Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
A445 (1974)	A395/A395M – Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
A446/A446M (1994)	A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A448 (1976)	No Replacement
A452 (1995)	No Replacement
A454 (1980)	No Replacement
A457 (1990)	No Replacement
A458 (1991)	No Replacement
A461 (1971)	A564/A564M – Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes A637 – Discontinued; Redesignated B637 – Precipitation-Hardening and Cold Worked Nickel Alloy Bars, Forgings, and Forging Stock for Moderate or High-Temperature Service A638 – Precipitation Hardening Iron Base Superalloy Bars, Forgings, and Forging Stock for High-Temperature Service A639 – Discontinued; Redesignated B639 – Precipitation Hardening Cobalt-Containing Alloys (UNS R30155 and UNS R30816) Rod, Bar, Forgings, and Forging Stock for High-Temperature Service
A462 (1970)	E165 – Practice for Liquid Penetrant Examination for General Industry
A464 (1968)	A376/A376M – Seamless Austenitic Steel Pipe for High-Temperature Service
A465 (1975)	No Replacement
A468 (1969)	A6/A6M – General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling A341/A341M – Test Method for Direct Current Magnetic Properties of Materials Using D-C Permeameters and the Ballistic Test Methods
A476M (2000)	A476/A476M – Ductile Iron Castings for Paper Mill Dryer Rolls
A477 (1991)	No Replacement
A486/A486M (1987)	No Replacement
A496/A496M (2013)	A1064/A1064M – Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
A497/A497M (2013)	A1064/A1064M – Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
A502 (1999)*	No Replacement
A509 (1983)	A788/A788M – Steel Forgings, General Requirements
A510M (2011)	A510/A510M – General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel
A518 M (1999)	A518/A518 M – Corrosion-Resistant High-Silicon Iron Castings
A520 (2000)	No Replacement
A525 (1994)	A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A525M (1994)	A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A526/A526M (1994)	A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A527/A527M (1994)	A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A528/A528M (1994)	A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A535 (1998)	No Replacement
A538/A538M (1989)	No Replacement
A539 (2004)	No Replacement
A544 (1991)	No Replacement
A545 (1991)	No Replacement
A546 (1991)	No Replacement
A547 (1991)	No Replacement
A548 (1991)	No Replacement
A549 (1991)	No Replacement
A552 (1974)	A689 – Carbon and Alloy Steel Bars for Springs
A557/A557M (1995)	A178/A178M – Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes

Discontinued	Replaced By
A558 (1969)	No Replacement
A559 (1969)	No Replacement
A566 (1984)	No Replacement
A567/A567M (1985)	No Replacement
A568M (1990)	A568/A568M – Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
A569/A569M (2000)	A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
A570/A570M (2000)	A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
A571M (2001)	A571/A571M – Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low-Temperature Service
A583 (2004)	No Replacement
A584 (2002)	A116 – Metallic-Coated, Steel Woven Wire Fence Fabric
A585 (2002)	A121 – Metallic-Coated Carbon Steel Barbed Wire
A590 (1984)	No Replacement
A591/A591M (2005)	A879/A879M – Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
A593 (1976)	No Replacement
A594 (1986)	No Replacement
A599 (1992)	A599/A599M – Tin Mill Products, Electrolytic Tin-Coated, Cold-Rolled Sheet
A605/A605M (1987)	No Replacement
A607 (2000)	A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable, and A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
A611 (2000)	A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
A613 (1984)	No Replacement
A614 (1986)	No Replacement
A615M (1993)	A615/A615M – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A616/A616M (1999)	A996/A996M – Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
A617/A617M (1999)	A996/A996M – Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
A619/A619M (1997)	No Replacement
A620/A620M (2000)	A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
A621/A621M (1997)	No Replacement
A622/A622M (2000)	A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
A624M (1995)	A624/A624M – Tin Mill Products, Electrolytic Tin Plate, Single Reduced
A625M (1992)	A625/A625M – Tin Mill Products, Black Plate, Single Reduced
A626M (1995)	A626/A626M – Tin Mill Products, Electrolytic Tin Plate, Double Reduced
A628 (1981)	No Replacement
A629 (2004)	A627 – Test Methods for Tool-Resisting Steel Bars, Flats, and Shapes for Detention and Correctional Facilities
A631 (1993)	A583 – Discontinued 2004; No Replacement
A634 (1977)	No Replacement
A635M (1990)	A635/A635M – Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for
A637 (1981)	Redesignated B637 – Precipitation-Hardening and Cold Worked Nickel Alloy Bars, Forgings, and Forging Stock for Moderate or High-Temperature Service
A639 (1980)	Redesignated B639 – Precipitation Hardening Cobalt-Containing Alloys (UNS R30155 and UNS R30816) Rod, Bar, Forgings, and Forging Stock for High-Temperature Service
A641M (1997)	A641/A641M – Zinc-Coated (Galvanized) Carbon Steel Wire
A642/A642M (1994)	A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A643 (1982)	No Replacement
A647 (1981)	No Replacement
A650M (1988)	A650/A650M – Tin Mill Products, Black Plate, Double Reduced
A651 (1986)	No Replacement

Discontinued	Replaced By
A652 (1983)	No Replacement
A654 (1983)	No Replacement
A655 (1983)	No Replacement
A658/A658M (1988)	No Replacement
A661	Not Yet Assigned
A665 (1987)	A876 – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types
A665M (1987)	A876 – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types
A667M (1987)	A667/A667M – Centrifugally Cast Dual Metal (Gray and White Cast Iron) Cylinders
A669 (1983)	A789/A789M – Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service
A670 (1979)	Redesignated B670 – Precipitation-Hardening Nickel Alloy (UNS N07718) Plate, Sheet, and Strip for High-Temperature Service
A676 (1990)	No Replacement
A677M (2000)	A677 – Nonoriented Electrical Steel Fully Processed Types
A678/A678M (2010)	No Replacement
A680/A680M (1986)	A684/A684M – Steel, Strip, High-Carbon, Cold-Rolled
A682/A682M (2009)	A684/A684M – Steel, Strip, High-Carbon, Cold-Rolled
A683M (1999)	A683 – Nonoriented Electrical Steel, Semiprocessed Types
A685 (1985)	A681 – Tool Steels Alloy
A687 (1999)	No Replacement
A692 (1995)	A209/A209M – Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes
A695 (2002)	No Replacement
A699 (1985)	No Replacement
A708 (1988)	No Replacement
A714 (2014)	No Replacement
A715 (2000)	A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable, and A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
A718 (1996)	No Replacement
A725 (1988)	A876 – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types
A725M (1988)	A876M – Discontinued 1998; Replaced by A876 – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types
A726M (1998)	A726 – Cold-Rolled Magnetic Lamination Quality Steel, Semiprocessed Types
A728	Not Yet Assigned
A730 (2004)	A668/A668M – Steel Forgings, Carbon and Alloy, for General Industrial Use
A731/A731M (1995)	A268/A268M – Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
A749M (1991)	A749/A749M – Steel, Strip, Carbon and High-Strength, Low-Alloy, Hot-Rolled, General Requirements for
A750 (2004)	No Replacement
A752 (2011)	A510/A510M – General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel
A752M (2011)	A510/A510M – General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel
A766/A766M (1989)	No Replacement
A771/A771M (2004)	No Replacement
A776	Not Yet Assigned
A777 (1995)	No Replacement
A782/A782M (2010)	No Replacement
A783 (1986)	No Replacement
A784 (1987)	No Replacement
A785 (1987)	No Replacement
A791/A791M (1995)	A268/A268M – Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
A792M (1994)	A792/A792M – Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
A797 (1988)	No Replacement
A806/A806M (1995)	No Replacement
A808/A808M (2005)	A656/A656M – Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability
A812/A812M (1997)	No Replacement
A816/A816M (1994)	A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A924/A924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

Discontinued	Replaced By
A819 (1995)	A929/A929M – Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
A825 (1989)	No Replacement
A826/A826M (2004)	No Replacement
A828	Not Yet Assigned
A831/A831M (2005)	No Replacement
A840/A840M (2011)	No Replacement
A843 (1987)	A876 – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types
A845 (2005)	No Replacement
A846 (2005)	No Replacement
A850 (1990)	No Replacement
A851 (2002)	No Replacement
A852/A852M (2010)	No Replacement
A863 (1990)	No Replacement
A864/A864M (1997)	No Replacement
A868	Not Yet Assigned
A869	Not Yet Assigned
A870	Not Yet Assigned
A873/A873M (1997)	No Replacement
A874M (1999)	A874/A874M – Ferritic Ductile Iron Castings Suitable for Low-Temperature Service
A876M (1998)	A876 – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types
A880 (2004)	No Replacement
A883/A883M (2006)	No Replacement
A885/A885M (2006)	No Replacement
A897M (2001)	A897/A897M – Austempered Ductile Iron Castings
A900	A900/A900M – Test Method for Lamination Factor of Amorphous Magnetic Strip
A907/A907M (2001)	A1018/A1018M – Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
A916 (1995)	A929/A929M – Steel Sheet Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
A919 (1999)	A941 – Terminology Relating to Steel, Stainless Steel, Related Alloys and Ferroalloys
A935/A935M (2001)	A1018/A1018M – Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
A936/A936M (2001)	A1018/A1018M – Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
A946 (2012)	No Replacement
A948	Not listed
A953 (2005)	No Replacement
A954 (2005)	No Replacement
A963/A963M (2000)	A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
A969/A969M (2000)	A1008/A1008M – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
A984/A984M (2014)	No Replacement
A993 (2004)	No Replacement
A995	A995/A995M – Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts
A1005/A1005M (2014)	No Replacement
A1006/A1006M (2014)	No Replacement
A1019/A1019M (2012)	No Replacement
A1026 (2007)	No Replacement
A1027	Not listed
A1029	Not listed
A1041/A1041M (2013)	No Replacement
A1042/A1042M (2015)	No Replacement
A1050	Not listed
A1051	Not listed
A1052	Not listed

Discontinued	Replaced By
A1070	Not listed
A1091	Not listed
A1093	Not listed

*Note: A502-93 (Standard Specification for Steel Structural Rivets) was withdrawn in 1999. A502-03 (Standard Specification for Rivets, Steel, Structural) became an active standard, and has been reapproved in 2015.

AFNOR STANDARDS

Discontinued	Replaced By
NF A32-053:1992	No Replacement
NF A49-141:1978	No Replacement
NF A49-214:1978	No Replacement
NF A49-244:1993	EN 10217-7:2014
NF A49-247:1981	EN 10217-7:2014
NF A49-250:1979	No Replacement
NF A49-317:1980	EN 10297-2:2005

DIN STANDARD

Discontinued	Replaced By
DIN 1615:1984	No Replacement

BSI STANDARDS

Discontinued	Replaced By
BS 3605-1:1991 AMD 2:1997	EN 10216-5:2013
BS 3605-2:1991 AMD 1:1997	EN 10217-7:2014
BS 6258:1988 A1:1992	EN 10294-1:2005 and EN 10294-2:2012

EN STANDARDS

Discontinued	Replaced By
EN 10016-1	EN ISO 16120-1
EN 10016-2	EN ISO 16120-2
EN 10016-3	EN ISO 16120-3
EN 10016-4	EN ISO 16120-4
EN 10113-1	EN 10025-1, EN 10025-3, EN 10025-4
EN 10113-2	EN 10025-1, EN 10025-3
EN 10113-3	EN 10025-1, EN 10025-4
EN 10137-1	EN 10025-1, EN 10025-6
EN 10137-2	EN 10025-1, EN 10025-6
EN 10137-3	No Replacement
EN 10155	EN 10025-1, EN 10025-5
EN 10165	EN 10341
EN 10169-2	EN 10169
EN 10208-1	EN ISO 3183
EN 10208-2	EN ISO 3183
EN 10258	EN ISO 9445-1
EN 10259	EN ISO 9445-2
EN 10292	EN 10346
EN 10327	EN 10346
EN 12070	EN ISO 21952
EN 12072	EN ISO 14343

Discontinued	Replaced By
EN 1599	EN ISO 3580
EN 1600	EN ISO 3581
EN 1668	EN ISO 636
EN 440	EN ISO 14341
EN 50112	EN 50446
EN 756	EN ISO 14171
EN 758	EN ISO 17632

ISO Standards

Discontinued	Replaced By
ISO 3183-1:1996	EN ISO 3183
ISO 3183-2:1996	EN ISO 3183

JIS Standards

Standard	Date Withdrawn/Replaced by
JIS G 0204:2000	Withdrawn in: 2014-09-22 Replaced by: G 0203
JIS G 0301:1950	Withdrawn in: 1954-12-18
JIS G 0302:1956	Withdrawn in: 1966-11-01 Replaced by: G 1501; G 1511; G 1512; G1513
JIS G 0304:1951	Withdrawn in: 1957-10-30
JIS G 0305:1953	Withdrawn in: 1962-03-01
JIS G 0405:1950	Withdrawn in: 1959-12-01 Replaced by: G 4801
JIS G 0406:1950	Withdrawn in: 1959-12-01 Replaced by: G 4801
JIS G 0501:1952	Withdrawn in: 1955-02-12 Replaced by: G 3421; G 3422; G 3423
JIS G 0502:1952	Withdrawn in: 1955-02-12 Replaced by: G 3436; G 3437; G 3438
JIS G 0552:1998	Withdrawn in: 2005-01-20 Replaced by: G 0551
JIS G 0565:1992	Withdrawn in: 2007-01-20 Replaced by: Z 2320-1; Z 2320-2; Z 2320-3
JIS G 0574:1980	Withdrawn in: 2004-03-20
JIS G 0704:1977	Withdrawn in: 1980-03-01
JIS G 1202:1975	Withdrawn in: 1995-07-01 Replaced by: G 1253
JIS G 1203:1977	Withdrawn in: 1986-06-01 Replaced by: Z 2611
JIS G 1204:1978	Withdrawn in: 2004-03-20
JIS G 1230:1969	Withdrawn in: 1982-09-01 Replaced by: G 1257
JIS G 1231:1969	Withdrawn in: 1981-03-01 Replaced by: G 1236; G 1237
JIS G 1238:1992	Withdrawn in: 2005-02-20 Replaced by: G 1217
JIS G 1251:1976	Withdrawn in: 1995-07-01
JIS G 1252:1975	Withdrawn in: 1995-07-01 Replaced by: G 1253
JIS G 1254:1976	Withdrawn in: 1986-06-01 Replaced by: G 1256
JIS G 1255:1977	Withdrawn in: 1986-06-01 Replaced by: G 1256
JIS G 1257:1994	Withdrawn in: 2013-11-20
JIS G 1258:1999	Withdrawn in: 2007-07-20 Replaced by: G 1258-0; G 1258-1; G 1258-2; G 1258-3; G 1258-4; G 1258-5; G 1258-6; G 1258-7
JIS G 1315:1974	Withdrawn in: 1983-11-01
JIS G 1511:1976	Withdrawn in: 1986-02-01 Replaced by: G 1601
JIS G 1512:1976	Withdrawn in: 1986-02-01 Replaced by: G 1601
JIS G 1513:1976	Withdrawn in: 1986-02-01 Replaced by: G 1601
JIS G 1514:1976	Withdrawn in: 1986-02-01 Replaced by: G 1601
JIS G 1515:1976	Withdrawn in: 1986-02-01 Replaced by: G 1601
JIS G 1516:1976	Withdrawn in: 1986-02-01 Replaced by: G 1601
JIS G 1517:1975	Withdrawn in: 1985-03-01
JIS G 1518:1976	Withdrawn in: 1986-02-01 Replaced by: G 1602
JIS G 1519:1975	Withdrawn in: 1986-02-01 Replaced by: G 1602
JIS G 1520:1976	Withdrawn in: 1986-02-01 Replaced by: G 1602
JIS G 1521:1975	Withdrawn in: 1986-02-01 Replaced by: G 1602

Standard	Date Withdrawn/Replaced by
JIS G 1522:1975	Withdrawn in: 1986-02-01 Replaced by: G 1603
JIS G 1523:1975	Withdrawn in: 1986-02-01 Replaced by: G 1603
JIS G 1524:1976	Withdrawn in: 1986-02-01 Replaced by: G 1603
JIS G 1525:1975	Withdrawn in: 1986-02-01 Replaced by: G 1603
JIS G 1526:1976	Withdrawn in: 1986-02-01 Replaced by: G 1603
JIS G 1527:1976	Withdrawn in: 1986-02-01 Replaced by: G 1601
JIS G 1528:1968	Withdrawn in: 1986-02-01 Replaced by: G 1604
JIS G 1529:1975	Withdrawn in: 1985-03-01
JIS G 1530:1975	Withdrawn in: 1986-02-01 Replaced by: G 1603
JIS G 1531:1975	Withdrawn in: 1986-02-01 Replaced by: G 1602
JIS G 2201:1976	Withdrawn in: 2000-12-20
JIS G 2202:1976	Withdrawn in: 2000-12-20
JIS G 2203:1950	Withdrawn in: 1953-11-07 Replaced by: G 2201; G 2202
JIS G 2204:1950	Withdrawn in: 1953-11-07 Replaced by: G 2201; G 2202
JIS G 2205:1953	Withdrawn in: 1953-11-07 Replaced by: G 2201; G 2202
JIS G 2305:1969	Withdrawn in: 1978-12-01
JIS G 2317:1969	Withdrawn in: 1978-12-01
JIS G 3102:1964	Withdrawn in: 1965-07-01 Replaced by: G 4051
JIS G 3104:2004	Withdrawn in: 2011-02-21
JIS G 3107:1952	Withdrawn in: 1956-04-18 Replaced by: G 3111
JIS G 3110:1953	Withdrawn in: 1965-03-01 Replaced by: G 3112
JIS G 3111:2005	Withdrawn in: 2013-02-20
JIS G 3115-1:1995	Withdrawn in: 2000-06-20 Replaced by: G 3115
JIS G 3121:1951	Withdrawn in: 1955-02-12 Replaced by: G 3123
JIS G 3122:1952	Withdrawn in: 1955-02-12 Replaced by: G 3123
JIS G 3128:2009	Note: JIS G 3128:2009 no longer has Annexes attached to the standard, thus no longer containing the following grades that were included in DS67C: • Grade E355 Quality DD • Grade E355 Quality E • Grade E460 Quality CC • Grade E460 Quality DD • Grade E460 Quality E • Grade E550 Quality DD • Grade E550 Quality E • Grade E690 Quality DD • Grade E690 Quality E
JIS G 3211:1977	Withdrawn in: 1982-07-01 Replaced by: G 3202; G 3203; G 3204; G 3205
JIS G 3212:1977	Withdrawn in: 1982-07-01 Replaced by: G 3202; G 3203; G 3204; G 3205
JIS G 3213:1977	Withdrawn in: 1982-07-01 Replaced by: G 3202; G 3203; G 3204; G 3205
JIS G 3301:1965	Withdrawn in: 1967-07-01 Replaced by: G 3131
JIS G 3304:1950	Withdrawn in: 1956-07-17 Replaced by: G 3301
JIS G 3305:1953	Withdrawn in: 1956-07-17 Replaced by: G 3310
JIS G 3306:1954	Withdrawn in: 1956-07-17 Replaced by: G 3310
JIS G 3307:1965	Withdrawn in: 1967-07-01 Replaced by: G 3131
JIS G 3308:1957	Withdrawn in: 1969-08-06 Replaced by: G 3141
JIS G 3309:1950	Withdrawn in: 1953-05-08
JIS G 3310:1965	Withdrawn in: 1969-08-06 Replaced by: G 3141
JIS G 3391:1953	Withdrawn in: 1988-10-01
JIS G 3421:1951	Withdrawn in: 1955-02-12 Replaced by: G 3432; G 3433; G 3434; G 3435; G 3436
JIS G 3422:1951	Withdrawn in: 1955-02-12 Replaced by: G 3433
JIS G 3423:1951	Withdrawn in: 1955-02-12 Replaced by: G 3435
JIS G 3424:1951	Withdrawn in: 1955-02-12 Replaced by: G 3436
JIS G 3425:1951	Withdrawn in: 1955-02-12 Replaced by: G 3437
JIS G 3426:1951	Withdrawn in: 1955-02-12 Replaced by: G 3438
JIS G 3427:1951	Withdrawn in: 1955-02-12 Replaced by: G 3432
JIS G 3428:1950	Withdrawn in: 1956-04-18 Replaced by: G 3440
JIS G 3430:1952	Withdrawn in: 1957-10-30 Replaced by: G 3443

