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Handbook of Comparative World Steel Standards

Third Edition

John E. Bringas, Editor

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John E. Bringas, Editor

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One person could not have produced this handbook and the accompanying e-book. 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 book would never have been completed.

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 member of ASTM A01 and B02 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, which created far too many surprises and delays in completing this book.

Comparing steel standards is not an exact science, so the biggest challenge of 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.

To say the least, these rules changed from chapter to chapter while the book was being written. It wasn't until the last chapter and 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 which made yet another review of the book necessary.

After more than two years of researching steel standards and gathering data from around the world for the 2nd and 3rd editions of this handbook, then developing a comparison order to more than 100,000 pieces of data, this handbook is an ongoing and expanding project. The addition of a fully searchable e-book on CD-ROM makes this product even more valuable, since trying to find one piece of data in more than 100,000 is not an easy task. The e-book makes searching for a comparable steel a quick and easy process. In some cases, the user may find out that the steel is non-comparable.

I hope you enjoy using this handbook as much as I will. Tie a chain to it and anchor it to your desk, because once others see it, they'll want to use your copy. I am interested in your comments and suggestions to improve this handbook, so I encourage you to send your feedback directly to ASTM.

John E. Bringas, P.Eng.

Getting Started With This Book

Comparing steel standards is not an exact science and there is no foolproof method. When you begin to use this book, you'll quickly discover that there is no such thing as "equivalent" steel standards. Then, consider the fact that not all steels have comparative counterparts and you'll begin to understand the methodology used in this book. Before proceeding directly to the contents of this book, it is strongly recommended that you read Chapter 1, which includes a detailed explanation of the "rules of comparison" used in this book.

Since there was 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 grey. Black lines separate groups of steels that are more closely comparable to each other, whereas grey lines separate steel data within a comparative group.

Caution: do not confuse the thinner dividing black line within a table, with the thicker black line that borders the outside of the table. The pages 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 place 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.

Getting Started With This CD-ROM

Minimum System Requirements

- Intel Pentium processor
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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 A 516/A 516M Grade 70 is *comparable* to JIS G 3118 symbol SGV 480 and to EN 10028-2 steel name P295GH, based on chemical compositions and mechanical properties. Yet they are not *equivalent* since there are differences in their chemical compositions and mechanical properties. 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, since there will always be differences between standards.

These differences may be significant to one user, but not significant to another user. 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 end user's requirements, 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 A 485 and EN ISO 683-17 share seven identical bearing steel grade chemical compositions, yet the body of each standard is different (that is, grain size, hardenability, microstructure and hardness, inspection, testing, etc.). As a result, these seven bearing steels within these two standards are not equivalent, but 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, since there would be no comparisons otherwise. Since 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. The following is one example of the comparison process, with technically comparative steels and closest match steels used in the table.

Table 1.1 lists the chemical compositions of nine grades of cast steels that are essentially Cr-Ni-Mo alloys, with nominally 0.30 % C. If a strict technical comparison was made based on their chemical composition, none of these alloys would be comparable since they would differ in either their carbon, manganese, chromium, nickel, or molybdenum contents. Try comparing these data yourself.

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 958-00	SC 4330	---	---	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	---
	SC 4340	---	---	0.38-0.43	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	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	---
DIN 17205:1992	GS-25 CrNiMo 4	1.6515	---	0.22-0.29	0.60-1.00	0.60	0.020	0.015	0.80-1.20	0.80-1.20	0.20-0.30	---
	GS-34 CrNiMo 6	1.6582	---	0.30-0.37	0.60-1.00	0.60	0.020	0.015	1.40-1.70	1.40-1.70	0.20-0.30	---
	GS-30 CrNiMo 8 5	1.6570	---	0.27-0.34	0.60-1.00	0.60	0.015	0.010	1.10-1.40	1.80-2.10	0.30-0.40	---
	GS-33 CrNiMo 7 4 4	1.8740	---	0.30-0.36	0.50-0.80	0.60	0.015	0.007	0.90-1.20	1.50-1.80	0.35-0.60	---
AFNOR NF A 32-053:1992	20 NCD4-M	---	---	0.17-0.23	0.80-1.20	0.60	0.025	0.020	0.30-0.50	0.80-1.20	0.40-0.80	---
AFNOR NF A 32-054:1994	G30NiCrMo8	---	---	0.33	1.00	0.60	0.030	0.020	0.80-1.20	1.70-2.30	0.30-0.60	---

Five grades of steel were eventually eliminated from Table 1.1 after technical comparison. This produced Table 1.2, which was then divided into two separate comparative groups based on the differing molybdenum contents above and below 0.30–0.35 % Mo. The thin black line in Table 1.2 is the separator between the two comparative groups.

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 958-00	SC 4330	---	---	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	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	---
DIN 17205:1992	GS-33 CrNiMo 7 4 4	1.8740	---	0.30-0.36	0.50-0.80	0.60	0.015	0.007	0.90-1.20	1.50-1.80	0.35-0.60	---
AFNOR NF A 32-054:1994	G30NiCrMo8	---	---	0.33	1.00	0.60	0.030	0.020	0.80-1.20	1.70-2.30	0.30-0.60	---

However, if strict technical comparison rules were applied, Grade SCNCrM 2 could be rejected based on its higher manganese content when comparing it to SC 4330. In that case, SC 4330 would be rejected since it would not have a comparative steel (that is, it takes two steels to make a comparison). The same argument could be made when comparing GS-33 CrNiMo 7 4 4 and G30NiCrMo8 in the second group, where the differing nickel contents could be a basis for rejection on a stricter comparison.

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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 355-89 (2000)	A	---	K24065	0.38-0.43	0.50-0.70	0.15-0.35	0.035	0.040	1.40-180	---	0.30-0.40	Al 0.95-1.30
JIS G 4202:1979	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
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
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 0.80-1.20

There are many opportunities to make technical errors that may lead to inappropriate steel comparisons. For example, when comparing stainless steels there are many technical decisions to make since it is not common to find identical chemical compositions within standards from different countries. Table 1.4 shows a list of comparative Cr-Ni-Mo wrought austenitic stainless steels from the USA, Japan, and European Union. Note the differences in the Cr, Ni, and Mo contents among all the standards and the N limit in the EN standard. These differences will 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.

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 276-03	316L	---	S31603	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
JIS G 4303:1998	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	SUS316L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
EN 10088-3:1995	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
	X2CrNiMo17-12-3	1.4432	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.00	2.50-3.00	N 0.11
	X2CrNiMo18-14-3	1.4435	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	12.00-15.00	2.50-3.00	N 0.11

In summary, if strict technical comparison is made to this type of data, no relationships or no associations between the various grades of steel would be established, which 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, related manufacturing processes (including heat treatment), etc., 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 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 the above list 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, 9th 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 A 240/A 240M-04 on Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications, 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).