Standard	Date Withdrawn/Replaced by
JIS G 3431:1952	Withdrawn in: 1957-10-30 Replaced by: G 3443
JIS G 3432:1958	Withdrawn in: 1962-03-01 Replaced by: G 3452
JIS G 3433:1958	Withdrawn in: 1962-03-01 Replaced by: G 3454; G 3456
JIS G 3434:1958	Withdrawn in: 1962-03-01 Replaced by: G 3455
JIS G 3435:1958	Withdrawn in: 1962-03-01 Replaced by: G 3458; G 3459
JIS G 3436:1958	Withdrawn in: 1962-03-01 Replaced by: G 3461; G 3462; G 3463
JIS G 3437:1965	Withdrawn in: 1968-05-01
JIS G 3438:1958	Withdrawn in: 1962-03-01 Replaced by: G 3459; G 3461; G 3462; G 3463
JIS G 3439:1988	Withdrawn in: 1996-01-01
JIS G 3440:1956	Withdrawn in: 1961-02-01 Replaced by: G 3444; G 3445
JIS G 3443:2004	Withdrawn in: 2007-02-20 Replaced by: G 3443-1
JIS G 3451:1987	Withdrawn in: 2007-02-20 Replaced by: G 3443-2
JIS G 3491:1993	Withdrawn in: 2007-02-20
JIS G 3492:1993	Withdrawn in: 2004-03-20
JIS G 3501:1953	Withdrawn in: 1956-08-21 Replaced by: G 3505; G 3506
JIS G 3507:1991	Withdrawn in: 2005-01-20 Replaced by: G 3507-1
JIS G 3508:1991	Withdrawn in: 2005-01-20 Replaced by: G 3508-1
JIS G 3524:1953	Withdrawn in: 1957-10-30 Replaced by: Z 3211
JIS G 3526:1962	Withdrawn in: 1980-03-01
JIS G 3527:1951	Withdrawn in: 1954-01-30 Replaced by: G 3532
JIS G 3528:1951	Withdrawn in: 1954-01-30 Replaced by: G 3533
JIS G 3529:1951	Withdrawn in: 1954-01-30
JIS G 3530:1977	Withdrawn in: 1980-03-01
JIS G 3531:1977	Withdrawn in: 1980-03-01
JIS G 3534:1954	Withdrawn in: 1957-06-21 Replaced by: Z 3201
JIS G 3534:1988	Withdrawn in: 1994-06-01
JIS G 3539:1991	Withdrawn in: 2005-01-20 Replaced by: G 3507-2
JIS G 3541:1988	Withdrawn in: 1992-02-01
JIS G 3545:1991	Withdrawn in: 2005-01-20 Replaced by: G 3508-2
JIS G 3565:1988	Withdrawn in: 1994-06-01
JIS G 3566:1988	Withdrawn in: 1994-06-01 Replaced by: G 3561
JIS G 3567:1988	Withdrawn in: 1994-06-01 Replaced by: G 3560
JIS G 3568:1989	Withdrawn in: 1994-06-01 Replaced by: G 3560
JIS G 4102:1979	Withdrawn in: 2003-05-20 Replaced by: G 4053
JIS G 4103:1979	Withdrawn in: 2003-05-20 Replaced by: G 4053
JIS G 4104:1979	Withdrawn in: 2003-05-20 Replaced by: G 4053
JIS G 4105:1979	Withdrawn in: 2003-05-20 Replaced by: G 4053
JIS G 4106:1979	Withdrawn in: 2003-05-20 Replaced by: G 4053
JIS G 4201:1950	Withdrawn in: 1953-11-07 Replaced by: G 3102; G 4102; G 4103; G 4104; G 4105
JIS G 4202:2005	Withdrawn in: 2008-11-20 Replaced by: G 4053
JIS G 4301:1955	Withdrawn in: 1959-12-01 Replaced by: G 4303; G 4304; G 4305; G 4306; G 4307; G 4308; G 4309
JIS G 4302:1954	Withdrawn in: 1964-09-01 Replaced by: G 4311; G 4312
JIS G 4306:1988	Withdrawn in: 1991-11-01 Replaced by: G 4304
JIS G 4307:1987	Withdrawn in: 1991-11-01 Replaced by: G 4305
JIS G 4310:1999	Withdrawn in: 2012-01-20 Replaced by: G 4304; G 4305; G 4312
JIS G 4402:1953	Withdrawn in: 1956-04-18 Replaced by: G 4404
JIS G 4405:1954	Withdrawn in: 1956-04-18
JIS G 4406:1954	Withdrawn in: 1956-04-18
JIS G 4407:1954	Withdrawn in: 1956-04-18 Replaced by: G 4404
JIS G 4410:1984	Withdrawn in: 2005-07-20
JIS G 5521:1977	Withdrawn in: 1983-02-01
JIS G 5522:1977	Withdrawn in: 1983-02-01
JIS G 5523:1977	Withdrawn in: 1983-02-01
JIS G 5524:1977	Withdrawn in: 1989-01-01
JIS G 5701:1952	Withdrawn in: 1960-03-01 Replaced by: G 5702; G 5703; G 5704

Standard	Date Withdrawn/Replaced by
JIS G 5702:1988	Withdrawn in: 2000-02-20 Replaced by: G 5705
JIS G 5703:1988	Withdrawn in: 2000-02-20 Replaced by: G 5705
JIS G 5704:1988	Withdrawn in: 2000-02-20 Replaced by: G 5705
JIS G 7101:2000	Withdrawn in: 2014-09-22 Replaced by: G 3114
JIS G 7102:2000	Withdrawn in: 2013-11-20 Replaced by: G 3125
JIS G 7103:2000	Withdrawn in: 2014-02-20 Replaced by: G 3112
JIS G 7104:2000	Withdrawn in: 2014-02-20 Replaced by: G 3112
JIS G 7121:2000	Withdrawn in: 2013-11-20 Replaced by: G 3303
JIS G 7122:2000	Withdrawn in: 2013-11-20 Replaced by: G 3315
JIS G 7123:2000	Withdrawn in: 2013-11-20 Replaced by: G 3303
JIS G 7124:2000	Withdrawn in: 2013-11-20 Replaced by: G 3314
JIS G 7219:2003	Withdrawn in: 2013-11-20 Replaced by: G 3454
JIS G 7220:2003	Withdrawn in: 2013-11-20 Replaced by: G 3455; G 3456; G 3458; G 3461; G 3462
JIS G 7221:2003	Withdrawn in: 2013-11-20 Replaced by: G 3460; G 3464
JIS G 7222:2003	Withdrawn in: 2013-11-20 Replaced by: G 3459; G 3463
JIS G 7223:2003	Withdrawn in: 2013-11-20 Replaced by: G 3454
JIS G 7224:2003	Withdrawn in: 2013-11-20 Replaced by: G 3456; G 3461; G 3462
JIS G 7225:2003	Withdrawn in: 2013-11-20 Replaced by: G 3460; G 3464
JIS G 7226:2003	Withdrawn in: 2013-11-20 Replaced by: G 3459; G 3463; G 3468
JIS G 7301:1998	Withdrawn in: 2013-11-20
JIS G 7501:2000	Withdrawn in: 2014-02-20 Replaced by: G 4051; G 4052
JIS G 7503:2000	Withdrawn in: 2014-02-20 Replaced by: G 4051; G 4052; G 4053
JIS G 7601:2000	Withdrawn in: 2014-09-22 Replaced by: G 4311; G 4312; G 4901; G 4902
JIS G 7602:2000	Withdrawn in: 2014-09-22 Replaced by: G 4314
JIS G 7603:2000	Withdrawn in: 2014-09-22 Replaced by: G 4311
JIS G 7604:2000	Withdrawn in: 2014-09-22 Replaced by: G 4901; H 4553
JIS G 7605:2001	Withdrawn in: 2014-09-22 Replaced by: H 4551
JIS G 7751:2000	Withdrawn in: 2014-02-20 Replaced by: G 4801
JIS G 9071:1976	Withdrawn in: 1992-02-01
JIS G 9072:1976	Withdrawn in: 1992-02-01

Appendix

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***JIS STEEL AND
RELATED STANDARDS***

Standard	Title
G 3101:2015	Rolled steels for general structure
G 3103:2012	Carbon steel and molybdenum alloy steel plates for boilers and pressure vessels
G 3105:2004	Steel bars for chains
G 3106:2015	Rolled steels for welded structure
G 3108:2004	Rolled carbon steel for cold-finished steel bars
G 3109:2008	Steel bars for prestressed concrete
G 3112:2010	Steel bars for concrete reinforcement
G 3113:2006	Hot-rolled steel plate, sheet and strip for automobile structural uses
G 3114:2008	Hot-rolled atmospheric corrosion resisting steels for welded structure
G 3115:2010	Steel plates for pressure vessels for intermediate temperature service
G 3116:2013	Steel sheet, plates and strip for gas cylinders
G 3117:1987	Rerolled steel bars for concrete reinforcement
G 3118:2010	Carbon steel plates for pressure vessels for intermediate and moderate temperature services
G 3119:2013	Manganese-molybdenum and manganese-molybdenum-nickel alloy steel plates for boilers and pressure vessels
G 3120:2014	Manganese-molybdenum and manganese-molybdenum-nickel alloy steel plates quenched and tempered for pressure vessels
G 3123:2004	Cold finished carbon and alloy steel bars
G 3124:2015	High strength steel plates for pressure vessel for intermediate and moderate temperature service
G 3125:2010	Superior atmospheric corrosion resisting rolled steels
G 3126:2015	Carbon steel plates for pressure vessels for low temperature service
G 3127:2013	Nickel steel plates for pressure vessels for low temperature services
G 3128:2009	High yield strength steel plates for welded structure
G 3129:2005	High tensile strength steel for tower structural purposes
G 3131:2010	Hot-rolled mild steel plates, sheets and strip
G 3132:2011	Hot-rolled carbon steel strip for pipes and tubes
G 3133:2015	Decarburized steel sheet and strip for porcelain enamelling
G 3134:2006	Hot-rolled high strength steel plate, sheet and strip with improved formability for automobile structural uses
G 3135:2006	Cold-reduced high strength steel sheet and strip with improved formability for automobile structural uses
G 3136:2012	Rolled steels for building structure
G 3137:2008	Small diameter steel bars for prestressed concrete
G 3138:2005	Rolled steel bars for building structure
G 3141:2011	Cold-reduced carbon steel sheet and strip
G 3191:2012	Dimensions, mass and permissible variations of hot rolled steel bars and bar in coil
G 3192:2014	Dimensions, mass and permissible variations of hot rolled steel sections
G 3193:2008	Dimensions, mass and permissible variations of hot rolled steel plates, sheets and strips
G 3194:1998	Dimensions, mass and permissible variations of hot rolled flat steel
G 3199:2009	Specification for through-thickness characteristics of steel plate, wide flat and sections
G 3201:1988	Carbon steel forgings for general use
G 3202:1988	Carbon steel forgings for pressure vessels
G 3203:1988	Alloy steel forgings for pressure vessels for high-temperature service
G 3204:1988	Quenched and tempered alloy steel forgings for pressure vessels
G 3205:1988	Carbon and alloy steel forgings for pressure vessels for low-temperature service
G 3206:1993	High strength chromium-molybdenum alloy steel forgings for pressure vessels under high-temperature service
G 3214:1991	Stainless steel forgings for pressure vessels
G 3221:1988	Chromium molybdenum steel forgings for general use
G 3222:1988	Nickel chromium molybdenum steel forgings for general use
G 3223:1988	High tensile strength steel forgings for tower flanges
G 3251:1988	Carbon steel blooms and billets for forgings
G 3302:2010	Hot-dip zinc-coated steel sheet and strip
G 3303:2008	Tinplate and blackplate
G 3311:2010	Cold rolled special steel strip
G 3312:2012	Prepainted hot-dip zinc-coated steel sheet and strip
G 3313:2015	Electrolytic zinc-coated steel sheet and strip
G 3314:2010	Hot-dip aluminium-coated steel sheet and strip
G 3315:2008	Chromium coated tin free steel
G 3316:1987	Shapes and dimensions of corrugated steel sheets

Standard	Title
G 3317:2010	Hot-dip zinc-5% aluminium alloy-coated steel sheet and strip
G 3318:2012	Prepainted hot-dip zinc-5% aluminium alloy-coated steel sheet and strip
G 3320:1999	Coated stainless steel sheets
G 3321:2010	Hot-dip 55% aluminium-zinc alloy-coated steel sheet and strip
G 3322:2012	Prepainted hot-dip 55% aluminium-zinc alloy-coated steel sheet and strip
G 3350:2009	Light gauge steel sections for general structure
G 3351:1987	Expanded metals
G 3352:2014	Steel decks
G 3353:2011	Welded light gauge steel H sections for general structure
G 3429:2013	Seamless steel tubes for high pressure gas cylinders
G 3441:2015	Alloy steel tubes for machine purposes
G 3442:2015	Galvanized steel pipes for ordinary piping
G 3443-1:2014	Coated steel pipes for water service – Part 1: Pipes
G 3443-2:2014	Coated steel pipes for water service – Part 2: Fittings
G 3443-3:2014	Coated steel pipes for water service – Part 3: Long-life external plastic coatings
G 3443-4:2014	Coated steel pipes for water service – Part 4: Internal epoxy coatings
G 3444:2010	Carbon steel tubes for general structure
G 3445:2010	Carbon steel tubes for machine structure
G 3446:2012	Stainless steel pipes for machine and structural purposes
G 3447:2015	Stainless steel sanitary pipes
G 3448:2012	Light gauge stainless steel tubes for ordinary piping
G 3452:2014	Carbon steel pipes for ordinary piping
G 3454:2012	Carbon steel tubes for pressure service
G 3455:2012	Carbon steel pipes for high pressure service
G 3456:2014	Carbon steel pipes for high temperature service
G 3457:2012	Arc welded carbon steel pipes
G 3458:2013	Alloy steel pipes
G 3459:2012	Stainless steel pipes
G 3460:2013	Steel tubes for low temperature service
G 3461:2012	Carbon steel boiler and heat exchanger tubes
G 3462:2014	Alloy steel tubes for boiler and heat exchanger
G 3463:2012	Stainless steel boiler and heat exchanger tubes
G 3464:2013	Steel heat exchanger tubes for low temperature service
G 3465:2014	Seamless steel tubes for drilling
G 3466:2010	Carbon steel square and rectangular tubes for general structure
G 3467:2013	Steel tubes for fired heater
G 3468:2011	Large diameter welded stainless steel pipes
G 3469:2010	Polyethylene coated steel pipes
G 3471:2012	Corrugated steel pipe
G 3472:2013	Electric resistance welded carbon steel tubes for automobile
G 3473:2013	Carbon steel tubes for cylinder barrels
G 3474:2014	High strength steel tubes for steel tower
G 3475:2014	Carbon steel tubes for building structure
G 3502:2013	Piano wire rods
G 3503:2006	Wire rods for core wire of covered electrode
G 3505:2004	Low carbon steel wire rods
G 3506:2004	High carbon steel wire rods
G 3507-1:2010	Carbon steels for cold heading – Part 1: Wire rods
G 3507-2:2005	Carbon steels for cold heading – Part 2: Wires
G 3508-1:2010	Boron steels for cold heading – Part 1: Wire rods
G 3508-2:2005	Boron steels for cold heading – Part 2: Wires
G 3509-1:2010	Low-alloyed steels for cold heading – Part 1: Wire rods
G 3509-2:2003	Low-alloyed steels for cold heading – Part 2: Wires
G 3510:1992	Testing methods for steel tire cords
G 3521:1991	Hard drawn steel wires

Standard	Title
G 3522:2014	Piano wires
G 3523:1980	Core wires for covered electrode
G 3525:2013	Wire ropes
G 3532:2011	Low carbon steel wires
G 3533:1993	Barbed wires
G 3535:2012	Wire ropes for aircraft control
G 3536:2014	Steel wires and strands for prestressed concrete
G 3537:2011	Zinc-coated steel wire strands
G 3538:1994	Hard drawn steel wire for prestressed concrete
G 3540:2012	Wire ropes for mechanical control
G 3542:1993	Precoated color zinc-coated steel wires
G 3543:2005	Steel wire coated with colored plastics
G 3544:1993	Hot-dip aluminium-coated steel wires
G 3546:2012	Wire ropes with profile wires
G 3547:2015	Zinc-coated low carbon steel wires
G 3548:2011	Zinc-coated steel wires
G 3549:2000	Wire ropes for structure
G 3550:2003	Stainless steel wire ropes for structure
G 3551:2005	Welded steel wire and bar fabrics
G 3552:2007	Chain link wire netting
G 3553:2002	Crimped wire cloth
G 3554:2002	Hexagonal wire netting
G 3555:2004	Woven wire cloth
G 3556:2002	Industrial woven wire cloth
G 3557:2004	Stainless steel wire ropes for general purposes
G 3560:1994	Oil tempered wire for mechanical springs
G 3561:1994	Oil tempered wire for valve springs
G 3601:2012	Stainless-clad steels
G 3602:2012	Nickel and nickel alloy clad steels
G 3603:2012	Titanium clad steels
G 3604:2012	Copper and copper alloy clad steels
G 4051:2009	Carbon steels for machine structural use
G 4052:2008	Structural steels with specified hardenability bands
G 4053:2008	Low-alloyed steels for machine structural use
G 4107:2007	Alloy steel bolting materials for high temperature service
G 4108:2007	Alloy steel bars for special application bolting materials
G 4109:2013	Chromium-molybdenum alloy steel plates for boilers and pressure vessels
G 4110:2015	High strength chromium-molybdenum and chromium-molybdenum-vanadium alloy steel plates for pressure vessels under high-temperature service
G 4303:2012	Stainless steel bars
G 4304:2012	Hot-rolled stainless steel plate, sheet and strip
G 4305:2012	Cold-rolled stainless steel plate, sheet and strip
G 4308:2013	Stainless steel wire rods
G 4309:2013	Stainless steel wires
G 4311:2011	Heat-resisting steel bars and wire rods
G 4312:2011	Heat-resisting steel plate, sheet and strip
G 4313:2011	Cold rolled stainless steel strip for springs
G 4314:2013	Stainless steel wires for springs
G 4315:2013	Stainless steel wires for cold heading and cold forging
G 4316:1991	Stainless steel wire rods for welding
G 4317:2013	Hot-formed stainless steel sections
G 4318:1998	Cold finished stainless steel bars
G 4319:1991	Stainless steel blooms and billets for forgings
G 4320:2003	Cold-formed stainless steel sections
G 4321:2000	Stainless steel for building structure
G 4401:2009	Carbon tool steels

Standard	Title
G 4403:2006	High speed tool steels
G 4404:2006	Alloy tool steels
G 4801:2011	Spring steels
G 4802:2011	Cold-rolled steel strip for springs
G 4804:2008	Free-cutting steels
G 4805:2008	High carbon chromium bearing steels
G 4901:1999	Corrosion-resisting and heat-resisting superalloy bars
G 4902:1991	Corrosion-resisting and heat-resisting superalloy plates and sheets
G 4903:2008	Seamless nickel-chromium-iron alloy pipes
G 4904:2008	Seamless nickel-chromium-iron alloy heat exchanger tubes
G 5101:1991	Carbon steel castings
G 5102:1991	Steel castings for welded structure
G 5111:1991	High tensile strength carbon steel castings and low alloy steel castings for structural purposes
G 5121:2003	Corrosion-resistant cast steels for general applications
G 5122:2003	Heat-resistant cast steels and alloys for general applications
G 5131:2008	High manganese steel castings
G 5151:1991	Steel castings for high temperature and high pressure service
G 5152:1991	Steel castings for low temperature and high pressure service
G 5201:1991	Centrifugally cast steel pipes for welded structure
G 5202:1991	Centrifugally cast steel pipes for high temperature and high pressure service
G 5501:1995	Grey iron castings
G 5502:2001	Spheroidal graphite iron castings
G 5503:1995	Austempered spheroidal graphite iron castings
G 5504:2005	Heavy-walled ferritic spheroidal graphite iron castings for low temperature service
G 5510:2012	Austenitic iron castings
G 5511:1991	Low thermal expansive Fe-alloy castings
G 5525:2000	Cast-iron drainage pipes and fittings
G 5526:2014	Ductile iron pipes
G 5527:2014	Ductile iron fittings
G 5528:2014	Epoxy-powder coating for interior of ductile iron pipes and fittings
G 5705:2000	Malleable iron castings
G 5901:1974	Molding silica sand
G 5902:1974	Molding natural sand
G 5903:1975	Cast shot and grit
G 5904:1966	Testing method of cast shot and grit grain size
G 7105:2000	Heat-treatable steels, alloy steels and free-cutting steels – Part 18: Bright products of unalloyed and low alloy steels
G 7125:2003	Hollow steel bars for machining (ISO specifications)
G 7214:2000	Seamless nickel and nickel alloy tube
G 7215:2003	Plain end seamless steel tubes for mechanical application (ISO specifications)
G 7216:2003	Plain end seamless precision steel tubes – Technical conditions for delivery (ISO specifications)
G 7217:2003	Plain end welded precision steel tubes – Technical conditions for delivery (ISO specifications)
G 7218:2003	Plain end as-welded and sized precision steel tubes – Technical conditions for delivery (ISO specifications)
G 7302:2000	Zinc coatings for steel wire
G 7303:2000	Zinc-coated steel wire for fencing
G 7304:2000	Steel wire for mechanical springs – Part 1: General requirements
G 7305:2000	Steel wire for mechanical springs – Part 2: Cold-drawn carbon steel wire
G 7306:2000	Steel wire for mechanical springs – Part 3: Oil-hardened and tempered wire
G 7307:2000	Steel for the prestressing of concrete – Part 1: General requirements
G 7308:2000	Steel for the prestressing of concrete – Part 2: Cold-drawn wire
G 7309:2000	Steel for the prestressing of concrete – Part 3: Quenched and tempered wire
G 7310:2000	Steel for the prestressing of concrete – Part 4: Strand
G 7311:2000	Steel for the prestressing of concrete – Part 5: Hot-rolled steel bars with or without subsequent processing
G 7401:2000	Steels for cold heading and cold extruding
G 7502:2000	Wrought nitriding steels
G 7701:2000	Tool steels