Definitions of Steel Terms

ASTM and CEN have established two separate standards for defining steel terms:

> ASTM A 941-03 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys (see Appendix 9) (defines the terms: carbon steel, alloy steel, low-alloy steel, and stainless steel);
>
> EN 10020:2000 Definition and Classification of Grades of Steel;(defines the terms: non-alloy steels, other alloy steels (which include alloy quality steels and alloy special steels), and stainless steels).

Note that these two standards, from the USA and EU, 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 A 941-03, A 902-03, and F 1789-04.

A summary of the chemical element limits for ASTM A 941-03 alloy steel and EN 10020:2000 non-alloy steel is shown in Table 1.5. Although the limits seem to be the same, it is important to note the 70 % rule in EN 10020, which states:

> 3.1.2 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 10028-3:2003, 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 becoming non-comparable with non-alloy steels.

ASTM A 941-03 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

ASTM A 941-03 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.

Table 1.5 Limits for EN 10020:2000 and ASTM A 941-03
Between Carbon Steels/Non Alloy Steel and Alloy Steel[a] (% by mass)

Symbol	Name	EN 10020:2000[b]	ASTM A 941-03
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	1.65[b]	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

[a] Alloy steel when equal to or greater than the limit.
[b] Where 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).

Cautionary Note

Many standard specifications include cautionary paragraphs that warn users about their responsibilities (e.g., see paragraph 1.5 from ASTM A 53/A 53M-02, shown below). 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.

> 1.5 The following precautionary caveat pertains only to the test method portion, Sections 9, 10, 11, 15, 16, and 17 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 limitations prior to use.

Questions Regarding the Rules of Comparison

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

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, etc.? 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, etc.? 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?

Should comparisons be based on the data's minimum values, maximum values, or average values of their min/max ranges? Should alloy steels and stainless steels be compared on their mechanical properties when they are generally selected for use based on their alloying elements' abilities to provide satisfactory service in their intended applications?

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?

Non-Comparable Steels

Not all steels have comparative counterparts. Knowing that a steel is non-comparable 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. All steel grades within the listed standards in this handbook are either designated as comparable or non-comparable to assist the user in finding data. Non-comparable steels can be found at the end of each chapter.

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. Since carbon steels are typically selected based on mechanical properties, it was decided that tensile strength would be the first

criterion used for comparing carbon steels. Likewise, since alloys steels and stainless steels are generally selected based on their chemistry, it was decided that chemical composition would be used to compare them.

An exception to the above methodology is 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 are generally 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 A 941 defines them separately.

Since 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, then see how well the data in the B table match the steels which are being compared.

This is not a foolproof methodology of comparison. For example, ASTM A 958 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 ordered 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/mm^2 or 7.25 ksi) in tensile strength (that is, a black line divides comparative groups every 50 MPa (50 N/mm^2 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 on 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 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 grey. Black lines separate groups of steels that are more closely comparable to each other, whereas grey lines separate steel data within a comparative group. This does not mean that steels outside of these groups cannot be compared, since 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, that is, "NOTE: this section continues on the next page."
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, for example, differing test temperatures or requirements for subsize 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 like: "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 them 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 Nb (niobium) or Cb (columbium). 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. This becomes significant when using the search engine on the accompanying e-book's CD-ROM.
19. When a steel grade was found to be non-comparable, it was included at the end of the chapter in the non-comparable list. Therefore, if a particular steel was found to be unique and did not have a comparable steel, the user would not have to search any further.

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 French government assigned a commission to formulate standard methods of testing materials of construction. Later that year, the European member countries of the International Association for Testing Materials (IATM) held their first conference in Zurich and the standardization of metals began.

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 A 548 is applicable to cold-heading quality carbon steel wire for tapping or sheet metal screws. 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 A 582/A 582M-95b (2000), Grade 303Se - Free-Machining Stainless Steel Bars:
>
> - *A* describes a ferrous metal, but does not subclassify it as cast iron, carbon steel, alloy steel, tool steel, or stainless steel.
> - *582* is a sequential number without any relationship to the metal's properties.
> - M indicates that the standard A 582M is written in rationalized SI units (the "M" comes from the word "Metric"), hence together A 582/A 582M includes both inch-pound and SI units.
> - 95 indicates the year of adoption or last revision and a letter *b* following the year indicates the third revision of the standard in 1995.
> - *(2000),* a number in parentheses, indicates the year of last reapproval.
> - Grade 303Se indicates the grade of the steel, and in this case, it has a Se (selenium) addition.

In the steel industry, the terms *Grade*, *Type*, and *Class* are generally 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 A 106-02a 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 (min.), 60 ksi tensile strength (min.); and
  Grade C: 0.35 % C, 70 ksi tensile strength (min.).

ASTM A 276-03, Type 304, 316, 410 – Stainless and Heat-Resisting Steel Bars and Shapes:

- Types 304, 316, 410 and others are based on the SAE designation system for stainless steels (see SAE and former 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 A 335/A 335M-03, Grade P22; Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service.
- ASTM A 213/A 213M-03a, Grade T22; Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes.
- ASTM A 312/A 312M-03, Grade TP304; Seamless and Welded Austenitic Stainless Steel Pipes.
- ASTM A 336/A 336M-03a, Class F22 - Steel Forgings, Alloy, for Pressure and High-Temperature Parts.

ASTM Referenced Standards and Supplementary Requirements

ASTM standards contain a "Referenced Documents" section that lists other ASTM standards which are referenced in the text 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

Carbon and Alloy Steels

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. Since the American Iron and Steel Institute (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 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 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 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 applicable to alloy steels. The full series of classification groups is shown in Table 1.6.

Table 1.6 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

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 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 1.6. The UNS designations for ferrous metals and alloys are described in Table 1.7.

Table 1.7 UNS Designations for Ferrous Metals and Alloys

UNS Descriptor	**Ferrous Metals**
Dxxxxx	Specified mechanical properties 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

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 towards the exclusive use of SI units than others, and thus the reason for these differences.

As far as practicable, rationalization with relevant International Standards Organization (ISO) standards has been achieved in CSA G4, Steel Wire Rope for General Purpose and for Mine Hoisting and for Mine Haulage. Similarly, the 2002 edition of CSA Z245.1, Steel Line Pipe, references requirements for ISO 1027:1993 on radiographic image indicators for non-destructive testing: principles and identification, as well as ISO 5579:1985 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) (European Committee for Standardization) was founded in 1961 by the national standards bodies in the European Economic Community and EFTA countries. Now CEN is contributing to the objectives of the European Union and European Economic Area with voluntary technical standards. CEN is a system of formal processes to produce standards, shared principally between:

- 28 national members and the representative expertise they assemble from each country. These members vote for and implement European Standards (EN);
- 8 associate members and two counsellors;
- The CEN Management Centre, Brussels.

It works closely with the European Committee for Electrotechnical Standardization (CENELEC), the European Telecommunications Standards Institute (ETSI), and the International Organization for Standardization (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 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 BSI in the United Kingdom, DIN for DIN in Germany, NF for AFNOR in France, etc. 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 are 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 8, where each part specifies a particular characteristic of the steel product, and may not include the word *part* in the designation, but rather replace it with a hyphen, e.g., EN 10028-1, 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.

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 - Steel Numbers

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 not identical with, that outlined in an ISO technical report (ISO TR 4949:1989 (E) "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 P275N.

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

Steel Numbers

EN 10027-2 describes the system used for assigning steel numbers, which are complementary to the steel names described above. The number consists of a fixed number of digits and is hence more suitable than the name for data processing purposes. The number is 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 more difficult to compare the superseded national standards with current standards from other nations outside of Europe and the UK, let alone comparing them to the new EN standards. Appendix 6 lists the EN standards with the superseded national standards and Appendix 7 lists the national standards that were superseded by the current EN standards (that is, the reverse of Appendix 6).

For example, if you are looking up a former national standard such as DIN 17441, Appendix 7 shows that it has been superseded by EN 10028-7:2000. Appendix 6 shows this information in reverse order, so that no matter which standard designation you are interested in, that is, the superseded or current standard, you can find it in this handbook.

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. These details can be found in Appendixes 6 and 7.

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. The indexes are built around the steel designation systems described previously, namely:

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

Chapter 2

CARBON AND ALLOY STEELS FOR GENERAL USE

ASTM Standards

ASTM A 29/A 29M-03	Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished
ASTM A 108-03	Steel Bars, Carbon and Alloy, Cold-Finished
ASTM A 576-90b (2000)	Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A 322-91 (2001)	Steel Bars, Alloy, Standard Grades
ASTM A 355-89 (2000)	Standard Specification for Steel Bars, Alloys, for Nitriding

SAE Standards

SAE J403 NOV01	Chemical Compositions of SAE Carbon Steels (Hot Rolled and Cold Finished Bars Only)
SAE J404 JUN00	Chemical Compositions of SAE Alloy Steels (Hot Rolled and Cold Finished Bars Only)

JIS Standards

JIS G 4051:1979	Carbon Steels for Machine Structural Use
JIS G 4053:2003	Low-alloyed Steels for Machine Structural Use
JIS G 4103:1979	Nickel Chromium Molybdenum Steels
JIS G 4105:1979	Chromium Molybdenum Steels
JIS G 4202:1979	Aluminium Chromium Molybdenum Steels

CEN Standards

EN 10016-2:1995	Non-Alloy Steel Rod for Drawing and/or Cold Rolling – Part 2: Specific Requirements for General Purposes Rod
EN 10016-4:1995	Non-Alloy Steel Rod for Drawing and/or Cold Rolling – Part 4: Specific Requirements for Rod for Special Applications
EN 10083-1:1991 A2:1999	Quenched and Tempered Steels – Technical Delivery Conditions for Special Steels (Amendment A2:1999)
EN 10083-2:1991 A1:1998	Quenched and Tempered Steels – Technical Delivery Conditions for Unalloyed Quality Steels (Amendment A1:1998)
EN 10083-3:1995	Quenched and Tempered Steels – Technical Delivery Conditions for Boron Steels
EN 10084:1998 A1:1998	Case Hardening Steels – Technical Delivery Conditions
EN 10085:2001	Nitriding Steels

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

2.1 Chemical Composition of Carbon Steels for General Use

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	1005	---	G10050	0.06	0.35	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1005	---	G10050	0.06	0.35	---	0.030	0.050	---	---	---	---
EN 10016-2:1995	C4D	1.0300	---	0.06	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1995	C3D2	1.1110	---	0.05	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
ASTM A 29/A 29M-03	1006	---	G10060	0.08	0.25-0.40	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1006	---	G10060	0.08	0.25-0.40	---	0.030	0.050	---	---	---	---
EN 10016-2:1995	C7D	1.0313	---	0.05-0.09	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1995	C5D2	1.1111	---	0.07	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
ASTM A 29/A 29M-03	1008	---	G10080	0.10	0.30-0.50	---	0.040	0.050	---	---	---	---
ASTM A 108-03	1008	---	G10080	0.10	0.30-0.50	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1008	---	G10080	0.10	0.30-0.50	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1008	---	G10080	0.10	0.30-0.50	---	0.030	0.050	---	---	---	---
EN 10016-2:1995	C9D	1.0304	---	0.10	0.60	0.30	0.035	0.035	0.25	0.25	0.08	Cu 0.30
EN 10016-4:1995	C8D2	1.1113	---	0.06-0.10	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
ASTM A 29/A 29M-03	1010	---	G10100	0.08-0.13	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 108-03	1010	---	G10100	0.08-0.13	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1010	---	G10100	0.08-0.13	0.30-0.60	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1010	---	G10100	0.08-0.13	0.30-0.60	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 10 C	---	---	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
	S 09 CK	---	---	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
EN 10016-2:1995	C10D	1.0310	---	0.08-0.13	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1995	C10D2	1.1114	---	0.08-0.12	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
EN 10084:1998	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	---	---	---	---
ISO 683-11:1987	C 10	---	---	0.07-0.13	0.30-0.60	0.15-0.40	0.035	0.035	---	---	---	---
ASTM A 29/A 29M-03	1012	---	G10120	0.10-0.15	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1012	---	G10120	0.10-0.15	0.30-0.60	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1012	---	G10120	0.10-0.15	0.30-0.60	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 12 C	---	---	0.10-0.15	0.30-0.60	0.15-0.35	0.030	0.035	.20	.20	---	Cu 0.30; Ni+Cr 0.35
EN 10016-2:1995	C12D	1.0311	---	0.10-0.15	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1995	C12D2	1.1124	---	0.10-0.14	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	1015	---	G10150	0.13-0.18	0.30-0.60	---	0.040	0.050	---	---	---	---
	1016	---	G10160	0.13-0.18	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 108-03	1015	---	G10150	0.13-0.18	0.30-0.60	---	0.040	0.050	---	---	---	---
	1016	---	G10160	0.13-0.18	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1015	---	G10150	0.13-0.18	0.30-0.60	---	0.040	0.050	---	---	---	---
	1016	---	G10160	0.13-0.18	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1015	---	G10150	0.13-0.18	0.30-0.60	---	0.030	0.050	---	---	---	---
	1016	---	G10160	0.13-0.18	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 15 C	---	---	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
	S 15 CK	---	---	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
EN 10016-2:1995	C15D	1.0413	---	0.12-0.17	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1995	C15D2	1.1126	---	0.13-0.17	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
EN 10084:1998	C15E	1.1141	---	0.12-0.18	0.30-0.60	0.40	0.035	0.035	---	---	---	---
	C15R	1.1140	---	0.12-0.18	0.30-0.60	0.40	0.035	0.020-0.040	---	---	---	---
	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	---	---	---	---
ISO 683-11:1987	C 15 E4	---	---	0.12-0.18	0.30-0.60	0.15-0.40	0.035	0.035	---	---	---	---
	C 15 M2	---	---	0.12-0.18	0.30-0.60	0.15-0.40	0.035	0.020-0.040	---	---	---	---
	C 16 E4	---	---	0.12-0.18	0.60-0.90	0.15-0.40	0.035	0.035	---	---	---	---
	C 16 M2	---	---	0.12-0.18	0.60-0.90	0.15-0.40	0.035	0.020-0.040	---	---	---	---
ASTM A 29/A 29M-03	1017	---	G10170	0.15-0.20	0.30-0.60	---	0.040	0.050	---	---	---	---
	1018	---	G10180	0.15-0.20	0.60-0.90	---	0.040	0.050	---	---	---	---
	1019	---	G10190	0.15-0.20	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A 108-03	1018	---	G10180	0.15-0.20	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1017	---	G10170	0.15-0.20	0.30-0.60	---	0.040	0.050	---	---	---	---
	1018	---	G10180	0.15-0.20	0.60-0.90	---	0.040	0.050	---	---	---	---
	1019	---	G10190	0.15-0.20	0.70-1.00	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1017	---	G10170	0.15-0.20	0.30-0.60	---	0.030	0.050	---	---	---	---
	1018	---	G10180	0.15-0.20	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 17 C	---	---	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
EN 10016-2:1995	C18D	1.0416	---	0.15-0.20	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1995	C18D2	1.1129	---	0.16-0.20	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	1020	---	G10200	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
	1021	---	G10210	0.18-0.23	0.60-0.90	---	0.040	0.050	---	---	---	---
	1022	---	G10220	0.18-0.23	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A 108-03	1020	---	G10200	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
	1022	---	G10220	0.18-0.23	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1020	---	G10200	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
	1021	---	G10210	0.18-0.23	0.60-0.90	---	0.040	0.050	---	---	---	---
	1022	---	G10220	0.18-0.23	0.70-1.00	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1020	---	G10200	0.18-0.23	0.30-0.60	---	0.030	0.050	---	---	---	---
	1021	---	G10210	0.18-0.23	0.60-0.90	---	0.030	0.050	---	---	---	---
	1022	---	G10220	0.18-0.23	0.70-1.00	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 20 C	---	---	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
	S 20 CK	---	---	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
EN 10016-2:1995	C20D	1.0414	---	0.18-0.23	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1995	C20D2	1.1137	---	0.18-0.23	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	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
	C22R	1.1149	---	0.17-0.24	0.40-0.70	0.40	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	C22	1.0402	---	0.17-0.24	0.40-0.70	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Ni+Mo 0.63
ASTM A 29/A 29M-03	1023	---	---	0.20-0.25	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1023	---	G10230	0.20-0.25	0.30-0.60	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1023	---	G10230	0.20-0.25	0.30-0.60	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 22 C	---	---	0.20-0.25	0.30-0.60	0.15-0.35	0.030	0.035	.20	.20	---	Cu 0.30; Ni+Cr 0.35