Standard	Title
G 7821:2000	Cast carbon steels for general engineering purposes

Appendix

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EN CURRENT STEEL STANDARDS

Standard	Title
EN 39:2001	Loose steel tubes for tube and coupler scaffolds - Technical delivery conditions
EN 502:2013	Roofing products from metal sheet - Specification for fully supported roofing products of stainless steel sheet
EN 505:2013	Roofing products from metal sheet - Specification for fully supported roofing products of steel sheet
EN 508-1:2014	Roofing and cladding products from metal sheet - Specification for self-supporting of steel, aluminium or stainless steel sheet - Part 1: Steel
EN 508-2:2008	Roofing products from metal sheet - Specification for self-supporting products of steel, aluminium or stainless steel sheet - Part 2: Aluminium
EN 508-3:2008	Roofing products from metal sheet - Specification for self-supporting products of steel, aluminium or stainless steel sheet - Part 3: Stainless steel
EN 523:2003	Steel strip sheaths for prestressing tendons - Terminology, requirements, quality control
EN 524-1:1997	Steel strip sheaths for prestressing tendons - Test methods - Part 1: Determination of shape and dimensions
EN 524-2:1997	Steel strip sheaths for prestressing tendons - Test methods - Part 2: Determination of flexural behaviour
EN 524-3:1997	Steel strip sheaths for prestressing tendons - Methods of test - Part 3: To-and-fro bending test
EN 524-4:1997	Steel strip sheaths for prestressing tendons - Test methods - Part 4: Determination of lateral load resistance
EN 524-5:1997	Steel strip sheaths for prestressing tendons - Test methods - Part 5: Determination of tensile load resistance
EN 524-6:1997	Steel strip sheaths for prestressing tendons - Test methods - Part 6: Determination of leaktightness (determination of water loss)
EN 544:2011	Bitumen shingles with mineral and/or synthetic reinforcements - Product specification and test methods
EN 1123-1:1999	Pipes and fittings of longitudinally welded hot-dip galvanized steel pipes with spigot and socket for waste water systems - Part 1: Requirements, testing, quality control
EN 1123-2:2006	Pipes and fittings of longitudinally welded hot-dip galvanized steel tube with spigot and socket for waste water systems - Part 2: Dimensions
EN 1123-3:2004	Pipes and fittings of longitudinally welded hot-dip galvanized steel pipes with spigot and socket for waste water systems - Part 3: Dimensions and special requirements for vacuum drainage systems and for drainage systems in ship-building
EN 1124-1:1999	Pipes and fittings of longitudinally welded stainless steel pipes with spigot and socket for waste water systems - Part 1: Requirements, testing, quality control
EN 1124-2:2014	Pipes and fittings of longitudinally welded stainless steel pipes with spigot and socket for waste water systems - Part 2: System S, forms and dimensions
EN 1124-3:2008	Pipes and fittings of longitudinally welded stainless steel pipes with spigot and socket for waste water systems - Part 3: System X - Dimensions
EN 1124-4:2013	Pipes and fittings of longitudinally welded stainless steel pipes with spigot and socket for wastewater systems - Part 4: Components for vacuum drainage systems and for drainage systems on ships
EN 1370:2011	Founding - Examination of surface condition
EN 1503-1:2000	Valves - Materials for bodies, bonnets and covers - Part 1: Steels specified in European Standards
EN 1503-2:2000	Valves - Materials for bodies, bonnets and covers - Part 2: Steels other than those specified in European Standards
EN 1503-3:2000	Valves - Materials for bodies, bonnets and covers - Part 3: Cast irons specified in European Standards
EN 1503-4:2002	Valves - Materials for bodies, bonnets and covers - Part 4: Copper alloys specified in European Standards
EN 1559-1:2011	Founding - Technical conditions of delivery - Part 1: General
EN 1559-2:2014	Founding - Technical conditions of delivery - Part 2: Additional requirements for steel castings
EN 1559-3:2011	Founding - Technical conditions of delivery - Part 3: Additional requirements for iron castings
EN 1559-4:2015	Founding - Technical conditions of delivery - Part 4: Additional requirements for aluminium alloy castings
EN 1559-5:1997	Founding - Technical conditions of delivery - Part 5: Additional requirements for magnesium alloy castings
EN 1559-6:1998	Founding - Technical conditions of delivery - Part 6: Additional requirements for zinc alloy castings
EN 1561:2011	Founding - Grey cast irons
EN 1562:2012	Founding - Malleable cast irons
EN 1563:2011	Founding - Spheroidal graphite cast irons
EN 1677-1:2000	Components for slings - Safety - Part 1: Forged steel components, Grade 8
EN 1677-2:2000	Components for slings - Safety - Part 2: Forged steel lifting hooks with latch, Grade 8
EN 1677-3:2001	Components for slings - Safety - Part 3: Forged steel self-locking hooks - Grade 8
EN 1677-4:2000	Components for slings - Safety - Part 4: Links, Grade 8
EN 1677-5:2001	Components for slings - Safety - Part 5: Forged steel lifting hooks with latch - Grade 4
EN 1677-6:2001	Components for slings - Safety - Part 6: Links - Grade 4
EN 1759-1:2004	Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, Class designated - Part 1: Steel flanges, NPS 1/2 to 24
EN 2515:1990	Rod ends, adjustable single fork and threaded shank - Dimensions and loads
EN 3305:1996	Screws, 100° countersunk reduced head, offset cruciform recess, close tolerance normal shank, short thread, in alloy steel, cadmium plated - Classification: 1 100 MPa (at ambient temperature)/235 °C
EN 10024:1995	Hot rolled taper flange I sections - Tolerances on shape and dimensions
EN 10025-1:2004	Hot rolled products of structural steels - Part 1: General technical delivery conditions
EN 10025-2:2004	Hot rolled products of structural steels - Part 2: Technical delivery conditions for non-alloy structural steels

Standard	Title
EN 10025-3:2004	Hot rolled products of structural steels - Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels
EN 10025-4:2004	Hot rolled products of structural steels - Part 4: Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels
EN 10025-5:2004	Hot rolled products of structural steels - Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance
EN 10025-6:2004	Hot rolled products of structural steels - Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition
EN 10027-1:2005	Designation systems for steels - Part 1: Steel names
EN 10027-2:2015	Designation systems for steels - Part 2: Numerical system
EN 10028-1:2007	Flat products made of steels for pressure purposes - Part 1: General requirements
EN 10028-2:2009	Flat products made of steels for pressure purposes - Part 2: Non-alloy and alloy steels with specified elevated temperature properties
EN 10028-3:2009	Flat products made of steels for pressure purposes - Part 3: Weldable fine grain steels, normalized
EN 10028-4:2009	Flat products made of steels for pressure purposes - Part 4: Nickel alloy steels with specified low temperature properties
EN 10028-5:2009	Flat products made of steels for pressure purposes - Part 5: Weldable fine grain steels, thermomechanically rolled
EN 10028-6:2009	Flat products made of steels for pressure purposes - Part 6: Weldable fine grain steels, quenched and tempered
EN 10028-7:2007	Flat products made of steels for pressure purposes - Part 7: Stainless steels
EN 10029:2010	Hot-rolled steel plates 3 mm thick or above - Tolerances on dimensions and shape
EN 10034:1993	Structural steel I and H sections - Tolerances on shape and dimensions
EN 10048:1996	Hot rolled narrow steel strip - Tolerances on dimensions and shape
EN 10051:2010	Continuously hot-rolled strip and plate/sheet cut from wide strip of non-alloy and alloy steels - Tolerances on dimensions and shape
EN 10055:1995	Hot rolled steel equal flange tees with radiused root and toes - Dimensions and tolerances on shape and dimensions
EN 10056-1:1998	Structural steel equal and unequal leg angles - Part 1: Dimensions
EN 10056-2:1993	Structural steel equal and unequal leg angles - Part 2: Tolerances on shape and dimensions
EN 10067:1996	Hot rolled bulb flats - Dimensions and tolerances on shape, dimensions and mass
EN 10079:2007	Definition of steel products
EN 10080:2005	Steel for the reinforcement of concrete - Weldable reinforcing steel - General
EN 10083-1:2006	Steels for quenching and tempering - Part 1: General technical delivery conditions
EN 10083-2:2006	Steels for quenching and tempering - Part 2: Technical delivery conditions for non-alloy steels
EN 10083-3:2006	Steels for quenching and tempering - Part 3: Technical delivery conditions for alloy steels
EN 10084:2008	Case hardening steels - Technical delivery conditions
EN 10085:2001	Nitriding steel - Technical delivery conditions
EN 10087:1998	Free cutting steels - Technical delivery conditions for semi-finished products, hot-rolled bars and rods
EN 10088-1:2014	Stainless steels - Part 1: List of stainless steels
EN 10088-2:2014	Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes
EN 10088-3:2014	Stainless steels - Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes
EN 10088-4:2009	Stainless steels - Part 4: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes
EN 10088-5:2009	Stainless steels - Part 5: Technical delivery conditions for bars, rods, wire, sections and bright products of corrosion resisting steels for construction purposes
EN 10089:2002	Hot-rolled steels for quenched and tempered springs - Technical delivery conditions
EN 10090:1998	Valve steels and alloys for internal combustion engines
EN 10095:1999	Heat resisting steel and nickel alloys
EN 10106:2007	Cold rolled non-oriented electrical steel sheet and strip delivered in the fully processed state
EN 10107:2014	Grain-oriented electrical steel strip and sheet delivered in the fully processed state
EN 10111:2008	Continuously hot rolled low carbon steel sheet and strip for cold forming - Technical delivery conditions
EN 10120:1996	Steel sheet and strip for welded gas cylinders
EN 10130:2006	Cold rolled low carbon steel flat products for cold forming - Technical delivery conditions
EN 10131:2006	Cold rolled uncoated and zinc or zinc-nickel electrolytically coated low carbon and high yield strength steel flat products for cold forming - Tolerances on dimensions and shape
EN 10132-1:2000	Cold rolled narrow steel strip for heat treatment - Technical delivery conditions - Part 1: General
EN 10132-2:2000	Cold rolled narrow steel strip for heat treatment - Technical delivery conditions - Part 2: Case hardening steels
EN 10132-3:2000	Cold rolled narrow steel strip for heat treatment - Technical delivery conditions - Part 3: Steels for quenching and tempering
EN 10132-4:2000	Cold rolled narrow steel strip for heat treatment - Technical delivery conditions - Part 4: Spring steels and other applications

Standard	Title
EN 10139:1997	Cold rolled uncoated mild steel narrow strip for cold forming - Technical delivery conditions
EN 10140:2006	Cold rolled narrow steel strip - Tolerances on dimensions and shape
EN 10143:2006	Continuously hot-dip metal coated steel sheet and strip - Tolerances on dimensions and shape
EN 10149-1:2013	Hot rolled flat products made of high yield strength steels for cold forming - Part 1: General technical delivery conditions
EN 10149-2:2013	Hot rolled flat products made of high yield strength steels for cold forming - Part 2: Technical delivery conditions for thermomechanically rolled steels
EN 10149-3:2013	Hot rolled flat products made of high yield strength steels for cold forming - Part 3: Technical delivery conditions for normalized or normalized rolled steels
EN 10151:2002	Stainless steel strip for springs - Technical delivery conditions
EN 10152:2009	Electrolytically zinc coated cold rolled steel flat products for cold forming - Technical delivery conditions
EN 10160:1999	Ultrasonic testing of steel flat product of thickness equal or greater than 6 mm (reflection method)
EN 10162:2003	Cold rolled steel sections - Technical delivery conditions - Dimensions and cross-sectional tolerances
EN 10163-1:2004	Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections - Part 1: General requirements
EN 10163-2:2004	Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections - Part 2: Plate and wide flats
EN 10163-3:2004	Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections - Part 3: Sections
EN 10164:2004	Steel products with improved deformation properties perpendicular to the surface of the product - Technical delivery conditions
EN 10169:2010	Continuously organic coated (coil coated) steel flat products - Technical delivery conditions
EN 10202:2001	Cold reduced tinmill products - Electrolytic tinplate and electrolytic chromium/chromium oxide coated steel
EN 10204:2004	Metallic products - Types of inspection documents
EN 10205:1991	Cold reduced blackplate in coil form for the production of tinplate or electrolytic chromium/chromium oxide coated steel
EN 10207:2005	Steels for simple pressure vessels - Technical delivery requirements for plates, strips and bars
EN 10209:2013	Cold rolled low carbon steel flat products for vitreous enamelling - Technical delivery conditions
EN 10210-1:2006	Hot finished structural hollow sections of non-alloy and fine grain steels - Part 1: Technical delivery conditions
EN 10210-2:2006	Hot finished structural hollow sections of non-alloy and fine grain steels - Part 2: Tolerances, dimensions and sectional properties
EN 10213:2007	Steel castings for pressure purposes
EN 10216-1:2013	Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 1: Non-alloy steel tubes with specified room temperature properties
EN 10216-2:2013	Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties
EN 10216-3:2013	Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 3: Alloy fine grain steel tubes
EN 10216-4:2013	Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 4: Non-alloy and alloy steel tubes with specified low temperature properties
EN 10216-5:2013	Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 5: Stainless steel tubes
EN 10217-1:2002	Welded steel tubes for pressure purposes - Technical delivery conditions - Part 1: Non-alloy steel tubes with specified room temperature properties
EN 10217-2:2002	Welded steel tubes for pressure purposes - Technical delivery conditions - Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties
EN 10217-3:2002	Welded steel tubes for pressure purposes - Technical delivery conditions - Part 3: Alloy fine grain steel tubes
EN 10217-4:2002	Welded steel tubes for pressure purposes - Technical delivery conditions - Part 4: Electric welded non-alloy steel tubes with specified low temperature properties
EN 10217-5:2002	Welded steel tubes for pressure purposes - Technical delivery conditions - Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties
EN 10217-6:2002	Welded steel tubes for pressure purposes - Technical delivery conditions - Part 6: Submerged arc welded non-alloy steel tubes with specified low temperature properties
EN 10217-7:2014	Welded steel tubes for pressure purposes - Technical delivery conditions - Part 7: Stainless steel tubes
EN 10218-1:2012	Steel wire and wire products - General - Part 1: Test methods
EN 10218-2:2012	Steel wire and wire products - General - Part 2: Wire dimensions and tolerances
EN 10219-1:2006	Cold formed welded structural hollow sections of non-alloy and fine grain steels - Part 1: Technical delivery conditions
EN 10219-2:2006	Cold formed welded structural hollow sections of non-alloy and fine grain steels - Part 2: Tolerances, dimensions and sectional properties
EN 10221:1995	Surface quality classes for hot-rolled bars and rods - Technical delivery conditions
EN 10222-1:1998	Steel forgings for pressure purposes - Part 1: General requirements for open die forgings
EN 10222-2:1999	Steel forgings for pressure purposes - Part 2: Ferritic and martensitic steels with specified elevated temperature properties
EN 10222-3:1998	Steel forgings for pressure purposes - Part 3: Nickel steels with specified low-temperature properties
EN 10222-4:1998	Steel forgings for pressure purposes - Part 4: Weldable fine-grain steels with high proof strength

Standard	Title
EN 10222-5:1999	Steel forgings for pressure purposes - Part 5: Martensitic, austenitic and austenitic-ferritic stainless steels
EN 10223-1:2012	Steel wire and wire products for fencing and netting - Part 1: Zinc and zinc-alloy coated steel barbed wire
EN 10223-2:2012	Steel wire and wire products for fencing and netting - Part 2: Hexagonal steel wire netting for agricultural, insulation and fencing purposes
EN 10223-3:2013	Steel wire and wire products for fencing and netting - Part 3: Hexagonal steel wire mesh products for civil engineering purposes
EN 10223-4:2012	Steel wire and wire products for fencing and netting - Part 4: Steel wire welded mesh fencing
EN 10223-5:2012	Steel wire and wire products for fencing and netting - Part 5: Steel wire woven hinged joint and knotted mesh fencing
EN 10223-6:2012	Steel wire and wire products for fencing and netting - Part 6: Steel wire chain link fencing
EN 10223-7:2012	Steel wire and wire products for fencing and netting - Part 7: Steel wire welded panels for fencing
EN 10224:2002	Non-alloy steel tubes and fittings for the conveyance of aqueous liquids including water for human consumption - Technical delivery conditions
EN 10225:2009	Weldable structural steels for fixed offshore structures - Technical delivery conditions
EN 10228-1:1999	Non-destructive testing of steel forgings - Part 1: Magnetic particle inspection
EN 10228-2:1998	Non-destructive testing of steel forgings - Part 2: Penetrant testing
EN 10228-3:1998	Non-destructive testing of steel forgings - Part 3: Ultrasonic testing of ferritic or martensitic steel forgings
EN 10228-4:1999	Non-destructive testing of steel forgings - Part 4: Ultrasonic testing of austenitic and austenitic-ferritic stainless steel forgings
EN 10238:2009	Automatically blast-cleaned and automatically prefabrication primed structural steel products
EN 10240:1997	Internal and/or external protective coatings for steel tubes - Specification for hot dip galvanized coatings applied in automatic plants
EN 10241:2000	Steel threaded pipe fittings
EN 10243-1:1999	Steel die forgings - Tolerances on dimensions - Part 1: Drop and vertical press forgings
EN 10243-2:1999	Steel die forgings - Tolerances on dimensions - Part 2: Upset forgings made on horizontal forging machines
EN 10244-1:2009	Steel wire and wire products - Non-ferrous metallic coatings on steel wire - Part 1: General principles
EN 10244-2:2009	Steel wire and wire products - Non-ferrous metallic coatings on steel wire - Part 2: Zinc or zinc alloy coatings
EN 10244-3:2001	Steel wire and wire products - Non-ferrous metallic coatings on steel wire - Part 3: Aluminium coatings
EN 10244-4:2001	Steel wire and wire products - Non-ferrous metallic coatings on steel wire - Part 4: Tin coatings
EN 10244-5:2001	Steel wire and wire products - Non-ferrous metallic coatings on steel wire - Part 5: Nickel coatings
EN 10244-6:2001	Steel wire and wire products - Non-ferrous metallic coatings on steel wire - Part 6: Copper, bronze or brass coatings
EN 10245-1:2011	Steel wire and wire products - Organic coatings on steel wire - Part 1: General rules
EN 10245-2:2011	Steel wire and wire products - Organic coatings on steel wire - Part 2: PVC finished wire
EN 10245-3:2011	Steel wire and wire products - Organic coatings on steel wire - Part 3: PE coated wire
EN 10245-4:2011	Steel wire and wire products - Organic coatings on steel wire - Part 4: Polyester coated wire
EN 10245-5:2011	Steel wire and wire products - Organic coatings on steel wire - Part 5: Polyamide coated wire
EN 10248-1:1995	Hot rolled sheet piling of non alloy steels - Part 1: Technical delivery conditions
EN 10248-2:1995	Hot rolled sheet piling of non alloy steels - Part 2: Tolerances on shape and dimensions
EN 10249-1:1995	Cold formed sheet piling of non alloy steels - Part 1: Technical delivery conditions
EN 10249-2:1995	Cold formed sheet piling of non alloy steels - Part 2: Tolerances on shape and dimensions
EN 10250-1:1999	Open die steel forgings for general engineering purposes - Part 1: General requirements
EN 10250-2:1999	Open die steel forgings for general engineering purposes - Part 2: Non-alloy quality and special steels
EN 10250-3:1999	Open die steel forgings for general engineering purposes - Part 3: Alloy special steels
EN 10250-4:1999	Open die steel forgings for general engineering purposes - Part 4: Stainless steels
EN 10251:1997	Magnetic materials - Methods of determination of the geometrical characteristics of electrical steel sheet and strip
EN 10252:1997	Magnetic materials - Methods of measurement of magnetic properties of magnetic steel sheet and strip at medium frequencies
EN 10253-1:1999	Butt-welding pipe fittings - Part 1: Wrought carbon steel for general use and without specific inspection requirements
EN 10253-2:2007	Butt-welding pipe fittings - Part 2: Non-alloy and ferritic alloy steels with specific inspection requirements
EN 10253-3:2008	Butt-welding pipe fittings - Part 3: Wrought austenitic and austenitic-ferritic (duplex) stainless steels without specific inspection requirements
EN 10253-4:2008	Butt-welding pipe fittings - Part 4: Wrought austenitic and austenitic-ferritic (duplex) stainless steels with specific inspection requirements
EN 10254:1999	Steel closed die forgings - General technical delivery conditions
EN 10255:2004	Non-alloy steel tubes suitable for welding and threading - Technical delivery conditions
EN 10257-1:2011	Zinc or zinc alloy coated non-alloy steel wire for armouring either power cables or telecommunication cables - Part 1: Land cables
EN 10257-2:2011	Zinc or zinc alloy coated non-alloy steel wire for armouring either power cables or telecommunication cables - Part 2: Submarine cables
EN 10263-1:2001	Steel rod, bars and wire for cold heading and cold extrusion - Part 1: General technical delivery conditions
EN 10263-2:2001	Steel rod, bars and wire for cold heading and cold extrusion - Part 2: Technical delivery conditions for steels not