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
	1026	---	G10260	0.22-0.28	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 108-03	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
	1026	---	G10260	0.22-0.28	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.030	0.050	---	---	---	---
	1026	---	G10260	0.22-0.28	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 25 C	---	---	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
EN 10016-2:1995	C26D	1.0415	---	0.24-0.29	0.50-0.80	0.10-0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1995	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	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	C25E	1.1178	---	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
	C25R	1.1179	---	0.22-0.29	0.40-0.70	0.40	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	C25	1.0402	---	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
ISO 683-1:1987	C 25	---	---	0.22-0.29	0.40-0.70	0.10-0.40	0.045	0.045	---	---	---	---
	C 25 E 4	---	---	0.22-0.29	0.40-0.70	0.10-0.40	0.035	0.035	---	---	---	---
	C 25 M 2	---	---	0.22-0.29	0.40-0.70	0.10-0.40	0.035	0.020-0.040	---	---	---	---
ASTM A 29/A 29M-03	1029	---	G10290	0.25-0.31	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1029	---	G10290	0.25-0.31	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1029	---	G10290	0.25-0.31	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 28 C	---	---	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
ASTM A 29/A 29M-03	1030	---	G10300	0.28-0.34	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 108-03	1030	---	G10300	0.28-0.34	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1030	---	G10300	0.28-0.34	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1030	---	G10300	0.28-0.34	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 30 C	---	---	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
EN 10016-4:1995	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	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	C30E	1.1178	---	0.27-0.34	0.50-0.80	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
	C30R	1.1179	---	0.27-0.34	0.50-0.80	0.40	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	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
ISO 683-1:1987	C 30	---	---	0.27-0.34	0.50-0.80	0.10-0.40	0.045	0.045	---	---	---	---
	C 30 E 4	---	---	0.27-0.34	0.50-0.80	0.10-0.40	0.035	0.035	---	---	---	---
	C 30 M 2	---	---	0.27-0.34	0.50-0.80	0.10-0.40	0.035	0.020-0.040	---	---	---	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4051:1979	S 33 C	---	---	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
EN 10016-2:1995	C32D	1.0530	---	0.30-0.35	0.50-0.80	0.10-0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
ASTM A 29/A 29M-03	1034	---	G10340	0.32-0.38	0.50-0.80	---	0.040	0.050	---	---	---	---
	1035	---	G10350	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
	1037	---	G10370	0.32-0.38	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A 108-03	1035	---	G10350	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1035	---	G10350	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
	1037	---	G10350	0.32-0.38	0.70-1.00	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1035	---	G10350	0.32-0.38	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 35 C	---	---	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
EN 10016-4:1995	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	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	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
	C35R	1.1180	---	0.32-0.39	0.50-0.80	0.40	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	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
ISO 683-1:1987	C 35	---	---	0.32-0.39	0.50-0.80	0.10-0.40	0.045	0.045	---	---	---	---
	C 35 E 4	---	---	0.32-0.39	0.50-0.80	0.10-0.40	0.035	0.035	---	---	---	---
	C 35 M 2	---	---	0.32-0.39	0.50-0.80	0.10-0.40	0.035	0.020-0.040	---	---	---	---
ASTM A 29/A 29M-03	1038	---	G10380	0.35-0.42	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1038	---	G10380	0.35-0.42	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1038	---	G10380	0.35-0.42	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 38 C	---	---	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
EN 10016-2:1995	C38D	1.0516	---	0.35-0.40	0.50-0.80	0.10-0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1995	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	Cu 0.15; Al 0.01; N 0.007