Standard	Title
	intended for heat treatment after cold working
EN 10263-3:2001	Steel rod, bars and wire for cold heading and cold extrusion - Part 3: Technical delivery conditions for case hardening steels
EN 10263-4:2001	Steel rod, bars and wire for cold heading and cold extrusion - Part 4: Technical delivery conditions for steels for quenching and tempering
EN 10263-5:2001	Steel rod, bars and wire for cold heading and cold extrusion - Part 5: Technical delivery conditions for stainless steels
EN 10264-1:2012	Steel wire and wire products - Steel wire for ropes - Part 1: General requirements
EN 10264-2:2012	Steel wire and wire products - Steel wire for ropes - Part 2: Cold drawn non alloy steel wire for ropes for general applications
EN 10264-3:2012	Steel wire and wire products - Steel wire for ropes - Part 3: Round and shaped non alloyed steel wire for high duty applications
EN 10264-4:2012	Steel wire and wire products - Steel wire for ropes - Part 4: Stainless steel wire
EN 10267:1998	Ferritic-pearlitic steels for precipitation hardening from hot-working temperatures
EN 10268:2006	Cold rolled steel flat products with high yield strength for cold forming - Technical delivery conditions
EN 10269:2013	Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties
EN 10270-1:2011	Steel wire for mechanical springs - Part 1: Patented cold drawn unalloyed spring steel wire
EN 10270-2:2011	Steel wire for mechanical springs - Part 2: Oil hardened and tempered spring steel wire
EN 10270-3:2011	Steel wire for mechanical springs - Part 3: Stainless spring steel wire
EN 10271:1998	Electrolytically zinc-nickel (ZN) coated steel flat products - Technical delivery conditions
EN 10272:2007	Stainless steel bars for pressure purposes
EN 10273:2007	Hot rolled weldable steel bars for pressure purposes with specified elevated temperature properties
EN 10277-1:2008	Bright steel products - Technical delivery conditions - Part 1: General
EN 10277-2:2008	Bright steel products - Technical delivery conditions - Part 2: Steels for general engineering purposes
EN 10277-3:2008	Bright steel products - Technical delivery conditions - Part 3: Free-cutting steels
EN 10277-4:2008	Bright steel products - Technical delivery conditions - Part 4: Case-hardening steels
EN 10277-5:2008	Bright steel products - Technical delivery conditions - Part 5: Steels for quenching and tempering
EN 10278:1999	Dimensions and tolerances of bright steel products
EN 10279:2000	Hot rolled steel channels - Tolerances on shape, dimensions and mass
EN 10283:2010	Corrosion resistant steel castings
EN 10293:2015	Steel castings - Steel castings for general engineering uses
EN 10294-1:2005	Hollow bars for machining - Technical delivery conditions - Part 1: Non alloy and alloy steels
EN 10294-2:2012	Hollow bars for machining - Technical delivery conditions - Part 2: Stainless steels with specified machinability properties
EN 10295:2002	Heat resistant steel castings
EN 10296-1:2003	Welded circular steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 1: Non-alloy and alloy steel tubes
EN 10296-2:2005	Welded circular steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 2: Stainless steel
EN 10297-1:2003	Seamless circular steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 1: Non-alloy and alloy steel tubes
EN 10297-2:2005	Seamless circular steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 2: Stainless steel
EN 10302:2008	Creep resisting steels, nickel and cobalt alloys
EN 10303:2001	Thin magnetic steel sheet and strip for use at medium frequencies
EN 10305-1:2010	Steel tubes for precision applications - Technical delivery conditions - Part 1: Seamless cold drawn tubes
EN 10305-2:2010	Steel tubes for precision applications - Technical delivery conditions - Part 2: Welded cold drawn tubes
EN 10305-3:2010	Steel tubes for precision applications - Technical delivery conditions - Part 3: Welded cold sized tubes
EN 10305-4:2011	Steel tubes for precision applications - Technical delivery conditions - Part 4: Seamless cold drawn tubes for hydraulic and pneumatic power systems
EN 10305-5:2010	Steel tubes for precision applications - Technical delivery conditions - Part 5: Welded cold sized square and rectangular tubes
EN 10305-6:2005	Steel tubes for precision applications - Technical delivery conditions - Part 6: Welded cold drawn tubes for hydraulic and pneumatic power systems
EN 10312:2002	Welded stainless steel tubes for the conveyance of aqueous liquids including water for human consumption - Technical delivery conditions
EN 10324:2004	Steel wire and wire products - Hose reinforcement wire
EN 10325:2006	Steel - Determination of yield strength increase by the effect of heat treatment [Bake-Hardening-Index]
EN 10340:2007	Steel castings for structural uses
EN 10341:2006	Cold rolled electrical non-alloy and alloy steel sheet and strip delivered in the semi-processed state
EN 10343:2009	Steels for quenching and tempering for construction purposes - Technical delivery conditions
EN 10346:2015	Continuously hot-dip coated steel flat products for cold forming - Technical delivery conditions

Standard	Title
EN 10347:2006	Guidance for forming of structural steels in processing
EN 12007-1:2012	Gas infrastructure - Pipelines for maximum operating pressure up to and including 16 bar - Part 1: General functional requirements
EN 12007-2:2012	Gas infrastructure - Pipelines for maximum operating pressure up to and including 16 bar - Part 2: Specific functional requirements for polyethylene (MOP up to and including 10 bar)
EN 12007-3:2015	Gas infrastructure - Pipelines for maximum operating pressure up to and including 16 bar - Part 3: Specific functional requirements for steel
EN 12007-4:2012	Gas infrastructure - Pipelines for maximum operating pressure up to and including 16 bar - Part 4: Specific functional requirements for renovation
EN 12007-5:2014	Gas infrastructure - Pipelines for maximum operating pressure up to and including 16 bar - Part 5: Service lines - Specific functional requirements
EN 12269-1:2000	Determination of the bond behaviour between reinforcing steel and autoclaved aerated concrete by the "beam test" - Part 1: Short term test
EN 12269-2:2010	Determination of the bond behaviour between reinforcing steel and autoclaved aerated concrete by the beam test - Part 2: Long term test
EN 12385-1:2002	Steel wire ropes - Safety - Part 1: General requirements
EN 12385-2:2002	Steel wire ropes - Safety - Part 2: Definitions, designation and classification
EN 12385-3:2004	Steel wire ropes - Safety - Part 3: Information for use and maintenance
EN 12385-4:2002	Steel wire ropes - Safety - Part 4: Stranded ropes for general lifting applications
EN 12385-5:2002	Steel wire ropes - Safety - Part 5: Stranded ropes for lifts
EN 12385-6:2004	Steel wire ropes - Safety - Part 6: Stranded ropes for mine shafts
EN 12385-7:2002	Steel wire ropes - Safety - Part 7: Locked coil ropes for mine shafts
EN 12385-8:2002	Steel wire ropes - Safety - Part 8: Stranded hauling and carrying-hauling ropes for cableway installations designed to carry persons
EN 12385-9:2002	Steel wire ropes - Safety - Part 9: Locked coil carrying ropes for cableway installations designed to carry persons
EN 12385-10:2003	Steel wire ropes - Safety - Part 10: Spiral ropes for general structural applications
EN 12513:2011	Founding - Abrasion resistant cast irons
EN 12536:2000	Welding consumables - Rods for gas welding of non alloy and creep-resisting steels - Classification
EN 13262:2004	Railway applications - Wheelsets and bogies - Wheels - Product requirement
EN 13411-1:2002	Terminations for steel wire ropes - Safety - Part 1: Thimbles for steel wire rope slings
EN 13411-2:2001	Terminations for steel wire ropes - Safety - Part 2: Splicing of eyes for wire rope slings
EN 13411-3:2004	Terminations for steel wire ropes - Safety - Part 3: Ferrules and ferrule-securing
EN 13411-4:2011	Terminations for steel wire ropes - Safety - Part 4: Metal and resin socketing
EN 13411-5:2003	Terminations for steel wire ropes - Safety - Part 5: U-bolt wire rope grips
EN 13411-6:2004	Terminations for steel wire ropes - Safety - Part 6: Asymmetric wedge socket
EN 13674-1:2011	Railway applications - Track - Rail - Part 1: Vignole railway rails 46 kg/m and above
EN 13674-2:2006	Railway applications - Track - Rail - Part 2: Switch and crossing rails used in conjunction with Vignole railway rails 46 kg/m and above
EN 13674-3:2006	Railway applications - Track - Rail - Part 3: Check rails
EN 13674-4:2006	Railway applications - Track - Rail - Part 4: Vignole railway rails from 27 kg/m to, but excluding 46 kg/m
EN 13835:2012	Founding - Austenitic cast irons
EN 14195:2014	Metal framing components for gypsum board systems - Definitions, requirements and test methods
EN 14783:2013	Fully supported metal sheet and strip for roofing, external cladding and internal lining - Product specification and requirements
EN 50446:2006	Straight thermocouple assembly with metal or ceramic protection tube and accessories

Appendix

5

EN ISO CURRENT STEEL STANDARDS

Standard	Title
EN ISO 636:2008	Welding consumables - Rods, wires and deposits for tungsten inert gas welding of non-alloy and fine-grain steels - Classification
EN ISO 683-17:2014	Heat-treated steels, alloy steels and free-cutting steels - Part 17: Ball and roller bearing steels
EN ISO 1127:1996	Stainless steel tubes - Dimensions, tolerances and conventional masses per unit length
EN ISO 3183:2012	Petroleum and natural gas industries - Steel pipe for pipeline transportation systems
EN ISO 3580:2011	Welding consumables - Covered electrodes for manual metal arc welding of creep-resisting steels - Classification
EN ISO 3581:2012	Welding consumables - Covered electrodes for manual metal arc welding of stainless and heat-resisting steels - Classification
EN ISO 3766:2003	Construction drawings - Simplified representation of concrete reinforcement
EN ISO 4957:1999	Tool steels
EN ISO 7153-1:2000	Surgical instruments - Metallic Materials - Part 1: Stainless steel
EN ISO 9445-1:2010	Continuously cold-rolled stainless steel - Tolerances on dimensions and form - Part 1: Narrow strip and cut lengths
EN ISO 9445-2:2010	Continuously cold-rolled stainless steel - Tolerances on dimensions and form - Part 2: Wide strip and plate/sheet
EN ISO 10893-1:2011	Non-destructive testing of steel tubes - Part 1: Automated electromagnetic testing of seamless and welded (except submerged arc-welded) steel tubes for the verification of hydraulic leaktightness
EN ISO 10893-2:2011	Non-destructive testing of steel tubes - Part 2: Automated eddy current testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of imperfections
EN ISO 10893-3:2011	Non-destructive testing of steel tubes - Part 3: Automated full peripheral flux leakage testing of seamless and welded (except submerged arc-welded) ferromagnetic steel tubes for the detection of longitudinal and/or transverse imperfections
EN ISO 10893-4:2011	Non-destructive testing of steel tubes - Part 4: Liquid penetrant inspection of seamless and welded steel tubes for the detection of surface imperfections
EN ISO 10893-5:2011	Non-destructive testing of steel tubes - Part 5: Magnetic particle inspection of seamless and welded ferromagnetic steel tubes for the detection of surface imperfections
EN ISO 10893-6:2011	Non-destructive testing of steel tubes - Part 6: Radiographic testing of the weld seam of welded steel tubes for the detection of imperfections
EN ISO 10893-7:2011	Non-destructive testing of steel tubes - Part 7: Digital radiographic testing of the weld seam of welded steel tubes for the detection of imperfections
EN ISO 10893-8:2011	Non-destructive testing of steel tubes - Part 8: Automated ultrasonic testing of seamless and welded steel tubes for the detection of laminar imperfections
EN ISO 10893-9:2011	Non-destructive testing of steel tubes - Part 9: Automated ultrasonic testing for the detection of laminar imperfections in strip/plate used for the manufacture of welded steel tubes
EN ISO 10893-10:2011	Non-destructive testing of steel tubes - Part 10: Automated full peripheral ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of longitudinal and/or transverse imperfections
EN ISO 10893-11:2011	Non-destructive testing of steel tubes - Part 11: Automated ultrasonic testing of the weld seam of welded steel tubes for the detection of longitudinal and/or transverse imperfections
EN ISO 10893-12:2011	Non-destructive testing of steel tubes - Part 12: Automated full peripheral ultrasonic thickness testing of seamless and welded (except submerged arc-welded) steel tubes
EN ISO 11960:2014	Petroleum and natural gas industries - Steel pipes for use as casing or tubing for wells
EN ISO 14171:2010	Welding consumables - Solid wire electrodes, tubular cored electrodes and electrode/flux combinations for submerged arc welding of non alloy and fine grain steels - Classification
EN ISO 14341:2011	Welding consumables - Wire electrodes and weld deposits for gas shielded metal arc welding of non alloy and fine grain steels - Classification
EN ISO 14343:2009	Welding consumables - Wire electrodes, strip electrodes, wires and rods for arc welding of stainless and heat resisting steels - Classification
EN ISO 16120-1:2011	Non-alloy steel wire rod for conversion to wire - Part 1: General requirements
EN ISO 16120-2:2011	Non-alloy steel wire rod for conversion to wire - Part 2: Specific requirements for general-purpose wire rod
EN ISO 16120-3:2011	Non-alloy steel wire rod for conversion to wire - Part 3: Specific requirements for rimmed and rimmed substitute, low-carbon steel wire rod
EN ISO 16120-4:2011	Non-alloy steel wire rod for conversion to wire - Part 4: Specific requirements for wire rod for special applications
EN ISO 17632:2008	Welding consumables - Tubular cored electrodes for gas shielded and non-gas shielded metal arc welding of non-alloy and fine grain steels - Classification
EN ISO 21952:2012	Welding consumables - Wire electrodes, wires, rods and deposits for gas shielded arc welding of creep-resisting steels - Classification

Appendix

6

***ISO IRON AND STEEL
PRODUCT STANDARDS***

Standard	Title
ISO 65:1981	Carbon steel tubes suitable for screwing in accordance with ISO 7-1
ISO 404:1992	Steel and steel products -- General technical delivery requirements
ISO 559:1991	Steel tubes for water and sewage
ISO 630:1995	Structural steels -- Plates, wide flats, bars, sections and profiles
ISO 630-2:2000	Structural steels -- Part 2: Technical delivery requirements for hot-finished hollow sections
ISO 657-1:1989	Hot-rolled steel sections -- Part 1: Equal-leg angles -- Dimensions
ISO 657-2:1989	Hot-rolled steel sections -- Part 2: Unequal-leg angles -- Dimensions
ISO 657-5:1976	Hot-rolled steel sections -- Part 5: Equal-leg angles and unequal-leg angles -- Tolerances for metric and inch series
ISO 657-11:1980	Hot-rolled steel sections -- Part 11: Sloping flange channel sections (Metric series) -- Dimensions and sectional properties
ISO 657-14:2000	Hot-rolled steel sections -- Part 14: Hot-finished structural hollow sections -- Dimensions and sectional properties
ISO 657-15:1980	Hot-rolled steel sections -- Part 15: Sloping flange beam sections (Metric series) -- Dimensions and sectional properties
ISO 657-16:1980	Hot-rolled steel sections -- Part 16: Sloping flange column sections (metric series) -- Dimensions and sectional properties
ISO 657-18:1980	Hot-rolled steel sections -- Part 18: L sections for shipbuilding (metric series) -- Dimensions, sectional properties and tolerances
ISO 657-19:1980	Hot-rolled steel sections -- Part 19: Bulb flats (metric series) -- Dimensions, sectional properties and tolerances
ISO 657-21:1983	Hot-rolled steel sections -- Part 21: T-sections with equal depth and flange width -- Dimensions
ISO 683-1:1987	Heat-treatable steels, alloy steels and free-cutting steels -- Part 1: Direct-hardening unalloyed and low-alloyed wrought steel in form of different black products
ISO 683-9:1988	Heat-treatable steels, alloy steels and free-cutting steels -- Part 9: Wrought free-cutting steels
ISO 683-10:1987	Heat-treatable steels, alloy steels and free-cutting steels -- Part 10: Wrought nitriding steels
ISO 683-11:1987	Heat-treatable steels, alloy steels and free-cutting steels -- Part 11: Wrought case-hardening steels
ISO 683-14:2004	Heat-treatable steels, alloy steels and free-cutting steels -- Part 14: Hot-rolled steels for quenched and tempered springs
ISO 683-15:1992	Heat-treatable steels, alloy steels and free-cutting steels -- Part 15: Valve steels for internal combustion engines
ISO 683-17:1999	Heat-treated steels, alloy steels and free-cutting steels -- Part 17: Ball and roller bearing steels
ISO 683-18:1996	Heat-treatable steels, alloy steels and free-cutting steels -- Part 18: Bright products of unalloyed and low alloy steels
ISO 722:1991	Rock drilling equipment -- Hollow drill steels in bar form, hexagonal and round
ISO 1035-1:1980	Hot-rolled steel bars -- Part 1: Dimensions of round bars
ISO 1035-2:1980	Hot-rolled steel bars -- Part 2: Dimensions of square bars
ISO 1035-3:1980	Hot-rolled steel bars -- Part 3: Dimensions of flat bars
ISO 1035-4:1982	Hot-rolled steel bars -- Part 4: Tolerances
ISO 1052:1982	Steels for general engineering purposes
ISO 1127:1992	Stainless steel tubes -- Dimensions, tolerances and conventional masses per unit length
ISO 1129:1980	Steel tubes for boilers, superheaters and heat exchangers -- Dimensions, tolerances and conventional masses per unit length
ISO 1834:1999	Short link chain for lifting purposes -- General conditions of acceptance
ISO 1835:1980	Short link chain for lifting purposes -- Grade M (4), non-calibrated, for chain slings etc.
ISO 1837:2003	Lifting hooks -- Nomenclature
ISO 2037:1992	Stainless steel tubes for the food industry
ISO 2232:1990	Round drawn wire for general purpose non-alloy steel wire ropes and for large diameter steel wire ropes -- Specifications
ISO 2262:1984	General purpose thimbles for use with steel wire ropes -- Specification
ISO 2308:1972	Hooks for lifting freight containers of up to 30 tonnes capacity -- Basic requirements
ISO 2408:2004	Steel wire ropes for general purposes -- Minimum requirements
ISO 2415:2004	Forged shackles for general lifting purposes -- Dee shackles and bow shackles
ISO 2531:1998	Ductile iron pipes, fittings, accessories and their joints for water or gas applications
ISO 2532:1974	Steel wire ropes -- Vocabulary
ISO 2605-3:1985	Steel products for pressure purposes -- Derivation and verification of elevated temperature properties -- Part 3: An alternative procedure for deriving the elevated temperature yield or proof stress properties when data are limited
ISO 2701:1977	Drawn wire for general purpose non-alloy steel wire ropes -- Terms of acceptance
ISO 2937:1974	Plain end seamless steel tubes for mechanical application
ISO 2938:1974	Hollow steel bars for machining
ISO 3056:1986	Non-calibrated round steel link lifting chain and chain slings -- Use and maintenance
ISO 3075:1980	Short link chain for lifting purposes -- Grade S (6) non calibrated, for chain slings etc.
ISO 3076:1984	Short link chain for lifting purposes -- Grade T (8), non-calibrated, for chain slings etc.