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	1039	---	G10390	0.37-0.44	0.70-1.00	---	0.040	0.050	---	---	---	---
	1040	---	G10400	0.37-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 108-03	1040	---	G10400	0.37-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1039	---	G10390	0.37-0.44	0.70-1.00	---	0.040	0.050	---	---	---	---
	1040	---	G10400	0.37-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1039	---	G10400	0.37-0.44	0.70-1.00	---	0.030	0.050	---	---	---	---
	1040	---	G10400	0.37-0.43	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 40 C	---	---	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
EN 10016-4:1995	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	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	C40E	1.1186	---	0.37-0.44	0.50-0.80	0.040	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
	C40R	1.1189	---	0.37-0.44	0.50-0.80	0.040	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	C40	1.0511	---	0.37-0.44	0.50-0.80	0.040	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni 0.63
ISO 683-1:1987	C 40	---	---	0.37-0.44	0.50-0.80	0.10-0.40	0.045	0.045	---	---	---	---
	C 40 E 4	---	---	0.37-0.44	0.50-0.80	0.10-0.40	0.035	0.035	---	---	---	---
	C 40 M 2	---	---	0.37-0.44	0.50-0.80	0.10-0.40	0.035	0.020-0.040	---	---	---	---
ASTM A 29/A 29M-03	1042	---	G10420	0.40-0.47	0.60-0.90	---	0.040	0.050	---	---	---	---
	1043	---	G10430	0.40-0.47	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1042	---	G10420	0.40-0.47	0.60-0.90	---	0.040	0.050	---	---	---	---
	1043	---	G10430	0.40-0.47	0.70-1.00	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1042	---	G10420	0.40-0.47	0.60-0.90	---	0.030	0.050	---	---	---	---
	1043	---	G10430	0.40-0.47	0.70-1.00	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 43 C	---	---	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
EN 10016-2:1995	C42D	1.0541	---	0.40-0.45	0.50-0.80	0.10-0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1995	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	Cu 0.15; Al 0.01; N 0.007

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	1044	---	G10440	0.43-0.50	0.30-0.60	---	0.040	0.050	---	---	---	---
	1045	---	G10450	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
	1046	---	G10460	0.43-0.50	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A 108-03	1045	---	G10450	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1044	---	G10440	0.43-0.50	0.30-0.60	---	0.040	0.050	---	---	---	---
	1045	---	G10450	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
	1046	---	G10460	0.43-0.50	0.70-1.00	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1044	---	G10440	0.43-0.50	0.30-0.60	---	0.030	0.050	---	---	---	---
	1045	---	G10450	0.43-0.50	0.60-0.90	---	0.030	0.050	---	---	---	---
	1046	---	G10460	0.43-0.50	0.70-1.00	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 45 C	---	---	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
EN 10016-4:1995	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	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	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
	C45R	1.1201	---	0.42-0.50	0.50-0.80	0.40	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	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
ISO 683-1:1987	C 45	---	---	0.42-0.50	0.50-0.80	0.10-0.40	0.045	0.045	---	---	---	---
	C 45 E4	---	---	0.42-0.50	0.50-0.80	0.10-0.40	0.035	0.035	---	---	---	---
	C 45 M2	---	---	0.42-0.50	0.50-0.80	0.10-0.40	0.035	0.020-0.040	---	---	---	---
JIS G 4051:1979	S 48 C	---	---	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
EN 10016-2:1995	C48D	1.0517	---	0.45-0.50	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1995	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	Cu 0.15; Al 0.01; N 0.007

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	1049	---	G10490	0.46-0.53	0.60-0.90	---	0.040	0.050	---	---	---	---
	1050	---	G10500	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
	1053	---	G10530	0.48-0.55	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A 108-03	1050	---	G10500	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1049	---	G10490	0.46-0.53	0.60-0.90	---	0.040	0.050	---	---	---	---
	1050	---	G10500	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
	1053	---	G10530	0.48-0.55	0.70-1.00	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1049	---	G10490	0.46-0.53	0.60-0.90	---	0.030	0.050	---	---	---	---
	1050	---	G10500	0.48-0.55	0.60-0.90	---	0.030	0.050	---	---	---	---
	1053	---	G10530	0.48-0.55	0.70-1.00	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 50 C	---	---	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
EN 10016-2:1995	C50D	1.0586	---	0.48-0.53	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1995	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	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	C50E	1.1206	---	0.47-0.55	0.60-0.90	0.40	0.035	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	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	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
ISO 683-1:1987	C 50	---	---	0.47-0.55	0.60-0.90	0.10-0.40	0.045	0.045	---	---	---	---
	C 50 E4	---	---	0.47-0.55	0.60-0.90	0.10-0.40	0.035	0.035	---	---	---	---
	C 50 M2	---	---	0.47-0.55	0.60-0.90	0.10-0.40	0.035	0.020-0.040	---	---	---	---
JIS G 4051:1979	S 53 C	---	---	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
EN 10016-2:1995	C52D	1.0588	---	0.50-0.55	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1995	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	Cu 0.15; Al 0.01; N 0.007

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	1055	---	G10550	0.50-0.60	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1055	---	G10550	0.50-0.60	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1055	---	G10550	0.50-0.60	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 55 C	---	---	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
EN 10016-2:1995	C56D	1.0518	---	0.53-0.58	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1995	C56D2	1.1220	---	0.54-0.58	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	C55E	1.1203	---	0.52-0.60	0.60-0.90	0.40	0.035	0.035	0.40	040	0.10	Cr+Mo+Ni 0.63
	C55R	1.1209	---	0.52-0.60	0.60-0.90	0.40	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	C55	1.0835	---	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
ISO 683-1:1987	C 55	---	---	0.52-0.60	0.60-0.90	0.10-0.40	0.045	0.045	---	---	---	---
	C 55 E4	---	---	0.52-0.60	0.60-0.90	0.10-0.40	0.035	0.035	---	---	---	---
	C 55 M2	---	---	0.52-0.60	0.60-0.90	0.10-0.40	0.035	0.020-0.040	---	---	---	---
ASTM A 29/A 29M-03	1059	---	G10590	0.55-0.65	0.50-0.80	---	0.040	0.050	---	---	---	---
	1060	---	G10600	0.55-0.65	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1060	---	G10600	0.55-0.65	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1060	---	G10600	0.55-0.65	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 58 C	---	---	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
EN 10016-2:1995	C58D	1.0609	---	0.55-0.60	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
	C60D	1.0610	---	0.58-0.63	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1995	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	Cu 0.15; Al 0.01; N 0.007
	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	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	C60E	1.1221	---	0.57-0.65	0.60-0.90	0.40	0.035	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	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	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
ISO 683-1:1987	C 60	---	---	0.57-0.65	0.60-0.90	0.10-0.40	0.045	0.045	---	---	---	---
	C 60 E 4	---	---	0.57-0.65	0.60-0.90	0.10-0.40	0.035	0.035	---	---	---	---
	C 60 M 2	---	---	0.57-0.65	0.60-0.90	0.10-0.40	0.035	0.020-0.040	---	---	---	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	1064	---	G10640	0.60-0.70	0.50-0.80	---	0.040	0.050	---	---	---	---
	1065	---	G10650	0.60-0.70	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1065	---	G10650	0.60-0.70	0.60-0.90	---	0.030	0.050	---	---	---	---
EN 10016-2:1995	C62D	1.0611	---	0.60-0.65	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
	C66D	1.0612	---	0.63-0.68	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
	C68D	1.0613	---	0.65-0.70	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1995	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	Cu 0.15; Al 0.01; N 0.007
	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	Cu 0.15; Al 0.01; N 0.007
	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	Cu 0.15; Al 0.01; N 0.007
ASTM A 29/A 29M-03	1069	---	G10690	0.65-0.75	0.40-0.70	---	0.040	0.050	---	---	---	---
	1070	---	G10700	0.65-0.75	0.60-0.90	---	0.040	0.050	---	---	---	---
	1071	---	G10710	0.65-0.70	75-1.05	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1070	---	G10700	0.65-0.75	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1070	---	G10700	0.65-0.75	0.60-0.90	---	0.030	0.050	---	---	---	---
EN 10016-2:1995	C70D	1.0615	---	0.68-0.73	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
	C72D	1.0617	---	0.70-0.75	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1995	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	Cu 0.15; Al 0.01; N 0.007
	C72D2	1.1242	---	0.70-0.74	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.02	Cu 0.15; Al 0.01; N 0.007
ASTM A 29/A 29M-03	1074	---	G10740	0.70-0.80	0.50-0.80	---	0.040	0.050	---	---	---	---
	1075	---	G10750	0.70-0.80	0.40-0.70	---	0.040	0.050	---	---	---	---
EN 10016-2:1995	C76D	1.0614	---	0.73-0.78	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
	C78D	1.0620	---	0.75-0.80	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1995	C76D2	1.1253	---	0.74-0.78	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.02	Cu 0.15; Al 0.01; N 0.007
	C78D2	1.1252	---	0.76-0.80	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.02	Cu 0.15; Al 0.01; N 0.007
ASTM A 29/A 29M-03	1078	---	G10780	0.72-0.85	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1078	---	G10780	0.72-0.85	0.30-0.60	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1078	---	G10780	0.72-0.85	0.30-0.60	---	0.030	0.050	---	---	---	---
EN 10016-2:1995	C80D	1.0622	---	0.78-0.83	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
	C82D	1.0626	---	0.80-0.85	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1995	C80D2	1.1255	---	0.78-0.82	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.02	Cu 0.15; Al 0.01; N 0.007
	C82D2	1.1262	---	0.80-0.84	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.02	Cu 0.15; Al 0.01; N 0.007