Standard	Title
ISO 3077:2001	Short-link chain for lifting purposes -- Grade T, (types T, DAT and DT), fine-tolerance hoist chain
ISO 3108:1974	Steel wire ropes for general purposes -- Determination of actual breaking load
ISO 3183:2007	Petroleum and natural gas industries -- Steel pipe for pipeline transportation systems
ISO 3189-1:1985	Sockets for wire ropes for general purposes -- Part 1: General characteristics and conditions of acceptance
ISO 3189-2:1985	Sockets for wire ropes for general purposes -- Part 2: Special requirements for sockets produced by forging or machined from the solid
ISO 3189-3:1985	Sockets for wire ropes for general purposes -- Part 3: Special requirements for sockets produced by casting
ISO 3266:1984	Eyebolts for general lifting purposes
ISO 3304:1985	Plain end seamless precision steel tubes -- Technical conditions for delivery
ISO 3305:1985	Plain end welded precision steel tubes -- Technical conditions for delivery
ISO 3306:1985	Plain end as-welded and sized precision steel tubes -- Technical conditions for delivery
ISO 3545-1:1989	Steel tubes and fittings -- Symbols for use in specifications -- Part 1: Tubes and tubular accessories with circular cross-section
ISO 3545-2:1989	Steel tubes and fittings -- Symbols for use in specifications -- Part 2: Square and rectangular hollow sections
ISO 3573:1999	Hot-rolled carbon steel sheet of commercial and drawing qualities
ISO 3574:1999	Cold-reduced carbon steel sheet of commercial and drawing qualities
ISO 3575:2005	Continuous hot-dip zinc-coated carbon steel sheet of commercial and drawing qualities
ISO 3755:1991	Cast carbon steels for general engineering purposes
ISO 4019:2001	Structural steels -- Cold-formed, welded, structural hollow sections -- Dimensions and sectional properties
ISO 4101:1983	Drawn steel wire for elevator ropes -- Specifications
ISO 4179:2005	Ductile iron pipes for pressure and non-pressure pipelines -- Centrifugal cement mortar lining -- General requirements
ISO 4200:1991	Plain end steel tubes, welded and seamless -- General tables of dimensions and masses per unit length
ISO 4308-1:2003	Cranes and lifting appliances -- Selection of wire ropes -- Part 1: General
ISO 4308-2:1988	Cranes and lifting appliances -- Selection of wire ropes -- Part 2: Mobile cranes -- Coefficient of utilization
ISO 4309:2004	Cranes -- Wire ropes -- Care, maintenance, installation, examination and discard
ISO 4344:2004	Steel wire ropes for lifts -- Minimum requirements
ISO 4345:1988	Steel wire ropes -- Fibre main cores -- Specification
ISO 4346:1977	Steel wire ropes for general purposes -- Lubricants -- Basic requirements
ISO 4778:1981	Chain slings of welded construction -- Grades M (4), S (6) and T (8)
ISO 4779:1986	Forged steel lifting hooks with point and eye for use with steel chains of grade M(4)
ISO 4885:1996	Ferrous products -- Heat treatments -- Vocabulary
ISO 4950-1:1995	High yield strength flat steel products -- Part 1: General requirements
ISO 4950-2:1995	High yield strength flat steel products -- Part 2: Products supplied in the normalized or controlled rolled condition
ISO 4950-3:1995	High yield strength flat steel products -- Part 3: Products supplied in the heat-treated (quenched + tempered) condition
ISO 4951-1:2001	High yield strength steel bars and sections -- Part 1: General delivery requirements
ISO 4951-2:2001	High yield strength steel bars and sections -- Part 2: Delivery conditions for normalized, normalized rolled and as-rolled steels
ISO 4951-3:2001	High yield strength steel bars and sections -- Part 3: Delivery conditions for thermomechanically-rolled steels
ISO 4952:2006	Structural steels with improved atmospheric corrosion resistance
ISO 4954:1993	Steels for cold heading and cold extruding
ISO 4955:2005	Heat-resistant steels
ISO 4957:1999	Tool steels
ISO 4960:1999	Cold-reduced carbon steel strip with a carbon content over 0,25 %
ISO 4978:1983	Flat rolled steel products for welded gas cylinders
ISO 4986:1992	Steel castings -- Magnetic particle inspection
ISO 4987:1992	Steel castings -- Penetrant inspection
ISO 4990:2003	Steel castings -- General technical delivery requirements
ISO 4991:2005	Steel castings for pressure purposes
ISO 4993:1987	Steel castings -- Radiographic inspection
ISO 4995:2001	Hot-rolled steel sheet of structural quality
ISO 4996:2007	Hot-rolled steel sheet of high yield stress structural quality
ISO 4997:2007	Cold-reduced carbon steel sheet of structural quality
ISO 4998:2005	Continuous hot-dip zinc-coated carbon steel sheet of structural quality
ISO 4999:2005	Continuous hot-dip terne (lead alloy) coated cold-reduced carbon steel sheet of commercial, drawing and structural qualities
ISO 5000:2005	Continuous hot-dip aluminium-silicon-coated cold-reduced carbon steel sheet of commercial and drawing qualities

Standard	Title
ISO 5001:2007	Cold-reduced carbon steel sheet for vitreous enamelling
ISO 5002:1999	Hot-rolled and cold-reduced electrolytic zinc-coated carbon steel sheet of commercial and drawing qualities
ISO 5252:1991	Steel tubes -- Tolerance systems
ISO 5256:1985	Steel pipes and fittings for buried or submerged pipe lines -- External and internal coating by bitumen or coal tar derived materials
ISO 5949:1983	Tool steels and bearing steels -- Micrographic method for assessing the distribution of carbides using reference photomicrographs
ISO 5950:2000	Continuous electrolytic tin-coated cold-reduced carbon steel sheet of commercial and drawing qualities
ISO 5951:2001	Hot-rolled steel sheet of higher yield strength with improved formability
ISO 5952:2005	Continuously hot-rolled steel sheet of structural quality with improved atmospheric corrosion resistance
ISO 5954:1998	Cold-reduced carbon steel sheet according to hardness requirements
ISO 6303:1981	Pressure vessel steels not included in ISO 2604, Parts 1 to 6 -- Derivation of long-time stress rupture properties
ISO 6316:2000	Hot-rolled steel strip of structural quality
ISO 6317:2000	Hot-rolled carbon steel strip of commercial and drawing qualities
ISO 6594:2006	Cast iron drainage pipes and fittings -- Spigot series
ISO 6758:1980	Welded steel tubes for heat exchangers
ISO 6759:1980	Seamless steel tubes for heat exchangers
ISO 6761:1981	Steel tubes -- Preparation of ends of tubes and fittings for welding
ISO 6929:1987	Steel products -- Definitions and classification
ISO 6930-1:2001	High yield strength steel plates and wide flats for cold forming -- Part 1: Delivery conditions for thermomechanically-rolled steels
ISO 6930-2:2004	High yield strength steel plates and wide flats for cold forming -- Part 2: Delivery condition for normalized, normalized rolled and as-rolled steels
ISO 6931-1:1994	Stainless steels for springs -- Part 1: Wire
ISO 6931-2:2005	Stainless steels for springs -- Part 2: Narrow strip
ISO 6932:2001	Cold-reduced carbon steel strip with a maximum carbon content of 0,25 %
ISO 6934-1:1991	Steel for the prestressing of concrete -- Part 1: General requirements
ISO 6934-2:1991	Steel for the prestressing of concrete -- Part 2: Cold-drawn wire
ISO 6934-3:1991	Steel for the prestressing of concrete -- Part 3: Quenched and tempered wire
ISO 6934-4:1991	Steel for the prestressing of concrete -- Part 4: Strand
ISO 6934-5:1991	Steel for the prestressing of concrete -- Part 5: Hot-rolled steel bars with or without subsequent processing
ISO 6935-1:1991	Steel for the reinforcement of concrete -- Part 1: Plain bars
ISO 6935-2:1991	Steel for the reinforcement of concrete -- Part 2: Ribbed bars
ISO 6935-3:1992	Steel for the reinforcement of concrete -- Part 3: Welded fabric
ISO 6984:1990	Round non-alloy steel wires for stranded wire ropes for mine hoisting -- Specifications
ISO 7153-1:1991	Surgical instruments -- Metallic materials -- Part 1: Stainless steel Amd 1:1999
ISO 7186:1996	Ductile iron products for sewage applications
ISO 7452:2002	Hot-rolled structural steel plates -- Tolerances on dimensions and shape
ISO/TR 7468:1981	Summary of average stress rupture properties of wrought steels for boilers and pressure vessels
ISO 7531:1987	Wire rope slings for general purposes -- Characteristics and specifications
ISO 7592:1983	Calibrated round steel link lifting chains -- Guidelines to proper use and maintenance
ISO 7593:1986	Chain slings assembled by methods other than welding -- Grade T(8)
ISO 7597:1987	Forged steel lifting hooks with point and eye for use with steel chains of grade T(8)
ISO 7598:1988	Stainless steel tubes suitable for screwing in accordance with ISO 7-1
ISO 7778:1983	Steel plate with specified through-thickness characteristics
ISO 7788:1985	Steel -- Surface finish of hot-rolled plates and wide flats -- Delivery requirements
ISO 7900:2006	Steel wire and wire products for fences -- Zinc-and zinc-alloy-coated steel barbed wire
ISO 7989-1:2006	Steel wire and wire products -- Non-ferrous metallic coatings on steel wire -- Part 1: General principles
ISO 7989-2:2007	Steel wire and wire products -- Non-ferrous metallic coatings on steel wire -- Part 2: Zinc or zinc-alloy coating
ISO 8179-1:2004	Ductile iron pipes -- External zinc-based coating -- Part 1: Metallic zinc with finishing layer
ISO 8179-2:1995	Ductile iron pipes -- External zinc coating -- Part 2: Zinc rich paint with finishing layer
ISO 8180:2006	Ductile iron pipes -- Polyethylene sleeving for site application
ISO 8458-1:2002	Steel wire for mechanical springs -- Part 1: General requirements
ISO 8458-2:2002	Steel wire for mechanical springs -- Part 2: Patented cold-drawn non-alloy steel wire
ISO 8458-3:2002	Steel wire for mechanical springs -- Part 3: Oil-hardened and tempered wire
ISO 8539:1986	Forged steel lifting components for use with grade T(8) chain
ISO 8792:1986	Wire rope slings -- Safety criteria and inspection procedures for use

Standard	Title
ISO 8793:1986	Steel wire ropes -- Ferrule-secured eye terminations
ISO 8794:1986	Steel wire ropes -- Spliced eye terminations for slings
ISO 9034:1987	Hot-rolled structural steel wide flats -- Tolerances on dimensions and shape
ISO 9095:1990	Steel tubes -- Continuous character marking and colour coding for material identification
ISO 9302:1994	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Electromagnetic testing for verification of hydraulic leak-tightness
ISO 9303:1989	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Full peripheral ultrasonic testing for the detection of longitudinal imperfections
ISO 9304:1989	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Eddy current testing for the detection of imperfections
ISO 9305:1989	Seamless steel tubes for pressure purposes -- Full peripheral ultrasonic testing for the detection of transverse imperfections
ISO 9327-1:1999	Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 1: General requirements
ISO 9327-2:1999	Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 2: Non-alloy and alloy (Mo, Cr and CrMo) steels with specified elevated temperature properties
ISO 9327-3:1999	Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 3: Nickel steels with specified low temperature properties
ISO 9327-4:1999	Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 4: Weldable fine grain steels with high proof strength
ISO 9327-5:1999	Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 5: Stainless steels
ISO 9328-1:2003	Steel flat products for pressure purposes -- Technical delivery conditions -- Part 1: General requirements
ISO 9328-2:2004	Steel flat products for pressure purposes -- Technical delivery conditions -- Part 2: Non-alloy and alloy steels with specified elevated temperature properties
ISO 9328-3:2004	Steel flat products for pressure purposes -- Technical delivery conditions -- Part 3: Weldable fine grain steels, normalized
ISO 9328-4:2004	Steel flat products for pressure purposes -- Technical delivery conditions -- Part 4: Nickel-alloy steels with specified low temperature properties
ISO 9328-5:2004	Steel flat products for pressure purposes -- Technical delivery conditions -- Part 5: Weldable fine grain steels, thermomechanically rolled
ISO 9328-6:2004	Steel flat products for pressure purposes -- Technical delivery conditions -- Part 6: Weldable fine grain steels, quenched and tempered
ISO 9328-7:2004	Steel flat products for pressure purposes -- Technical delivery conditions -- Part 7: Stainless steels
ISO 9329-1:1989	Seamless steel tubes for pressure purposes -- Technical delivery conditions -- Part 1: Unalloyed steels with specified room temperature properties
ISO 9329-2:1997	Seamless steel tubes for pressure purposes -- Technical delivery conditions -- Part 2: Unalloyed and alloyed steels with specified elevated temperature properties
ISO 9329-3:1997	Seamless steel tubes for pressure purposes -- Technical delivery conditions -- Part 3: Unalloyed and alloyed steels with specified low temperature properties
ISO 9329-4:1997	Seamless steel tubes for pressure purposes -- Technical delivery conditions -- Part 4: Austenitic stainless steels
ISO 9330-1:1990	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 1: Unalloyed steel tubes with specified room temperature properties
ISO 9330-2:1997	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 2: Electric resistance and induction welded unalloyed and alloyed steel tubes with specified elevated temperature properties
ISO 9330-3:1997	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 3: Electric resistance and induction welded unalloyed and alloyed steel tubes with specified low temperature properties
ISO 9330-4:2000	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 4: Submerged arc-welded unalloyed and alloyed steel tubes with specified elevated temperature properties
ISO 9330-5:2000	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 5: Submerged arc-welded unalloyed and alloyed steel tubes with specified low temperature properties
ISO 9330-6:1997	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 6: Longitudinally welded austenitic stainless steel tubes
ISO 9364:2006	Continuous hot-dip aluminium/zinc-coated steel sheet of commercial, drawing and structural qualities
ISO 9402:1989	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Full peripheral magnetic transducer/flux leakage testing of ferromagnetic steel tubes for the detection of longitudinal imperfections
ISO 9442:1988	Steel -- Hot-rolled ribbed and grooved flats for spring leaves -- Tolerances and dimensions
ISO 9443:1991	Heat-treatable and alloy steels -- Surface quality classes for hot-rolled round bars and wire rods -- Technical delivery conditions
ISO 9444:2002	Continuously hot-rolled stainless steel strip, plate/sheet and cut lengths -- Tolerances on dimensions and form
ISO 9445:2002	Continuously cold-rolled stainless steel narrow strip, wide strip, plate/sheet and cut lengths -- Tolerances on dimensions and form
ISO 9473-1:2006	Textile machinery and accessories -- Strip steel for dents of reeds -- Part 1: Cold rolled strip steel
ISO 9473-2:2006	Textile machinery and accessories -- Strip steel for dents of reeds -- Part 2: Hardened strip steel

Standard	Title
ISO 9477:1992	High strength cast steels for general engineering and structural purposes
ISO 9598:1989	Seamless steel tubes for pressure purposes -- Full peripheral magnetic transducer/flux leakage testing of ferromagnetic steel tubes for the detection of transverse imperfections
ISO 9764:1989	Electric resistance and induction welded steel tubes for pressure purposes -- Ultrasonic testing of the weld seam for the detection of longitudinal imperfections
ISO 9765:1990	Submerged arc-welded steel tubes for pressure purposes -- Ultrasonic testing of the weld seam for the detection of longitudinal and/or transverse imperfections
ISO 9975:1990	Round non-alloy steel wires for locked coil mine winding ropes -- Specifications
ISO 10124:1994	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Ultrasonic testing for the detection of laminar imperfections
ISO 10144:1991	Certification scheme for steel bars and wires for the reinforcement of concrete structures
ISO 10332:1994	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Ultrasonic testing for the verification of hydraulic leak-tightness
ISO 10384:2001	Hot-rolled carbon steel sheet for machinery
ISO 10425:2003	Steel wire ropes for the petroleum and natural gas industries -- Minimum requirements and terms of acceptance
ISO 10474:1991	Steel and steel products -- Inspection documents
ISO 10543:1993	Seamless and hot-stretch-reduced welded steel tubes for pressure purposes -- Full peripheral ultrasonic thickness testing
ISO 10544:1992	Cold-reduced steel wire for the reinforcement of concrete and the manufacture of welded fabric
ISO 10763:1994	Hydraulic fluid power -- Plain-end, seamless and welded precision steel tubes -- Dimensions and nominal working pressures
ISO 10799:2001	Structural steels -- Cold-formed, welded, structural hollow sections -- Technical delivery requirements
ISO 10803:1999	Design method for ductile iron pipes
ISO 11054:2006	Cutting tools -- Designation of high-speed steel groups
ISO 11082:1992	Certification scheme for welded fabric for the reinforcement of concrete structures
ISO 11484:1994	Steel tubes for pressure purposes -- Qualification and certification of non-destructive testing (NDT) personnel
ISO 11496:1993	Seamless and welded steel tubes for pressure purposes -- Ultrasonic testing of tube ends for the detection of laminar imperfections
ISO/TR 11637:1997	Boron treated engineering steels for quenching and tempering
ISO 11692:1994	Ferritic-pearlitic engineering steels for precipitation hardening from hot-working temperatures
ISO 11949:1995	Cold-reduced electrolytic tinplate
ISO 11950:1995	Cold-reduced electrolytic chromium/chromium oxide-coated steel
ISO 11951:1995	Cold-reduced blackplate in coil form for the production of tinplate or electrolytic chromium/chromium oxide-coated steel
ISO 11960:2004	Petroleum and natural gas industries -- Steel pipes for use as casing or tubing for wells
ISO 11961:1996	Petroleum and natural gas industries -- Steel pipes for use as drill pipe -- Specification
ISO 11970:2001	Specification and approval of welding procedures for production welding of steel castings
ISO 11971:1997	Visual examination of surface quality of steel castings
ISO 11972:1998	Corrosion-resistant cast steels for general applications
ISO 11973:1999	Heat-resistant cast steels and alloys for general applications
ISO 12094:1994	Welded steel tubes for pressure purposes -- Ultrasonic testing for the detection of laminar imperfections in strips/plates used in the manufacture of welded tubes
ISO 12095:1994	Seamless and welded steel tubes for pressure purposes -- Liquid penetrant testing
ISO 12096:1996	Submerged arc-welded steel tubes for pressure purposes -- Radiographic testing of the weld seam for the detection of imperfections
ISO/TR 12662:1997	Certification scheme for prestressing steels
ISO 13521:1999	Austenitic manganese steel castings
ISO 13583-1:2000	Centrifugally cast steel and alloy products -- Part 1: General testing and tolerances
ISO 13583-2:2003	Centrifugally cast steel and alloy products -- Part 2: Heat resistant materials
ISO 13663:1995	Welded steel tubes for pressure purposes -- Ultrasonic testing of the area adjacent to the weld seam for the detection of laminar imperfections
ISO 13664:1997	Seamless and welded steel tubes for pressure purposes -- Magnetic particle inspection of the tube ends for the detection of laminar imperfections
ISO 13665:1997	Seamless and welded steel tubes for pressure purposes -- Magnetic particle inspection of the tube body for the detection of surface imperfections
ISO 13680:2000	Petroleum and natural gas industries -- Corrosion-resistant alloy seamless tubes for use as casing, tubing and coupling stock -- Technical delivery conditions
ISO 13887:2004	Cold-reduced steel sheet of higher yield strength with improved formability
ISO 13976:2005	Hot-rolled steel sheet in coils of structural quality and heavy thickness
ISO 14590:2005	Cold-reduced steel sheet of high tensile strength and low yield point with improved formability

Standard	Title
ISO 14654:1999	Epoxy-coated steel for the reinforcement of concrete
ISO 14655:1999	Epoxy-coated strand for the prestressing of concrete
ISO 14656:1999	Epoxy powder and sealing material for the coating of steel for the reinforcement of concrete
ISO 14657:2005	Zinc-coated steel for the reinforcement of concrete
ISO 14737:2003	Cast non-alloy and low alloy steels for general applications
ISO 14788:2005	Continuous hot-dip zinc-5 % aluminium alloy coated steel sheet
ISO/TR 15461:1997	Steel forgings -- Testing frequency, sampling conditions and test methods for mechanical tests
ISO/TR 15510:2003	Stainless steels -- Chemical composition
ISO 15630-1:2002	Steel for the reinforcement and prestressing of concrete -- Test methods -- Part 1: Reinforcing bars, wire rod and wire
ISO 15630-2:2002	Steel for the reinforcement and prestressing of concrete -- Test methods -- Part 2: Welded fabric
ISO 15630-3:2002	Steel for the reinforcement and prestressing of concrete -- Test methods -- Part 3: Prestressing steel
ISO 16120-1:2001	Non-alloy steel wire rod for conversion to wire -- Part 1: General requirements
ISO 16120-2:2001	Non-alloy steel wire rod for conversion to wire -- Part 2: Specific requirements for general purpose wire rod
ISO 16120-3:2001	Non-alloy steel wire rod for conversion to wire -- Part 3: Specific requirements for rimmed and rimmed-substitute, low-carbon steel wire rod
ISO 16120-4:2001	Non-alloy steel wire rod for conversion to wire -- Part 4: Specific requirements for wire rod for special applications
ISO 16143-1:2004	Stainless steels for general purposes -- Part 1: Flat products
ISO 16143-2:2004	Stainless steels for general purposes -- Part 2: Semi-finished products, bars, rods and sections
ISO 16143-3:2005	Stainless steels for general purposes -- Part 3: wire
ISO 16160:2005	Continuously hot-rolled steel sheet products -- Dimensional and shape tolerances
ISO 16162:2005	Continuously cold-rolled steel sheet products -- Dimensional and shape tolerances
ISO 16163:2005	Continuously hot-dipped coated steel sheet products -- Dimensional and shape tolerances
ISO 16172:2006	Continuous hot-dip metallic-coated steel sheet for corrugated steel pipe
ISO 16650:2004	Bead wire
ISO 20723:2004	Structural steels -- Surface condition of hot-rolled sections -- Delivery requirements
ISO 20805:2005	Hot-rolled steel sheet in coils of higher yield strength with improved formability and heavy thickness for cold forming
ISO 23717:2006	Steel wire and wire products -- Hose reinforcement wire
ISO 24314:2006	Structural steels -- Structural steels for building with improved seismic resistance -- Technical delivery conditions

Appendix

7

ASTM A941-15 STANDARD TERMINOLOGY RELATING TO STEEL, STAINLESS STEEL, RELATED ALLOYS, AND FERROALLOYS



Standard Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys¹

This standard is issued under the fixed designation A941; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This standard is a compilation of definitions of terms related to steel, stainless steel, related alloys, and ferroalloys.

1.2 When a term is used in an ASTM document for which Committee A01 is responsible, it is included herein only when judged, after review by Subcommittee A01.92, to be a generally usable term.

1.3 Some definitions include a discussion section, which is a mandatory part of the definition and contains additional information that is relevant to the meaning of the defined term.

1.4 Definitions of terms specific to a particular standard will appear in that standard and will supersede any definitions of identical terms in this standard.

2. Referenced Documents

2.1 ASTM Standards:²

E112 Test Methods for Determining Average Grain Size

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

A_{cm} , A_{c1} , A_{c3} , A_{c4} —See **transformation temperature**.

$A_{e_{cm}}$, A_{e1} , A_{e3} , A_{e4} —See **transformation temperature**.

age hardening, n —hardening by **aging**, usually after rapid cooling or **cold working**.

age hardening, n —see **precipitation hardening**.

aging, n —a change in the properties of certain **steels** that occurs at ambient or moderately elevated temperatures after hot working or a heat treatment (**quench aging**, **natural aging**, or **artificial aging**) or after a cold-working operation (**strain aging**).

DISCUSSION—The change in properties is often, but not always, due to **precipitation hardening**, but never involves a change in the chemical composition of the **steel**.

alloy steel, n —a **steel**, other than a **stainless steel**, that conforms to a specification that requires one or more of the following elements, by mass percent, to have a minimum content equal to or greater than: 0.30 for aluminum; 0.0008 for boron; 0.30 for chromium; 0.30 for cobalt; 0.40 for copper; 0.40 for lead; 1.65 for manganese; 0.08 for molybdenum; 0.30 for nickel; 0.06 for niobium (columbium); 0.60 for silicon; 0.05 for titanium; 0.30 for tungsten (wolfram); 0.10 for vanadium; 0.05 for zirconium; or 0.10 for any other alloying element, except sulphur, phosphorus, carbon, and nitrogen.

annealing, n —a generic term covering any of several **heat treatments**.

DISCUSSION—This treatment is used for purposes such as reducing hardness, improving machinability, facilitating **cold working**, producing a desired microstructure, or obtaining desired mechanical, physical, or other properties. Where applicable, it is preferred that the following more specific terms be used: **box annealing**, **bright annealing**, **full annealing**, **intermediate annealing**, **isothermal annealing**, **process annealing**, **spheroidizing**, and **subcritical annealing**. The term “annealing,” without qualification, implies **full annealing**. Any process of **annealing** will usually reduce stresses; however, if the treatment is applied for the sole purpose of stress reduction, it should be designated **stress relieving**.

$A_{r_{cm}}$, A_{r1} , A_{r3} , A_{r4} —See **transformation temperature**.

artificial aging, n —aging above room temperature.

atmospheric corrosion resistance, n —the ability to resist degradation or alteration of material through chemical reaction with the surrounding atmosphere.

DISCUSSION—This term generally pertains to carbon steel, low alloy steel, or micro-alloyed steel.

austempering, n —**heat treatment** involving **quenching** a steel object from a temperature above the **transformation range** in a medium maintained at a temperature above the **martensite range** sufficiently fast to avoid the formation of high temperature transformation products, and then holding it at that temperature until transformation is complete.

austenitizing, n —forming austenite by heating a steel object above the **transformation range**.

¹ This terminology is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.92 on Terminology.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.



baking, *n*—heating to a low temperature in order to remove gases.

batch furnace, *n*—a heating device within which steel objects are held stationary or oscillated during the thermal processing cycle.

blank carburizing, *n*—simulating the **carburizing** operation without introducing carbon.

DISCUSSION—This is usually accomplished by using an inert material in place of the carburizing agent, or by applying a suitable protective coating on the object being heat treated.

blank nitriding, *n*—simulating the nitriding operation without introducing nitrogen.

DISCUSSION—This is usually accomplished by using an inert material in place of the nitriding agent, or by applying a suitable protective coating on the object being heat treated.

bluing, *n*—subjecting the scale-free surface of a steel object to the action of air, steam, or other agents at a suitable temperature, thereby forming a thin blue film of oxide and improving the object's appearance and corrosion resistance.

DISCUSSION—This term is ordinarily applied to sheet, strip, or finished parts. It is used also to denote the heating of springs after fabrication in order to improve their properties.

box annealing, *n*—**annealing** in a sealed container under conditions that minimize oxidation.

DISCUSSION—The charge is usually heated slowly to a temperature below the **transformation range**, but sometimes above or within it, and is then cooled slowly.

bright annealing, *n*—**annealing** in a protective medium to prevent discoloration of the bright surface.

capped steel, *n*—a **rimmed steel** in which, during ingot solidification, the rimming action was limited by mechanical or chemical means.

carbon potential, *n*—the carbon content at the surface of a specimen of pure iron in equilibrium with the carburizing medium considered, and under the conditions specified.

carbon restoration, *n*—replacing the carbon lost from the surface layer in previous processing by carburizing this layer to substantially the original carbon level.

carbon steel, *n*—a **steel** that conforms to a specification that prescribes a maximum limit, by **heat analysis** in mass percent, of not more than: 2.00 for carbon and 1.65 for manganese, but does not prescribe a minimum limit for chromium, cobalt, molybdenum, nickel, niobium (columbium), tungsten (wolfram), vanadium, or zirconium.

DISCUSSION—Except as required above, it is permissible for carbon steel specifications to prescribe limits (minimum or maximum, or both) for each specified alloying element, subject to the following restrictions for the heat analysis limits in mass percent:

- (a) for wrought carbon steel products, the specified maximum limit is not to exceed: 0.10 for aluminum, 0.60 for silicon, and 0.050 for titanium;
- (b) for carbon steel castings, the specified maximum limit is not to exceed: 0.10 for aluminum, 1.00 for silicon, and 0.050 for titanium.
- (c) for **carbon steels** that are required to be rephosphorized, the specified minimum limit for phosphorus is not to be less than 0.040;
- (d) for **carbon steels** that are required to be resulfurized, the specified

minimum limit for sulfur is not to be less than 0.060;

(e) for **carbon steels** that are not required to be rephosphorized or resulfurized, the specified maximum limit is not to exceed: 0.60 for copper, 0.050 for phosphorus, and 0.060 for sulfur; and

(f) for **carbon steels** that are required to contain boron, copper, or lead, the specified minimum limit is not to exceed: 0.0005 for boron, 0.35 for copper, and 0.25 for lead.

carbonitriding, *n*—**case hardening** in which a suitable steel object is heated above A_{c1} in a gaseous atmosphere of such composition as to cause simultaneous absorption of carbon and nitrogen by the surface and, by diffusion, to create a concentration gradient.

carburizing, *n*—a process in which an austenitized steel object is brought into contact with a carbonaceous environment of sufficient carbon potential to cause absorption of carbon at the surface and, by diffusion, to create a concentration gradient.

case, *n*—*in case hardening*, the outer portion that has been made harder than the **core** as a result of altered composition or microstructure, or both, from treatments such as **carburizing**, **nitriding**, and **induction hardening**.

case hardening, *n*—a generic term covering any of several processes applicable to **steel** that change the chemical composition or microstructure, or both, of the surface layer.

DISCUSSION—The processes commonly used are: **carburizing** and **quench hardening**; **nitriding**; and **carbonitriding**. It is preferred that the applicable specific process name be used.

cast analysis—Deprecated term. Use the preferred term **heat analysis**.

cementation, *n*—the introduction of one or more elements into the outer portion of a steel object by means of diffusion at high temperature.

certificate of compliance, *n*—*in manufactured products*, a document that states that the product was manufactured, sampled, tested, and inspected in accordance with the requirements of the specification (including year of issue) and any other requirements specified in the purchase order or contract, and has been found to meet such requirements.

DISCUSSION—A single document, containing test report information and certificate of compliance information, may be used.

certifying organization, *n*—*in product specifications*, the entity responsible for the conformance and certification of the product to the specification requirements.

check analysis—Deprecated term. Use the preferred term **product analysis**.

coarse grain practice, *n*—a steelmaking practice for other than **stainless steel** that is intended to produce a **killed steel** in which aluminum, niobium (columbium), titanium, and vanadium are **residual elements**.

cold working, *n*—mechanical deformation of a metal at temperatures below its **recrystallization temperature**.

cold treatment, *n*—exposing a steel object to temperatures below room temperature for the purpose of obtaining desired conditions or properties, such as dimensional or structural stability.

conditioning heat treatment, *n*—a preliminary **heat treatment** used to prepare a steel object for a desired reaction to a subsequent **heat treatment**.

continuous-conveyance furnace, *n*—a heating device through which steel objects are intentionally moved at a constant rate during the thermal processing cycle.

controlled cooling, *n*—cooling a steel object from an elevated temperature in a predetermined manner to avoid hardening, cracking, or internal damage, or to produce a desired microstructure or mechanical properties.

core, *n*—*in case hardening*, the interior portion of unaltered composition or microstructure, or both, of a case hardened steel object.

core, *n*—*in clad products*, the central portion of a multilayer composite metallic material.

critical cooling rate, *n*—the slowest rate of continuous cooling at which austenite can be cooled from above the **transformation range** to prevent its transformation above M_s .

cycle annealing, *n*—**annealing** employing a predetermined and closely controlled time-temperature cycle to produce specific properties or a specific microstructure.

decarburization, *n*—the loss of carbon from the surface of a steel object as a result of its being heated in a medium that reacts with the carbon.

defect, *n*—an imperfection of sufficient magnitude to warrant rejection based on the specified requirements.

differential heating, *n*—heating that intentionally produces a temperature gradient within a steel object such that, after cooling, a desired stress distribution or variation in properties is present within the object.

diffusion coating, *n*—any process whereby a base metal is either coated with another metal and heated to a sufficient temperature in a suitable environment, or exposed to a gaseous or liquid medium containing the other metal, thereby causing diffusion of the coating or other metal into the base metal, with a resultant change in the composition and properties of its surface.

direct quenching, *n*—*in thermochemical processing*, **quenching** immediately following the thermochemical treatment.

direct quenching, *n*—*in thermomechanical processing*, **quenching** immediately following the final hot deformation.

document, *n*—a written, printed, or electronic record that provides information, evidence, or official statements.

double aging, *n*—employment of two different aging treatments, in sequence, to control the type of precipitate formed from a supersaturated alloy matrix in order to obtain the desired properties.

DISCUSSION—the first aging treatment, sometimes referred to as intermediate or stabilizing, is usually carried out at a higher temperature than the second.

double tempering, *n*—a treatment in which a quench-hardened steel object is given two complete tempering cycles at substantially the same temperature for the purpose of ensuring completion of the tempering reaction and promoting stability of the resultant microstructure.

electronic data interchange, *n*—the computer to computer exchange of business information in a standardized format.

ellipsis, *n*—*in a tabular entry*, three periods (...) that indicate that there is no requirement.

ferritizing anneal, *n*—a **heat treatment** that produces a predominantly ferritic matrix in a steel object.

ferroalloy, *n*—an alloy of iron and one or more other metals, for use as an addition to the molten metal during the manufacture of **steels**, nickel alloys, or cobalt alloys.

ferrous material, *n*—metals and alloys that contain iron as the principal component.

DISCUSSION—The iron content is not always stated in the specification and is not always determined by chemical analysis. The iron content may be taken to be 100 % minus the sum of the mean values permitted by the specification for all other elements having a specified range or a specified maximum. For conformance purposes, the mean value for iron, whether specified or calculated, is compared on an individual basis to the mean values permitted by the specification for each of the other elements having a specified range or a specified maximum. If an element other than iron is not specified, but is listed as remainder or balance, then, for conformance purposes the mean value for iron is compared to the calculated value for that other element.

fine grain practice, *n*—a steelmaking practice for other than **stainless steel** that is intended to produce a **killed steel** that is capable of meeting the requirements specified for fine austenitic grain size.

DISCUSSION—It normally involves the addition of one or more austenitic grain refining elements in amounts that have been established by the steel producer as being sufficient. Austenitic grain refining elements include, but are not limited to, aluminum, niobium (columbium), titanium, and vanadium.

flame annealing, *n*—**annealing** in which the heat is applied directly by a flame.

flame hardening, *n*—a process in which only the surface layer of a suitable steel object is heated by flame to above A_{c3} or A_{cm} , and then the object is **quenched**.

fog quenching, *n*—**quenching** in a mist.

full annealing, *n*—**annealing** a steel object by **austenitizing** it and then cooling it slowly through the **transformation range**.

DISCUSSION—The austenitizing temperature is usually above A_{c3} for hypoeutectoid steels and between A_{c1} and A_{cm} for hypereutectoid steels.

grain growth, *n*—an increase in the grain size of a steel object, usually as a result of exposure to elevated temperatures.

grain size, *n*—the dimensions of the grains or crystals in a polycrystalline metal, exclusive of twinned regions and subgrains when present.

DISCUSSION—**Grain size** is usually estimated or measured on the cross section of an aggregate of grains, and designated by an ASTM grain size number. (See Test Methods E112.)

graphitization annealing, *n*—**annealing** a steel object in such a way that some or all of the carbon is precipitated as graphite.

hardenability, *n*—the property that determines the depth and distribution of hardness induced by **quenching** a steel object.

hardening, *n*—increasing the hardness by suitable treatment, usually involving heating and cooling.

DISCUSSION—Where applicable, it is preferred that the following more specific terms be used: **age hardening**, **case hardening**, **flame hardening**, **induction hardening**, **precipitation hardening**, and **quench hardening**.

heat, *n*—a generic term denoting a specific lot of steel, based upon steelmaking and casting considerations.

DISCUSSION—Where it is necessary to be more definitive, the following more specific terms are used: **primary heat**, **multiple heat**, and **remelted heat**. In product specifications, the term **heat** generally is used, without qualification, to mean the **primary**, **multiple**, or **remelted heat**, whichever is applicable.

heat analysis, *n*—the chemical analysis determined by the steel producer as being representative of a specific **heat** of steel.

DISCUSSION—Where the analysis reported by the steel producer is not sufficiently complete for conformance with the heat analysis requirements of the applicable product specification to be fully assessed, the **manufacturer** may complete the assessment of conformance with such heat analysis requirements by using a product analysis for the **specified elements** that were not reported by the steel producer, provided that product analysis tolerances are not applied and the **heat analysis** is not altered.

heat number, *n*—the alpha, numeric, or alphanumeric designator used to identify a specific **heat** of steel.

heat treatment, *n*—heating and cooling a steel object in such a way as to obtain desired conditions or properties.

DISCUSSION—Heating for the sole purpose of hot working is excluded from the meaning of this definition.

high-strength low-alloy steel, *n*—a **steel**, other than a **carbon steel** or an **interstitial-free steel**, that conforms to a specification that requires the minimum content for each specified alloying element to be lower than the applicable limit in the definition for **alloy steel**, and the yield point or yield strength of the product to be at least 36 ksi or 250 MPa.

homogeneous carburizing, *n*—a process that converts a low-carbon steel to one of substantially uniform and higher carbon content throughout the section, so that a specific response to **hardening** may be obtained.

homogenizing, *n*—holding a steel object at high temperature to eliminate or decrease chemical segregation by diffusion.

hot-cold working, *n*—the mechanical deformation of austenitic and precipitation hardening steels at a temperature just below the **recrystallization temperature** to increase the

yield strength and hardness by plastic deformation or precipitation hardening effects induced by plastic deformation, or both.

hot-finished, *n*—the condition of a product that has been cooled directly after the last **hot-working** operation, without **cold-working** (except for straightening or flattening), and independent of the temperature at which hot-working was completed.

DISCUSSION—The tolerances and surface finish of hot-finished product can be different from those of cold-finished, cold-drawn, or cold-rolled product.

hot quenching, *n*—an imprecise term used to cover a variety of quenching procedures in which the quenching medium is maintained at a prescribed temperature above 160 °F or 70 °C.

hot working, *n*—mechanical deformation of a metal at temperatures above its **recrystallization temperature**.

imperfection, *n*—a material discontinuity or irregularity that is detectable by **inspection**.

inclusion shape control, *n*—the addition of elements during steel making in order to affect the inclusion morphology.

induction hardening, *n*—*in surface hardening*, a process in which only the surface layer of a suitable steel object is heated by electrical induction to above A_{c3} or A_{cm} , and then the object is **quenched**.

induction hardening, *n*—*in through hardening*, a process in which a suitable steel object is heated by electrical induction to above A_{c3} or A_{cm} throughout its section, and then the object is **quenched**.

induction heating, *n*—heating by electrical induction.

inspection, *n*—the process of measuring, examining, testing, gaging, or otherwise comparing the unit of product with the applicable requirements.

intermediate annealing, *n*—**annealing** wrought steel objects at one or more stages during manufacture prior to final thermal treatment.

interrupted aging, *n*—**aging** at two or more temperatures, by steps, and cooling to room temperature after each step.

interrupted quenching, *n*—**quenching** in which the object being quenched is removed from the quenching medium while the object is at a temperature substantially higher than that of the quenching medium.

interstitial-free steel, *n*—a **steel** that has essentially all of its carbon and nitrogen chemically combined with stabilization elements rather than being present interstitially.

DISCUSSION—The heat analysis limits (minimum or maximum, or both) that are permitted to be prescribed in interstitial-free steel specifications are as given in the definition for **carbon steel**, except that the 0.050 % maximum limit for titanium does not apply.

isothermal annealing, *n*—**austenitizing** a steel object and then cooling it to, and holding it at, a temperature at which austenite transforms to a ferrite-carbide aggregate.

isothermal transformation, *n*—a change in phase at any constant temperature.

killed steel, *n*—a **steel** deoxidized to such a level that essentially no reaction occurred between carbon and oxygen during solidification.

laser beam welding, *n*—a welding process that uses a laser beam as the heat source.

lot, *n*—a definite quantity of product manufactured under conditions that are considered uniform.

low-alloy steel, *n*—a **steel**, other than a **carbon steel** or an **interstitial-free steel**, that conforms to a specification that requires the minimum content for each specified alloying element to be lower than the applicable limit in the definition for **alloy steel**.

M_f , M_s —See **transformation temperature**.

manufacturer, *n*—the organization responsible for the conversion of materials into products meeting the requirements of a product specification.

maraging, *n*—a precipitation hardening treatment applied to a special group of **alloy steels** to precipitate one or more intermetallic compounds in a matrix of essentially carbon-free martensite.

martempering, *n*—**quenching** an austenitized steel object in a medium at a temperature in the upper part of, or slightly above, the **martensite range**, holding it in the medium until its temperature is substantially uniform throughout, and then cooling it in air through the **martensite range**.

martensite range, *n*—the temperature interval between M_s and M_f .

microalloyed steel, *n*—a **low-alloy steel** that conforms to a specification that requires the presence of one or more carbide-, nitride-, or carbonitride-forming elements, generally in individual concentrations less than 0.15 mass percent, to enhance strength.

DISCUSSION—The most common microalloying elements are niobium (columbium), titanium, and vanadium.

multiple heat, *n*—two or more molten **primary heats**, in whole or in part, combined in a common ladle or in a common non-oscillating mold.

DISCUSSION—A **multiple heat** is identified by a single **heat number** representative of the **multiple heat**, or by the individual **heat numbers** of the **primary heats** contained in the **multiple heat**. The **heat analysis** of a **multiple heat** identified by a single **heat number** is the weighted average analysis of the individual **primary heats** contained in the **multiple heat**. Two or more molten **primary heats** sequentially strand cast (poured into an oscillating mold) constitute a series of individual **heats**, not a **multiple heat**.

natural aging, *n*—spontaneous aging of a super-saturated solid solution at room temperature.

nickel alloy, *n*—a material that conforms to a specification that requires by mass percent more nickel than any other element.

DISCUSSION—In castings, the nickel content requirement is not normally stated in the specification and is not normally determined by chemical analysis, but is taken to be 100 % minus the sum of the mean values permitted by the specification for all other elements having a specified range or a specified maximum.

nitriding, *n*—introducing nitrogen into a solid steel object by holding it at a suitable temperature in contact with a nitrogenous environment.

nonferrous material, *n*—metals and alloys that do not contain iron as the principal component.

normalizing, *v*—reheating a steel object to a temperature above the **transformation range** and then cooling it in air to a temperature substantially below the transformation range to achieve both grain refinement and improved homogenization.

overaging, *n*—**aging** under conditions of time and temperature greater than those required to obtain maximum change in a certain property, so that the property is altered away from the maximum.

overheating, *n*—heating a steel object to such a high temperature that excessive grain growth occurs.

DISCUSSION—Unlike burning, it may be possible to restore the original properties/microstructure by further heat treatment or mechanical working, or a combination thereof.

patenting, *n*—*in wire making*, heating a medium-carbon or high-carbon steel before wire drawing, or between drafts, to a temperature above the **transformation range**, and then cooling it in air, or a bath of molten lead or salt, to a temperature below Ae_1 .

plate-as-rolled, *n*—the quantity of plate product rolled at one time, either from an individual slab or directly from an ingot.

DISCUSSION—This term does not refer to the surface condition or the heat-treatment state of the material; a **plate-as-rolled** may be in the as-rolled condition, or may have received one or more surface treatments or **heat treatments**, or both.

post-weld heat treatment, *n*—heating weldments immediately after welding, to provide **tempering**, **stress relieving**, or a controlled rate of cooling to prevent formation of a hard or brittle microstructure.

precipitation hardening, *n*—**hardening** caused by the precipitation of a constituent from a supersaturated solid solution.

precipitation heat treatment, *n*—**artificial aging** in which a constituent precipitates from a supersaturated solid solution.

preheating, *n*—heating before welding, a mechanical treatment, or some further thermal treatment.

preheating, *n*—*for tool steels*, heating to an intermediate temperature immediately before final **austenitizing**.

primary heat, *n*—the product of a single cycle of a batch melting process.

DISCUSSION—In the investment casting industry, the term *master heat* is used.

process annealing, *n*—*in the sheet and wire industries*, heating a steel object to a temperature close to, but below, Ac_1 and then cooling it, in order to soften it for further cold working.

product analysis, *n*—a chemical analysis of a specimen taken from the semi-finished product or the finished product.

progressive aging, *n*—aging by increasing the temperature in steps, or continuously, during the aging cycle.

quench aging, *n*—aging associated with **quenching** after **solution heat treatment**.

quench hardening, *n*—**hardening** a steel object by **austenitizing** it, and then cooling it rapidly enough that some or all of the austenite transforms to martensite.

DISCUSSION—The austenitizing temperature is usually above Ac_3 for hypoeutectoid steels and between Ac_1 and Ac_{cm} for hypereutectoid steels.

quenching, *n*—rapid cooling in a fluid at a rate sufficient to preserve or produce desired material characteristics.