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	1080	---	G10800	0.75-0.88	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1080	---	G10800	0.75-0.88	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1080	---	G10800	0.75-0.88	0.60-0.90	---	0.030	0.050	---	---	---	---
EN 10016-2:1995	C86D	1.0616	---	0.83-0.88	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1995	C86D2	1.1265	---	0.84-0.88	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.02	Cu 0.15; Al 0.01; N 0.007
ASTM A 29/A 29M-03	1084	---	G10840	0.80-0.93	0.60-0.90	---	0.040	0.050	---	---	---	---
	1086	---	G10860	0.80-0.93	0.30-0.50	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1084	---	G10840	0.80-0.93	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1086	---	G10860	0.80-0.93	0.30-0.50	---	0.030	0.050	---	---	---	---
EN 10016-2:1995	C88D	1.0628	---	0.85-0.90	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1995	C88D2	1.1272	---	0.86-0.90	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.02	Cu 0.15; Al 0.01; N 0.007
ASTM A 29/A 29M-03	1090	---	G10900	0.85-0.98	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1090	---	G10900	0.85-0.98	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1090	---	G10900	0.85-0.98	0.60-0.90	---	0.030	0.050	---	---	---	---
EN 10016-2:1995	C92D	1.0618	---	0.90-0.95	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1995	C92D2	1.1282	---	0.90-0.95	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.02	Cu 0.15; Al 0.01; N 0.007
ASTM A 29/A 29M-03	1095	---	G10950	0.90-1.03	0.30-0.50	---	0.040	0.050	---	---	---	---
ASTM A 108-03	1095	---	G10950	0.90-1.03	0.30-0.50	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1095	---	G10950	0.90-1.03	0.30-0.50	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1095	---	G10950	0.90-1.03	0.30-0.50	---	0.030	0.050	---	---	---	---
EN 10016-4:1995	C98D2	1.1283	---	0.96-1.00	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.02	Cu 0.15; Al 0.01; N 0.007

2.2 Chemical Composition of High Manganese Carbon Steels for General Use

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	1522	---	G15220	0.18-0.24	1.10-1.40	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1522	---	G15220	0.18-0.24	1.10-1.40	---	0.040	0.050	---	---	---	---
SAE J403 NOV01	1522	---	G15220	0.18-0.24	1.10-1.40	---	0.030	0.050	---	---	---	---
JIS G 4053:2003	SMn 420	---	---	0.17-0.23	1.20-1.50	0.15-0.35	0.030	0.030	0.35	0.25	---	Cu 0.30
	SMnC 420	---	---	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
ISO 683-1:1987	22 Mn 6	---	---	0.19-0.26	1.30-1.60	0.10-0.40	0.035	0.035	---	---	---	---
ASTM A 29/A 29M-03	1536	---	G15360	0.30-0.37	1.20-1.50	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1536	---	G15360	0.30-0.37	1.20-1.50	---	0.040	0.050	---	---	---	---
JIS G 4053:2003	SMn 433	---	---	0.30-0.36	1.20-1.50	0.15-0.35	0.030	0.030	0.35	0.25	---	Cu 0.30
EN 10083-1:1991	28Mn6	---	---	0.25-0.32	1.30-1.65	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Ni+Mo 0.63
ISO 683-1:1987	28 Mn 6	---	---	0.25-0.32	1.30-1.65	0.10-0.40	0.035	0.035	---	---	---	---
SAE J403 NOV01	1541	---	G15410	0.36-0.44	1.35-1.65	---	0.030	0.050	---	---	---	---
ASTM A 29/A 29M-03	1541	---	G15410	0.36-0.44	1.35-1.65	---	0.040	0.050	---	---	---	---
ASTM A 576-90b (2000)	1541	---	G15410	0.36-0.44	1.35-1.65	---	0.040	0.050	---	---	---	---
JIS G 4053:2003	SMn 438	---	---	0.35-0.41	1.35-1.65	0.15-0.35	0.030	0.030	0.35	0.25	---	Cu 0.30
ISO 683-1:1987	36 Mn 6	---	---	0.33-0.40	1.35-1.65	0.10-0.40	0.035	0.035	---	---	---	---
JIS G 4053:2003	SMn 443	---	---	0.40-0.46	1.35-1.65	0.15-0.35	0.030	0.030	0.35	0.25	---	Cu 0.30
	SMnC 443	---	---	0.40-0.46	1.35-1.65	0.15-0.35	0.030	0.030	0.35-0.70	0.25	---	Cu 0.30
ISO 683-1:1987	42 Mn 6	---	---	0.39-0.46	1.30-1.65	0.10-0.40	0.035	0.035	---	---	---	---