DISCUSSION—Where applicable, it is preferred that the following more specific terms be used: **fog quenching**, **hot quenching**, **interrupted quenching**, **selective quenching**, **spray quenching**, and **time quenching**. Quenching is often used in solution heat treatment of austenitic steels to retain certain constituents in solution. Quenching is also used for ferritic steels to develop desired characteristics (such as microstructure or toughness) in thicker sections that can otherwise only be achieved in thinner sections. Liquids and gasses are both fluids.

recrystallization, *n*—the formation of a new grain structure through a nucleation and growth process.

DISCUSSION—This is commonly produced by subjecting a steel object, which may be strained, to suitable conditions of time and temperature.

recrystallization annealing, *n*—**annealing** a cold-worked steel object to produce a new grain structure without a change in phase.

recrystallization temperature, *n*—the approximate minimum temperature at which recrystallization of a cold-worked steel object occurs within a specified time.

remelted heat, *n*—the product of the remelting of a **primary heat**, in whole or in part.

DISCUSSION—In the investment casting industry, the term *sub-heat* is used.

residual element, *n*—*in steel*, a specified or unspecified element, not intentionally added, originating in the raw materials, refractories, or surrounding atmospheres used in steel making.

rimmed steel, *n*—a **steel** that contained sufficient oxygen to generate carbon monoxide at the boundary between the solid metal and the remaining molten metal during solidification, resulting in an outer layer low in carbon.

secondary hardening, *n*—the hardening phenomenon that occurs during high-temperature **tempering** of certain **steels** containing one or more carbide-forming alloying elements.

selective heating, *n*—intentionally heating only certain portions of a steel object.

selective quenching, *n*—**quenching** only certain portions of a steel object.

semicontinuous-conveyance furnace, *n*—a heating device through which steel objects are intentionally moved in accordance with a predetermined start-stop-start pattern during the thermal processing cycle.

semikilled steel, *n*—an incompletely deoxidized **steel** that contained sufficient oxygen to form enough entrapped carbon monoxide during solidification to offset solidification shrinkage.

shell hardening, *n*—a surface hardening process in which a suitable steel object, when heated through and quench hardened, develops a martensitic layer or shell that closely follows the contour of the piece and surrounds a **core** of essentially pearlitic transformation product.

DISCUSSION—This result is accomplished by a proper balance between section size, **hardenability**, and severity of quench.

slack quenching, *n*—the incomplete **hardening** of a steel object due to **quenching** from the austenitizing temperature at a rate slower than the **critical cooling rate** for the particular steel composition, resulting in the formation of one or more transformation products in addition to martensite.

snap temper, *n*—a precautionary interim stress-relieving treatment applied to a high-hardenability steel immediately after **quenching** to prevent cracking because of delay in **tempering** it at the prescribed higher temperature.

soaking, *n*—prolonged holding at a selected temperature.

solution heat treatment, *n*—heating a steel object to a suitable temperature, holding it at that temperature long enough to cause one or more constituents to enter into solid solution, and then cooling it rapidly enough to hold such constituents in solution.

specified element, *n*—*in steel*, an element controlled to a specified minimum, maximum, or range, in accordance with the requirements of the applicable product specification.

spheroidizing, *n*—heating and cooling a steel object to produce a spheroidal or globular form of carbide in its microstructure.

DISCUSSION—Spheroidizing methods commonly used are the following: (1) prolonged holding at a temperature just below Ae_1 ; (2) heating and cooling alternately between temperatures that are just above, and just below, Ae_1 ; (3) heating to a temperature above Ae_1 or Ae_3 and then cooling very slowly in the furnace or holding at a temperature just below Ae_1 ; (4) cooling, from the minimum temperature at which all carbide is dissolved, at a rate suitable to prevent the reformation of a carbide network, and then reheating in accordance with Method (1) or (2) above. (Applicable to hypereutectoid steels containing a carbide network.)

spray quenching, *n*—**quenching** in a spray of liquid.

stabilized stainless steel, *n*—a **stainless steel** that conforms to a specification that prescribes limits (minimum or range) for niobium (columbium), tantalum, titanium, or a combination thereof.

DISCUSSION—Such limits are sometimes expressed as a function of the carbon and nitrogen contents. In an appropriately annealed condition, a **stabilized stainless steel** will resist sensitization to intergranular corrosion associated with the precipitation of chromium carbide at grain boundaries as a result of thermal exposure, such as **annealing**, **stress relieving**, welding, or high temperature service. Resistance to sensitization to intergranular corrosion is dependent upon the corrosivity of the environment. The condition of being stabilized with respect to sensitization is frequently demonstrated by passing one or more standard corrosion tests for sensitization.

stabilizing treatment, *n*—any treatment intended to stabilize the microstructure or dimensions of a steel object.

stainless steel, *n*—a **steel** that conforms to a specification that requires, by mass percent, a minimum chromium content of 10.5 or more, and a maximum carbon content of less than 1.20.

steel, *n*—a material that conforms to a specification that requires, by mass percent, more iron than any other element and a maximum carbon content of generally less than 2.

DISCUSSION—The iron content requirement is not normally stated in the specification and is not normally determined by chemical analysis, but is taken to be 100 % minus the sum of the mean values permitted by the specification for all other elements having a specified range or a specified maximum. For conformance purposes, this calculated value for iron is compared on an individual basis to the mean values permitted by the specification for each of the other elements having a specified range or a specified maximum. Some chromium-containing steels may contain more than 2 % carbon; however, 2 % carbon is generally considered to be the demarcation between **steel** and cast iron.

strain aging, *n*—aging induced by cold working.

strain hardening, *n*—an increase in hardness and strength of a metal caused by plastic deformation at temperatures below its **recrystallization temperature**. (Syn. *work hardening*)

stress relieving, *n*—heating a steel object to a suitable temperature, holding it long enough to reduce residual stresses, and then cooling it slowly enough to minimize the development of new residual stresses.

subcritical annealing, *n*—**annealing** at a temperature slightly below Ac_1 .

surface hardening, *n*—a generic term covering any of several processes that, by **quench hardening** only, produce in a steel object a surface layer that is harder or more wear resistant than the **core**.

DISCUSSION—There is no significant alteration of the chemical composition of the surface layer. Where applicable, it is preferred that the following more specific terms be used: **induction hardening**, **flame hardening**, and **shell hardening**.

temper brittleness, *n*—brittleness that results when certain **steels** are held within, or are cooled slowly through, a certain range of temperature below the **transformation range**.

tempering, *n*—reheating a quench hardened or normalized steel object to a temperature below Ac_1 , and then cooling it at any desired rate.

test record, *n*—a document or electronic record that contains the observations and derived data obtained by applying a given test method.

test report, *n*—a document that presents the applicable qualitative or quantitative results obtained by applying one or more given test methods.

DISCUSSION—A single document, containing test report information and certificate of compliance information, may be used.

Thermal-Mechanical Control Process (TMCP), *n*—a rolling process that produces a fine-grained ferritic steel by a particular combination of controls on the manufacturing process, from slab reheating to post-rolling cooling, thereby achieving enhanced mechanical properties.

DISCUSSION—(TMCP) requires appropriate selection of chemical composition and accurate control of steel temperature and rolling reduction.

thermochemical treatment, *n*—a **heat treatment** carried out in a medium suitably chosen to produce a change in the chemical composition of the steel object by exchange with the medium.

time quenching, *n*—interrupted **quenching** in which the duration of holding in the quenching medium is controlled.

transformation ranges, *n*—those ranges of temperature within which austenite forms during heating and transforms during cooling.

DISCUSSION—The two ranges are distinct, sometimes overlapping but never coinciding. The limiting temperatures of the ranges are dependent upon the steel composition and the rate of change of temperature, particularly during cooling.

transformation temperature, *n*—the temperature at which a change in phase occurs, with the limiting temperatures of the **transformation ranges** designated using the following symbols:

Ac_{cm} —the temperature at which the solution of cementite in austenite is completed during heating.

Ac_1 —the temperature at which austenite begins to form during heating.

Ac_3 —the temperature at which transformation of ferrite to austenite is completed during heating.

Ac_4 —the temperature at which austenite transforms to delta ferrite during heating.

Ae_1 , Ae_3 , Ae_{cm} , Ae_4 —the temperatures of phase change at equilibrium.

Ar_{cm} —the temperature at which precipitation of cementite starts during cooling.

Ar_1 —the temperature at which transformation of austenite to ferrite or to ferrite plus cementite is completed during cooling.

Ar_3 —the temperature at which austenite begins to transform to ferrite during cooling.

Ar_4 —the temperature at which delta ferrite transforms to austenite during cooling.

M_f —the temperature at which transformation of austenite to martensite is substantially completed during cooling.

M_s —the temperature at which transformation of austenite to martensite starts during cooling.

DISCUSSION—All of the above changes, except the formation of martensite, occur at lower temperatures during cooling than during heating, and are dependent upon the rate of change of temperature.

unspecified element, *n—in steel*, an element not controlled to a specified minimum, maximum, or range, in accordance with the requirements of the applicable product specification.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A941–13b) that may impact the use of this standard. (Approved November 1, 2015.)

(1) Added the term *ferrous material* (3.1).

(2) Edited the term *annealing* (3.1).

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Appendix

8

***ASTM E527-12 STANDARD PRACTICE FOR
NUMBERING METALS AND ALLOYS IN THE
UNIFIED NUMBERING SYSTEM (UNS)***



Standard Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)¹

This standard is issued under the fixed designation E527; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This practice (Note 1) covers a unified numbering system (UNS) for metals and alloys that have a “commercial standing” (see Note 2), and covers the procedure by which such numbers are assigned. Section 2 describes the system of alphanumeric designations or “numbers” established for each family of metals and alloys. Section 3 outlines the organization established for administering the system. Section 5 describes the procedure for requesting number assignment to metals and alloys for which UNS numbers have not previously been assigned.

NOTE 1—UNS designations are not to be used for metals and alloys that are not registered under the system described herein, or for any metal or alloy whose composition differs from those registered.

NOTE 2—The terms “commercial standing,” “production usage,” and other similar terms are intended to apply to metals and alloys in active commercial production and use, although the actual amount of such use will depend, among other things, upon the type of metals and alloys involved and their application.

The various standardizing organizations involved with the individual industries apply their own established criteria to define the status of a metal or alloy in terms of when a UNS designation number will be assigned. For instance, ASTM Committee A01 requires details of heat analysis, mechanical properties, and processing requirements for addition of a new grade or alloy to its specifications. The Copper Development Association requires that the material be “in commercial use (without tonnage limits);” the Aluminum Association requires that the alloy be “offered for sale (not necessarily in commercial use);” the SAE Aerospace

Materials Division calls for “repetitive procurement by at least two users.”

Thus, while no universal definition for usage criteria is established, the UNS numbers are intended to identify metals and alloys that are generally in regular production and use. A UNS number will not ordinarily be issued for a material that has just been conceived or that is still in only experimental trial.

2. Description of Numbers (or Codes) Established for Metals and Alloys

2.1 The UNS establishes 18 series of numbers for metals and alloys, as shown in Table 1. Each UNS number consists of a single letter-prefix followed by five digits. In most cases the letter is suggestive of the family of metals identified; for example, A for aluminum, P for precious metals, and S for stainless steels.

2.2 Whereas some of the digits in certain UNS number groups have special assigned meaning, each series is independent of the others in such significance; this practice permits greater flexibility and avoids complicated and lengthy UNS numbers.

NOTE 3—This arrangement of alphanumeric six-character numbers is a compromise between the thinking that identification numbers should indicate many characteristics of the material, and the belief that numbers should be short and uncomplicated to define only the chemical composition and leaving the other properties to the specifications involved.

2.3 Wherever feasible, identification “numbers” from previous systems are incorporated into the UNS numbers. For example: carbon steel, originally identified by “American Iron and Steel Institute (AISI) 1020,” is covered by “UNS G10200,” and free cutting brass, presently identified by “Copper Development Association (CDA) C36000,” is covered by “UNS C36000.” Table 2 shows the secondary division of some primary series of numbers.

¹ This practice is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.91 on Editorial.

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TABLE 1 Primary Series of Numbers

<i>Nonferrous Metals and Alloys</i>		
A00001–A99999		aluminum and aluminum alloys
C00001–C99999		copper and copper alloys
E00001–E99999		rare earth and rare earth-like metals and alloys (18 items; see Table 2)
L00001–L99999		low melting metals and alloys (15 items; see Table 2)
M00001–M99999		miscellaneous nonferrous metals and alloys (12 items; see Table 2)
N00001–N99999		nickel and nickel alloys
P00001–P99999		precious metals and alloys (8 items; see Table 2)
R00001–R99999		reactive and refractory metals and alloys (14 items; see Table 2)
Z00001–Z99999		zinc and zinc alloys
<i>Ferrous Metals and Alloys</i>		
D00001–D99999		specified mechanical properties steels
F00001–F99999		cast irons
G00001–G99999		carbon and alloy steels
H00001–H99999		H-steels
J00001–J99999		cast steels (except tool steels)
K00001–K99999		miscellaneous steels and ferrous alloys
S00001–S99999		heat and corrosion resistant (stainless) steels
T00001–T99999		tool steels
W00001–W99999		welding filler metals, covered and tubular electrodes, classified by weld deposit composition (see Table 2)

TABLE 2 Secondary Division of Some Series of Numbers

<i>E00001–E99999 Rare Earth and Rare Earth-Like Metals and Alloys</i>		
E00000–E00999		actinium
E01000–E20999		cerium
E21000–E45999		mixed rare earths ^A
E46000–E47999		dysprosium
E48000–E49999		erbium
E50000–E51999		europium
E52000–E55999		gadolinium
E56000–E57999		holmium
E58000–E67999		lanthanum
E68000–E68999		lutetium
E69000–E73999		neodymium
E74000–E77999		praseodymium
E78000–E78999		promethium
E79000–E82999		samarium
E83000–E84999		scandium
E85000–E86999		terbium
E87000–E87999		thulium
E88000–E89999		ytterbium
E90000–E99999		yttrium
<i>L00001–L99999 Low-Melting Metals and Alloys</i>		
L00001–L00999		bismuth
L01001–L01999		cadmium
L02001–L02999		cesium
L03001–L03999		gallium
L04001–L04999		indium
L06001–L06999		lithium
L07001–L07999		mercury
L08001–L08999		potassium
L09001–L09999		rubidium
L10001–L10999		selenium
L11001–L11999		sodium
L12001–L12999		thallium
L13001–L13999		tin
L50001–L59999		lead
<i>M00001–M99999 Miscellaneous Nonferrous Metals and Alloys</i>		
M00001–M00999		antimony
M01001–M01999		arsenic
M02001–M02999		barium
M03001–M03999		calcium
M04001–M04999		germanium
M05001–M05999		plutonium
M06001–M06999		strontium
M07001–M07999		tellurium
M08001–M08999		uranium

TABLE 2 Continued

M10001–M19999	magnesium
M20001–M29999	manganese
M30001–M39999	silicon
<i>P00001–P99999 Precious Metals and Alloys</i>	
P00001–P00999	gold
P01001–P01999	iridium
P02001–P02999	osmium
P03001–P03999	palladium
P04001–P04999	platinum
P05001–P05999	rhodium
P06001–P06999	ruthenium
P07001–P07999	silver
<i>R00001–R99999 Reactive and Refractory Metals and Alloys</i>	
R01001–R01999	boron
R02001–R02999	hafnium
R03001–R03999	molybdenum
R04001–R04999	niobium (columbium)
R05001–R05999	tantalum
R06001–R06999	thorium
R07001–R07999	tungsten
R08001–R08999	vanadium
R10001–R19999	beryllium
R20001–R29999	chromium
R30001–R39999	cobalt
R40001–R49999	rhenium
R50001–R59999	titanium
R60001–R69999	zirconium
<i>W00001–W99999 Welding Filler Metals Classified by Weld Deposit Composition</i>	
W00001–W09999	carbon steel with no significant alloying elements
W10000–W19999	manganese-molybdenum low alloy steels
W20000–W29999	nickel low alloy steels
W30000–W39999	austenitic stainless steels
W40000–W49999	ferritic stainless steels
W50000–W59999	chromium low alloy steels
W60000–W69999	copper base alloys
W70000–W79999	surfacing alloys
W80000–W89999	nickel base alloys

^A Alloys in which the rare earths are used in the ratio of their natural occurrence (that is, unseparated rare earths). In this mixture, cerium is the most abundant of the rare earth elements.

2.4 Welding filler metals fall into two general categories: those whose compositions are determined by the filler metal analysis (e.g. solid bare wire or rods and cast rods) and those whose composition is determined by the weld deposit analysis (e.g. covered electrodes, flux-cored and other composite wire electrodes). The latter are assigned to a primary series with the letter W as shown in Table 1. The solid bare wire and rods continue to be assigned in the established number series according to their composition.

NOTE 4—The assignment of UNS designations rests solely with the industry organizations listed herein. Readers are *not* to make their own assignments of numbers from such listings, as this may create a risk of duplication and conflict.

2.5 ASTM and SAE periodically publish up-to-date listings of all UNS numbers assigned to specific metals and alloys, with appropriate reference information on each.² Many trade associations also publish similar listings related to materials of primary interest to their organizations.

² Request the most recent version of ASTM DS 56 and SAE HS 1086, *Unified Numbering System for Metals and Alloys*, (a joint ASTM–SAE publication), PCN 05-056001-01.

3. Organization for Administering the UNS for Metals and Alloys

3.1 The organization for administering the UNS consists of the following:

3.1.1 *Advisory Board*—The Advisory Board has approximately 20 volunteer members who are affiliated with major producing and using industries, trade associations, government agencies, and standards societies, and who have extensive experience with identification, classification, and specification of materials. The Board is the administrative arm of SAE and ASTM on all matters pertaining to the UNS. It coordinates thinking on the format of each series of numbers and the administration of each by selected experts. It sets up ground rules for determining eligibility of any material for a UNS number, for requesting such numbers, and for appealing unfavorable rulings. It is the final referee on matters of disagreement between requesters and assigners.

3.1.2 *Several Number-Assigning Offices*— UNS number assigners for certain materials are set up at trade associations which have successfully administered their own numbering systems; for other materials, assigners are located at offices of

SAE. Each of these assigners has the responsibility for administering a specific series of numbers, as shown in Table 3. Each considers requests for assignment of new UNS numbers, and informs applicants of the action taken. Trade association UNS number assigners report immediately to SAE details of each number assignment. Assigners collaborate with designated consultants when considering requests for assignment of new numbers.

3.1.3 Corps of Volunteer Consultants— Consultants are selected by the Advisory Board to provide expert knowledge of a specific field of materials. Since they are utilized primarily by the Board and the SAE number assigners, they are not listed in this recommended practice. At the request of the SAE number assigner, a consultant considers a request for a new number in the light of the ground rules established for the material involved, decides whether a new number is justified, and informs the SAE number assigner accordingly. This utilization of experts (consultants and number assigners) is intended to ensure prompt and fair consideration of all requests. It permits

each decision to be based on current knowledge of the needs of a specific industry of producers and users.

3.1.4 Staff at SAE—Staff members at SAE maintain master listings of all UNS numbers assigned.

3.1.5 In addition, established SAE and ASTM committees which normally deal with standards and specifications for the materials covered by the UNS, and other knowledgeable persons, are called upon by the Advisory Board for advice when considering appeals of unfavorable rulings in the matter of UNS number assignments.

4. Significance and Use

4.1 The UNS provides a means of correlating many nationally used numbering systems currently administered by societies, trade associations, and individual users and producers of metals and alloys, thereby avoiding confusion caused by use of more than one identification number for the same material; and by the opposite situation of having the same number assigned to two or more entirely different materials. It

TABLE 3 Number Assigners and Areas of Responsibility

The Aluminum Association, Inc. 1425 Wilson Boulevard, Suite 600 Arlington, VA 22209 Attention: Office for Unified Numbering System for Metals Telephone: (703) 358-2960 www.aluminum.org	Aluminum and Aluminum Alloys UNS Number Series: A00001–A99999
American Welding Society 550 N. W. LeJeune Road P.O. Box 351040 Miami, FL 33126 Attention: Office for Unified Numbering System for Metals Telephone: (305) 443-9353 www.aws.org	Welding Filler Metals UNS Number Series: W00001–W99999
Copper Development Association 260 Madison Avenue, 16th Floor New York, NY 10016 Attention: Office for Unified Numbering System for Metals Telephone: (212) 251-7200 www.copper.org	Copper and Copper Alloys UNS Number Series: C00001–C99999
Society of Automotive Engineers 400 Commonwealth Drive Warrendale, PA 15096 Attention: Office for Unified Numbering System for Metals Telephone: (724) 776-4841 www.sae.org	Carbon and Alloy Steels UNS Number Series: G00001–G99999 H-Steels UNS Number Series: H00001–H99999 Tool Steels UNS Number Series: T00001–T99999 Miscellaneous Nonferrous Metals and Alloys UNS Number Series: M00001–M99999 Cast Steels UNS Number Series: J00001–J99999 Heat and Corrosion Resistant (Stainless) Steels UNS Number Series: S00001–S99999 Zinc and Zinc Alloys UNS Number Series: Z00001–Z99999 Precious Metals and Alloys UNS Number Series: P00001–P99999 Cast Irons UNS Number Series: F00001–F99999
	Nickel and Nickel Alloys UNS Number Series: N00001–N99999 Steels Specified by Mechanical Properties UNS Number Series: D00001–D99999 Reactive and Refractory Metals and Alloys UNS Number Series: R00001–R99999



also provides the uniformity necessary for efficient indexing, record keeping, data storage and retrieval, and cross referencing.