2.3 Chemical Composition of Alloy Steels for General Use

2.3.1 Chromium (Cr) Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4053:2003	SCr 415	---	---	0.13-0.18	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	---	Cu 0.30
EN 10084:1998	17Cr3	1.7016	---	0.14-0.20	0.60-0.90	0.40	0.035	0.035	0.70-1.00	---	---	---
	17CrS3	1.7014	---	0.14-0.20	0.60-0.90	0.40	0.035	0.020-0.040	0.70-1.00	---	---	---
ASTM A 29/A 29M-03	5120	---	G51200	0.17-0.22	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	0.25	0.06	Cu 0.35
ASTM A 322-91 (2001)	5120	---	G51200	0.17-0.22	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	0.25	0.06	Cu 0.35
SAE J404 JUN00	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
JIS G 4053:2003	SCr 420	---	---	0.18-0.23	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	---	Cu 0.30
ISO 683-11:1987	20 Cr 4	---	---	0.17-0.23	0.60-0.90	0.15-0.40	0.035	0.035	0.90-1.20	---	---	---
	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	---	---	---
ASTM A 29/A 29M-03	5130	---	G51300	0.28-0.33	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.06	Cu 0.35
ASTM A 322-91 (2001)	5130	---	G51300	0.28-0.33	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.06	Cu 0.35
SAE J404 JUN00	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
JIS G 4053:2003	SCr 430	---	---	0.28-0.33	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	---	Cu 0.30
EN 10084:1998	28Cr4	1.7030	---	0.24-0.31	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	---	---
	28CrS4	1.7036	---	0.24-0.31	0.60-0.90	0.40	0.035	0.020-0.040	0.90-1.20	---	---	---
ASTM A 29/A 29M-03	5132	---	G51320	0.30-0.35	0.60-0.80	0.15-0.35	0.035	0.040	0.75-1.00	0.25	0.06	Cu 0.35
ASTM A 322-91 (2001)	5132	---	G51320	0.30-0.35	0.60-0.80	0.15-0.35	0.035	0.040	0.75-1.00	0.25	0.06	Cu 0.35
SAE J404 JUN00	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
JIS G 4053:2003	SCr 435	---	---	0.33-0.38	0.60-0.85	0.15-0.35	0.035	0.030	0.90-1.20	0.25	---	Cu 0.30
EN 10083-1:1991	34Cr4	1.7033	---	0.30-0.37	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	---	---
	34CrS4	1.7037	---	0.30-0.37	0.60-0.90	0.40	0.035	0.020-0.040	0.90-1.20	---	---	---
ISO 683-1:1987	34 Cr 4	---	---	0.30-0.37	0.60-0.90	0.10-0.40	0.035	0.035	0.90-1.20	---	---	---
	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	---	---	---
ASTM A 29/A 29M-03	5135	---	G51350	0.33-0.38	0.60-0.80	0.15-0.35	0.035	0.040	0.80-1.05	0.25	0.06	Cu 0.35
ASTM A 322-91 (2001)	5135	---	G51350	0.33-0.38	0.60-0.80	0.15-0.35	0.035	0.040	0.80-1.05	0.25	0.06	Cu 0.35
EN 10083-1:1991	37Cr4	1.7034	---	0.34-0.41	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	---	---
	37CrS4	1.7038	---	0.34-0.41	0.60-0.90	0.40	0.035	0.020-0.040	0.90-1.20	---	---	---
ISO 683-1:1987	37 Cr 4	---	---	0.34-0.41	0.60-0.90	0.10-0.40	0.035	0.035	0.90-1.20	---	---	---
	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	---	---	---

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

2.3.1 Chromium (Cr) Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	5140	---	G51400	0.38-0.43	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	0.25	0.06	Cu 0.35
ASTM A 322-91 (2001)	5140	---	G51400	0.38-0.43	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	0.25	0.06	Cu 0.35
SAE J404 JUN00	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
JIS G 4053:2003	SCr 440	---	---	0.38-0.43	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	---	Cu 0.30
EN 10083-1:1991	41Cr4	1.7035	---	0.38-0.45	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	---	---
	41CrS4	1.7039	---	0.38-0.45	0.60-0.90	0.40	0.035	0.020-0.040	0.90-1.20	---	---	---
ISO 683-1:1987	41 Cr 4	---	---	0.38-0.45	0.60-0.90	0.10-0.40	0.035	0.035	0.90-1.20	---	---	---
	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	---	---	---
ASTM A 29/A 29M-03	5145	---	---	0.43-0.48	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	0.25	0.06	Cu 0.35
JIS G 4053:2003	SCr 445	---	---	0.43-0.48	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	---	Cu 0.35

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

2.3.2 Chromium-Molybdenum (Cr-Mo) Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	4118	---	G41180	0.18–0.23	0.70–0.90	0.15-0.35	0.035	0.040	0.40–0.60	0.25	0.08–0.15	Cu 0.35
	4120	---	G41200	0.18–0.23	0.90–1.20	0.15-0.35	0.035	0.040	0.40–0.60	0.25	0.13–0.20	Cu 0.35
	4121	---	G41210	0.18–0.23	0.75–1.00	0.15-0.35	0.035	0.040	0.45–0.65	0.25	0.20–0.30	Cu 0.35
ASTM A 322-91 (2001)	4118	---	G41180	0.18–0.23	0.70–0.90	0.15-0.35	0.035	0.040	0.40–0.60	0.25	0.08–0.15	Cu 0.35
	---	---	G41200	0.18–0.23	0.90–1.20	0.15-0.35	0.035	0.040	0.40–0.60	0.25	0.13–0.20	Cu 0.35
	---	---	G41210	0.18–0.23	0.75–1.00	0.15-0.35	0.035	0.040	0.45–0.65	0.25	0.20–0.30	Cu 0.35
SAE J404 JUN00	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
	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
JIS G 4053:2003	SCM 418	---	---	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
	SCM 420	---	---	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
	SCM 421	---	---	0.17-0.23	0.70-1.00	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.30	Cu 0.30
	SCM 822	---	---	0.20-0.25	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.35-0.45	Cu 0.30
EN 10084:1998	18CrMo4	1.7243	---	0.15-0.21	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	0.15-0.25	---
	18CrMoS4	1.7244	---	0.15-0.21	0.60-0.90	0.40	0.035	0.020-0.040	0.90-1.20	---	0.15-0.25	---
	22CrMoS3-5	1.7333	---	0.19-0.24	0.70-1.00	0.40	0.035	0.020-0.040	0.70-1.00	---	0.40-0.50	---
	20MoCr3	1.7320	---	0.17-0.23	0.60-0.90	0.40	0.035	0.035	0.40-0.70	---	0.30-0.40	---
	20MoCrS3	1.7319	---	0.17-0.23	0.60-0.90	0.40	0.035	0.020-0.040	0.40-0.70	---	0.30-0.40	---
	20MoCr4	1.7321	---	0.17-0.23	0.70-1.00	0.40	0.035	0.035	0.30-0.60	---	0.40-0.50	---
	20MoCrS4	1.7323	---	0.17-0.23	0.70-1.00	0.40	0.035	0.020-0.040	0.30-0.60	---	0.40-0.50	---
ISO 683-11:1987	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	---
	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	---
ASTM A 29/A 29M-03	4130	---	G41300	0.28-0.33	0.40-0.60	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
ASTM A 322-91 (2001)	4130	---	G41300	0.28-0.33	0.40-0.60	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
SAE J404 JUN00	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
JIS G 4053:2003	SCM 425	---	---	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
JIS G 4053:2003	SCM 430	---	---	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
	SCM 432	---	---	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
EN 10083-1:1991	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	---
	25CrMoS4	1.7213	---	0.22-0.29	0.60-0.90	0.40	0.035	0.020-0.040	0.90-1.20	---	0.15-0.30	---
ISO 683-1:1987	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	---
	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	---