4.2 A UNS number is not in itself a specification, since it establishes no requirements for form, condition, quality, etc. It is a unified identification of metals and alloys for which controlling limits have been established in specifications published elsewhere.

NOTE 5—Organizations that issue specifications should report to appropriate UNS number-assigning offices (3.1.2) any specification changes that affect descriptions shown in published UNS listings.

5. Procedure for Requesting Number Assignment to Metals and Alloys Not Already Covered by UNS Numbers (or Codes)

5.1 UNS numbers are assigned only to metals and alloys that have a commercial standing (as defined in Note 2).

5.2 The need for a new number should always be verified by determining from the latest complete listing of already assigned UNS numbers that a usable number is or is not available.

NOTE 6—In assigning UNS numbers, and consequently in searching complete listings of numbers, the predominant element of the metal or alloy usually determines the prefix letter of the series to which it is assigned. In certain instances where no one element predominates, arbitrary decisions are made as to what prefix letter to use, depending on the producing industry and other factors.

5.3 For a new UNS number to be assigned, the composition (or other properties, as applicable) must be significantly different from that of any metal or alloy which has already been assigned a UNS number.

5.3.1 In the case of metals or alloys that are normally identified or specified by chemical composition, the chemical composition limits must be reported.

5.3.2 In the case of metals or alloys that are normally identified or specified by mechanical (or other) properties, such properties and limits thereof must be reported. Only those chemical elements and limits, if any, which are significant in defining such materials need be reported.

5.4 Requests for new numbers shall be submitted on “Application for UNS Number Assignment” forms (see Fig. 1 and Fig. 2). Copies of these are available from any UNS number-assigning office (see Table 3) or facsimiles may be made of the one herein.

5.5 All instructions on the printed application form should be read carefully and all information provided as indicated.

NOTE 7—The application form is designed to serve also as a data input sheet to facilitate processing each request through to final print-out of the data on electronic data-processing equipment and to minimize transcription errors at number-assigning offices and data-processing centers.

5.6 To further assist in assigning UNS numbers, the requester is encouraged to suggest a possible UNS number in each request, giving appropriate consideration to any existing number presently used by a trade association, standards society, producer, or user.

5.7 Each completed application form shall be sent to the UNS number-assigning office having responsibility for the series of numbers that appears to most closely relate to the material described on the form (see Table 3).

6. Keywords

6.1 aluminum alloy numbering system; aluminum alloy UNS numbering; cast iron numbering system; cast iron UNS numbering; copper alloy numbering system; copper alloy UNS numbering; ferrous alloys numbering system; ferrous alloys UNS numbering; nickel alloy numbering system; nickel alloy UNS numbering; reactive metals and alloys numbering system; reactive metals and alloys UNS numbering; refractory metals and alloys numbering system; refractory metals and alloys UNS numbering; steel alloy numbering system; steel alloy UNS numbering; stainless steel alloy numbering system; stainless steel alloy UNS numbering; unified numbering system; UNS metal and alloy numbering system; weld filler metal numbering system; weld filler metal numbering; welding electrode numbering system; welding electrode UNS numbering



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APPLICATION FOR UNS NUMBER ASSIGNMENT and Data Input Sheet for Entering a Specific Material in the SAE-ASTM Unified Numbering System for Metals and Alloys (See Reverse Side for Instructions for Completing This Form)

Material Description _____

Suggested UNS No. _____

* UNS Assigned Description _____

* UNS Assigned No. _____

* Chemical Composition

Aluminum	Al	Indium	In	Selenium	Se
Antimony	Sb	Iridium	Ir	Silicon	Si
Arsenic	As	Iron	Fe	Silver	Ag
Beryllium	Be	Lead	Pb	Sulfur	S
Bismuth	Bi	Lithium	Li	Tantalum	Ta
Boron	B	Magnesium	Mg	Tellurium	Te
Cadmium	Cd	Manganese	Mn	Thorium	Th
Carbon	C	Mercury	Hg	Tin	Sn
Chromium	Cr	Molybdenum	Mo	Titanium	Ti
Cobalt	Co	Nickel	Ni	Tungsten	W
Columbium	Cb	Nitrogen	N	Uranium	U
Copper	Cu	Oxygen	O	Vanadium	V
Germanium	Ge	Phosphorus	P	Zinc	Zn
Gold	Au	Platinum	Pt	Zirconium	Zr
Hafnium	Hf	Rhenium	Re	Other	
Hydrogen	H	Rhodium	Rh		

* Cross References

AA	_____
ACI	_____
AISI	_____
ANSI	_____
AMS	_____
ASME	_____
ASTM	_____
AWS	_____
CDA	_____
FED	_____
MIL SPEC	_____
SAE	_____
OTHERS	_____

Requesting Person and Organization (full address) _____

Date of Request _____

* Assigning Org _____ * Date of UNS Assignment _____

Assigner's Name and Office _____

Applicant do not write in shaded areas.

* These items for Computer Operator.

NOTE—Reverse side of Fig. 1 is located on the next page.

FIG. 1 Sample Application Form.

General:

Before attempting to complete this form, the applicant should be thoroughly familiar with the objectives of the UNS and the “ground rules” for assigning numbers, as stated in SAE J 1086 and ASTM E527, Section 5.

Material Description:

Identify the base element; the single alloying element that constitutes 50 % or more of the total alloy content; other distinguishing predominant characteristics (such as “casting”); and common or generic names if any (such as “ounce metal” or “Waspalloy”). When no single element makes up 50 % or more of the total alloy content, list in decreasing order of abundance the two alloying elements that together constitute the largest portion of the total alloy contents; except that if no two elements make up at least 50 % of the total alloy content, list the three most abundant, and so on. Instead of “iron,” use “steel” to identify the base element of those iron-low-carbon alloys commonly known as steels.

When mechanical properties or physical characteristics are the primary defining criteria and chemical composition is secondary or nonsignificant, enter such properties and characteristics with the appropriate values or limits for each.

Suggested UNS No.:

While applicant's suggestion may or may not be the one finally assigned, it will assist proper identification of the material by the UNS Number Assigner.

Chemical Composition:

Enter limits such as 0.13–0.18 (*not* .13–.18 or 0.13 to 0.18) 1.5 max, 0.040 min, and balance. In space designated “other,” enter information such as “Each 0.05 max, Total 0.15 max,” and “Sn plus Pb 2.0 min.”

Cross References:

Letter-symbols listed indicated widely known trade associations and standards-issuing organizations. Enter after appropriate symbols any known specification numbers or identification numbers issued by such groups to cover material equivalent to, similar to, or closely resembling the subject material.

Examples: SAE J 404 (50B44), AISI 415, ASTM A638 (660)

In space designated “other,” enter any pertinent numbers issued by groups not listed above. In these instances, the full name and address of the issuing group shall be included.

SUBMIT COMPLETED FORM TO APPROPRIATE UNS NUMBER ASSIGNER,
AS LISTED IN SAE J 1086 AND ASTM E527

FIG. 2 Sample Application Form (Reverse Side).

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this practice since the last issue, E527 –07, that may impact the use of this practice. (Approved October 15, 2012)

(I) Added “EN” and “ISO” to list of cross reference organizations shown in Fig. 1.

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Appendix

9

SI QUICK REFERENCE GUIDE

SI QUICK REFERENCE GUIDE:
International System of Units (SI)
The Modern Metric System*

UNITS

The International System of Units (SI) is based on seven base units:

Base Units

<i>Quantity</i>	<i>Name</i>	<i>Symbol</i>
length	metre	m
mass	kilogram	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd

and a number of derived units which are combinations of base units and which may have special names and symbols:

Examples of Derived Units

<i>Quantity</i>	<i>Expression</i>	<i>Name</i>	<i>Symbol</i>
acceleration			
angular	rad/s ²		
linear	m/s ²		
angle			
plane	dimensionless	radian	rad
solid	dimensionless	steradian	sr
area	m ²		
Celsius temperature	K	degree Celsius	°C
density			
heat flux	W/m ²		
mass	kg/m ³		
current	A/m ²		
energy, enthalpy			
work, heat	N·m	joule	J
specific	J/kg		
entropy			
heat capacity	J/K		
specific	J/(kg·K)		
flow, mass	kg/s		
flow, volume	m ³ /s		
force	kg·m/s ²	newton	N
frequency			
periodic	1/s	hertz	Hz
rotating	rev/s		
inductance	Wb/A	henry	H
magnetic flux	V·s	weber	Wb
mass flow	kg/s		
moment of a force	N·m		
potential, electric	W/A	volt	V
power, radiant flux	J/s	watt	W
pressure, stress	N/m ²	pascal	Pa
resistance, electric	V/A	ohm	Ω
thermal conductivity	W/(m·K)		
velocity			
angular	rad/s		
linear	m/s		
viscosity			
dynamic (absolute) (μ)	Pa·s		
kinematic (ν)	m ² /s		
volume	m ³		
volume, specific	m ³ /kg		

* For complete information see IEEE/ASTM SI-10.

SYMBOLS

Symbol	Name	Quantity	Formula
A	ampere	electric current	base unit
Bq	becquerel	activity (of a radio nuclide)	1/s
C	coulomb	electric charge	A·s
°C	degree Celsius	temperature interval	°C = K
cd	candela	luminous intensity	base unit
F	farad	electric capacitance	C/V
Gy	gray	absorbed dose	J/kg
g	gram	mass	kg/1000
H	henry	inductance	Wb/A
Hz	hertz	frequency	1/s
ha	hectare*	area	10 000 m ²
J	joule	energy, work, heat	N·m
K	kelvin	temperature	base unit
kg	kilogram	mass	base unit
L	litre	volume	m ³ /1000
lm	lumen	luminous flux	cd·sr
lx	lux	illuminance	lm/m ²
m	metre	length	base unit
mol	mole	amount of substance	base unit
N	newton	force	kg·m/s ²
Ω	ohm	electric resistance	V/A
Pa	pascal	pressure, stress	N/m ²
rad	radian	plane angle	m/m (dimensionless)
S	siemens	electric conductance	A/V
Sv	sievert	dose equivalent	J/kg
s	second	time	base unit
sr	steradian	solid angle	m ² /m ² (dimensionless)
T	tesla	magnetic flux density	Wb/m ²
t	tonne, metric ton	mass	1000 kg; Mg
V	volt	electric potential	W/A
W	watt	power, radiant flux	J/s
Wb	weber	magnetic flux	V·s
	* allowed with SI		

Use of Symbols

The correct use of symbols is important because an incorrect symbol may change the meaning of a quantity. Some SI symbols are listed in the Symbol table.

SI has no abbreviations—only symbols. Therefore, no periods follow a symbol except at the end of a sentence.

Examples: A, *not* amp; s *not* sec; SI, *not* S.I.

Symbols appear in lower case unless the unit name has been taken from a proper name. In this case the first letter of the symbol is capitalized.

Examples: m, metre; Pa, pascal; W, watt

Exception: L, litre

Symbols and prefixes are printed in upright (roman) type regardless of the type style in surrounding text.

Example: . . . a distance of 73 km between . . .

Unit symbols are the same whether singular or plural.

Examples: 1 mm, 100 mm; 1 kg, 65 kg

Leave a space between the value and the symbol.

Examples: 115 W, *not* 115W; 0.75 L, *not* 0.75L
88 °C, *not* 88°C or 88° C

Exception: No space is left between the numerical value and symbol for degree of plane angle.

Examples: 73°, *not* 73 °

Note: Symbol for coulomb is C; for degree Celsius it is °C

Do not mix symbols and names in the same expression.

Examples: radians per second or rad/s,
not radians/second; *not* radians/s
m/s or metres per second,
not metres/second; *not* metres/s
J/kg or joules per kilogram,
not joules/kilogram; *not* joules/kg

Symbol for product—use the raised dot (·)

Examples: N·m; mPa·s; W/(m²·K)

Symbol for quotient—use one of the following forms:

Examples: m/s or m/s or use the negative exponent

Note: Use only one solidus (/) per expression and parentheses to avoid any ambiguity.

PREFIXES

Most prefixes indicate orders of magnitude in steps of 1000 and provide a convenient way to express large and small numbers and to eliminate nonsignificant digits and leading zeroes in decimal fractions.

Examples: 64 000 watts is the same as 64 kilowatts*
0.057 metre is the same as 57 millimetres
16 000 metres is the same as 16 kilometres*
*except for intended accuracy

Prefix	Symbol	Represents
yotta	Y	10 ²⁴
zetta	Z	10 ²¹
exa	E	10 ¹⁸
peta	P	10 ¹⁵
tera	T	10 ¹²
giga	G	10 ⁹
mega	M	10 ⁶
kilo	k	10 ³
hecto	h*	10 ²
deka	da*	10 ¹
deci	d*	10 ⁻¹
centi	c*	10 ⁻²
milli	m	10 ⁻³
micro	μ	10 ⁻⁶
nano	n	10 ⁻⁹
pico	p	10 ⁻¹²
femto	f	10 ⁻¹⁵
atto	a	10 ⁻¹⁸
zepto	z	10 ⁻²¹
yocto	y	10 ⁻²⁴
	* allowed with SI	

To realize the full benefit of the prefixes when expressing a quantity by numerical value, choose a prefix so that the number lies between 0.1 and 1000. For simplicity, give preference to prefixes representing 1000 raised to an integral power (i.e., mm, μm, km).

*Exceptions: In expressing area and volume, the prefixes hecto, deka, deci, and centi may be required; for example, cubic decimetre (L), square hectometre (hectare), cubic centimetre.

Tables of values of the same quantity.

Comparison of values.

For certain quantities in particular applications. For example, the millimetre is used for linear dimensions in architectural and engineering drawings even when the values lie far outside the range of 0.1 mm to 1000 mm; the centimetre is usually used for anatomical measurements and clothing sizes.

Compound Units. A compound unit is a derived unit expressed with two or more units. The prefix is attached to a unit in the numerator.

Examples: V/m not mV/mm

MJ/kg not kJ/g

Compound prefixes formed by a combination of two or more prefixes are not used. Use only one prefix.

Examples: 2 nm not 2 mμm;
6 m³ not 6 kL;
6 mPa not 6 kPa

Exponential Powers. An exponent attached to a symbol containing a prefix indicates that the multiple (of the unit with its prefix) is raised to the power of 10 expressed by the exponent.

Examples: 1 mm³ = (10⁻³ m)³ = 10⁻⁹ m³
1 ns⁻¹ = (10⁻⁹ s)⁻¹ = 10⁹ s⁻¹
1 mm²/s = (10⁻³ m)²/s = 10⁻⁶ m²/s

NUMBERS

International practice separates the digits of large numbers into groups of three, counting from the decimal to the left and to the right, and inserts a space to separate the groups. In numbers of four digits, the space is not necessary except for the uniformity in tables.

Examples: 6.358 568; 85 365; 51 845 953; 88 000;
0.246 113 562; 7 258

Small Numbers. When writing a number between one and minus one, put a zero before the decimal marker.

Note: This applies to large numbers which have an exponent: as -0.1 × 10⁶. This rule is given colloquially as “never use a naked decimal point.”

Decimal Marker. The recommended decimal marker is a dot on the line (period). (In some countries, a comma is used as the decimal marker.)

Because **billion** means a million million in most countries but a thousand million in the United States, avoid using billion in technical writing.

DO’S AND DON’TS

The units in the international system of units are called SI units—not Metric Units and not SI Metric Units.

Non-SI units include inch-pound units, old metric units and many other units. Inch=pound units (IP) refers to sets of units which contain inches and pounds. These include so-called customary units, US customary units, conventional units, imperial units, and English units.

Treat all spelled out names as nouns. Therefore, do not capitalize the first letter of a unit except at the beginning of a sentence or in capitalized material such as a title.

Examples: watt; pascal; ampere; volt; newton; kelvin
Exception: Always capitalize the first letter of Celsius.

Do not begin a sentence with a unit symbol—either rearrange the unit names or write the unit name in full.

Use plurals for spelled out unit names when required by the rules of grammar.

Examples: metre—metres; henry—henries;
kilogram—kilograms; kelvin—kelvins
Irregular: hertz—hertz; lux—lux; siemens—siemens

Do not put a space or hyphen between the prefix and unit name.

Examples: kilometre *not* kilo metre or kilo-metre;
milliwatt *not* milli watt or milli-watt

When a prefix ends with a vowel and the unit name begins with a vowel, retain and pronounce both vowels.

Example: kiloampere

Exceptions: hectare; kilohm; megohm

When a derived unit name is formed by multiplication, leave a space between units that are multiplied.

Examples: newton metre, *not* newton-metre;
volt ampere, *not* volt-ampere

Use the modifier squared or cubed after the unit name.

Example: metre per second squared
Exception: For area or volume the modifier may be placed before the units.

Example: square millimetre; cubic metre

When derived units are formed by division, use the word *per*, not a solidus (/).

Examples: metre per second, *not* metre/second; watt per square metre, *not* watt/square meter

SELECTED CONVERSION FACTORS

CAUTION: These conversion values are rounded to three or four significant figures, which is sufficiently accurate for most applications. When making conversions, remember that a converted value is no more precise than the original value. Round off the final value to the same number of significant figures as those in the original value. See ANSI SI 10 for additional conversions with more significant figures.

<i>Multiply</i>	<i>By</i>	<i>To Obtain</i>
acre	0.4047	ha
atmosphere, standard	*101.325	kPa
bar	*100	kPa
barrel (42 US gal, petroleum)	159	L
Btu, (International Table)	1.055	kJ
Btu/lb.°F (specific heat, C ^P)	4.184	kJ/(kg·K)
bushel	0.03524	m ³
calorie, kilogram (kilocalorie)	4.187	kJ
candle, candlepower	*1.0	cd
centipoise, dynamic viscosity, μ	*1.00	mPa·s
centistokes, kinematic viscosity, ν	*1.00	mm ² /s
ft	*0.3048	m
ft	*304.8	mm
ft/min, fpm	*0.00508	m/s
ft/s, fps	*0.3048	m/s
ft of water	2.99	kPa
ft ²	0.09290	m ²
ft ² /s, kinematic viscosity, ν	92 900	mm ² /s
ft ³	28.32	L
ft ³	0.02832	m ³
ft ³ /h, cfh	7.866	mL/s
ft ³ /min, cfm	0.4719	L/s
ft ³ /s, cfs	28.32	L/s
footcandle	10.76	lx
ft·lb _t (torque or moment)	1.36	N·m
ft·lb _f (work)	1.36	J
ft·lb/lb (specific energy)	2.99	J/kg
ft·lb/min (power)	0.0226	W
gallon, US (*231 in ³)	3.785	L
gph	1.05	mL/s
gpm	0.0631	L/s
gpm/ft ²	0.6791	L/(s·m ²)
gr/gal	17.1	g/m ³
horsepower (550 ft·lb _f /s)	0.746	kW
inch	*25.4	mm
in of mercury (60°F)	3.377	kPa

<i>Multiply</i>	<i>By</i>	<i>To Obtain</i>
in of water (60°F)	248.8	Pa
in-lb _t (torque or moment)	113	mN·m
in ²	645	mm ²
in ³ (volume)	16.4	mL
in ³ (section modulus)	16 400	mm ³
in ⁴ (section moment)	416 200	mm ⁴
km/h	0.278	m/s
kWh	*3.60	MJ
kip/in ² (ksi)	6.895	MPa
litre	*0.001	m ³
micron (μm) of mercury (60°F)	133	mPa
mil (0.001 in.)	*25.4	mm
mile	1.61	km
mile, nautical	1.85	km
mph	1.61	km/h
mph	0.447	m/s
millibar	*0.100	kPa
mm of mercury (60°F)	0.133	kPa
mm of water (60°F)	9.80	Pa
ounce (mass, avoirdupois)	28.35	g
ounce (force of thrust)	0.278	N
ounce (liquid, US)	29.6	mL
ounce (avoirdupois) per gallon	7.49	kg/m ³
pint (liquid, US)	473	mL
pound		
lb _m (mass)	0.4536	kg
lb _m (mass)	453.6	g
lb _t (force or thrust)	4.45	N
lb _m /ft (uniform load)	1.49	kg/m
lb _m /(ft·h) (dynamic viscosity, μ)	0.413	mPa·s
lb _m /(ft·s) (dynamic viscosity, μ)	1490	mPa·s
lb _t ·s/ft ² (dynamic viscosity, μ)	47 880	mPa·s
lb _m /min	0.00756	kg/s
lb _m /h	0.126	g/s
lb _f /ft ²	47.9	Pa
lb _m /ft ²	4.88	kg/m ²
lb _m /ft ³ (density, ρ)	16.0	kg/m ³
lb _m /gallon	120	kg/m ³
ppm (by mass)	*1.00	mg/kg
psi	6.895	kPa
quad (10 ¹⁵ Btu)	1.06	EJ
quart (liquid, US)	0.946	L
rpm	0.105	rad/s
tablespoon (approx.)	15	mL
teaspoon (approx.)	5	mL
therm (100,000 Btu)	105.5	MJ
ton, short (2000 lb)	0.907	Mg; t (tonne)
yd	*0.9144	m
yd ²	0.836	m ²
yd ³	0.7646	m ³

* Conversion factor is exact.

Note: In this list the kelvin (K) expresses temperature intervals. The degree Celsius symbol (C) may be used for this purpose as well

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