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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	4137	---	G41370	0.35-0.40	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
ASTM A 322-91 (2001)	4137	---	G41370	0.35-0.40	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
SAE J404 JUN00	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
JIS G 4053:2003	SCM 435	---	---	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
EN 10083-1:1991	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	---
	34CrMoS4	1.7226	---	0.30-0.37	0.60-0.90	0.40	0.035	0.020-0.040	0.90-1.20	---	0.15-0.30	---
ISO 683-1:1987	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	---
	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	---
ASTM A 29/A 29M-03	4140	---	G41400	0.38-0.43	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
ASTM A 322-91 (2001)	4140	---	G41400	0.38-0.43	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
SAE J404 JUN00	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
JIS G 4053:2003	SCM 440	---	---	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
EN 10083-1:1991	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	---
	42CrMoS4	1.7227	---	0.38-0.45	0.60-0.90	0.40	0.035	0.020-0.040	0.90-1.20	---	0.15-0.30	---
ISO 683-1:1987	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	---
	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	---
ASTM A 29/A 29M-03	4145	---	G41450	0.43-0.48	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
ASTM A 322-91 (2001)	4145	---	G41450	0.43-0.48	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
SAE J404 JUN00	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
JIS G 4053:2003	SCM 445	---	---	0.43-0.48	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 A 29/A 29M-03	4150	---	G41500	0.48-0.53	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
ASTM A 322-91 (2001)	4150	---	G41500	0.48-0.53	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
SAE J404 JUN00	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
EN 10083-1:1991	50CrMo4	1.7228	---	0.46-0.54	0.50-0.80	0.40	0.035	0.035	0.90-1.20	1.30-1.70	0.15-0.30	---
ISO 683-1:1987	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	---

2.3.3 Chromium-Nickel (Cr-Ni) Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 683-11:1987	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 4053:2003	SNC 815	---	---	0.12-0.18	0.35-0.65	0.15-0.35	0.30	0.30	0.60-1.00	3.00-3.50	---	Cu 0.30
EN 10084:1998	15NiCr13	1.5752	---	0.14-0.20	0.40-0.70	0.40	0.035	0.035	0.60-0.90	3.00-3.50	---	---

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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4053:2003	SNCM 415	---	---	0.12-0.18	0.40-0.70	0.15-0.35	0.030	0.030	0.40-0.65	1.60-2.00	0.15-0.30	Cu 0.30
ISO 683-11:1987	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	---
ASTM A 29/A 29M-03	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	Cu 0.35
ASTM A 322-91 (2001)	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	Cu 0.35
SAE J404 JUN00	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
JIS G 4053:2003	SNCM 420	---	---	0.17-0.23	0.40-0.70	0.15-0.35	0.030	0.030	0.40-0.65	1.60-2.00	0.15-0.30	Cu 0.30
EN 10084:1998	20NiCrMoS6-4	1.6571	---	0.16-0.23	0.50-0.90	0.40	0.035	0.020-0.040	0.60-0.90	1.40-1.70	0.25-0.35	---
ASTM A 29/A 29M-03	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	Cu 0.35
	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
ASTM A 322-91 (2001)	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	Cu 0.35
	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
SAE J404 JUN00	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
	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
JIS G 4053:2003	SNCM 439	---	---	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
ASTM A 29/A 29M-03	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	Cu 0.35
ASTM A 322-91 (2001)	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	Cu 0.35
SAE J404 JUN00	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
JIS G 4053:2003	SNCM 220	---	---	0.17-0.23	0.60-0.90	0.15-0.35	0.030	0.030	0.40-0.65	0.40-0.70	0.15-0.30	Cu 0.30
EN 10084:1998	20NiCrMo2-2	1.6523	---	0.17-0.23	0.65-0.95	0.40	0.035	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	0.035	0.020-0.040	0.35-0.70	0.40-0.70	0.15-0.25	---
ISO 683-11:1987	20 NiCrMo 2	---	---	0.17-0.23	0.65-0.95	0.15-0.40	0.035	0.035	0.30-0.65	0.40-0.70	0.15-0.25	---
	20 NiCrMoS 2	---	---	0.17-0.23	0.65-0.95	0.15-0.40	0.035	0.020-0.040	0.30-0.65	0.40-0.70	0.15-0.25	---
ASTM A 29/A 29M-03	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	Cu 0.35
ASTM A 322-91 (2001)	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	Cu 0.35
SAE J404 JUN00	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
JIS G 4053:2003	SNCM 240	---	---	0.38-0.43	0.70-1.00	0.15-0.35	0.030	0.030	0.40-0.65	0.40-0.70	0.15-0.30	Cu 0.30
ISO 683-1:1987	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	---
	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	---
ASTM A 29/A 29M-03	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 10084:1998	14NiCrMo13-4	1.6657	---	0.11-0.17	0.30-0.60	0.40	0.035	0.035	0.80-1.10	3.00-3.50	0.10-0.25	---

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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 355-89 (2000)	A	---	K24065	0.38-0.43	0.50-0.70	0.15-0.35	0.035	0.040	1.40-180	---	0.30-0.40	Al 0.95-1.30
JIS G 4202:1979	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
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
EN 10085:2001	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
EN 10085:2001	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
EN 10085:2001	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
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 0.80-1.20

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

2.3.6 Boron (B) Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	50B44	---	G50441	0.43–0.48	0.75–1.00	0.15–0.35	0.035	0.040	0.20–0.60	0.25	0.06	B 0.0005-0.003; Cu 0.35
	50B46	---	G50461	0.44–0.49	0.75–1.00	0.15–0.35	0.035	0.040	0.20–0.35	0.25	0.06	B 0.0005-0.003; Cu 0.35
	50B50	---	G50501	0.48–0.53	0.75–1.00	0.15–0.35	0.035	0.040	0.40–0.60	0.25	0.06	B 0.0005-0.003; Cu 0.35
	50B60	---	G50601	0.56–0.64	0.75–1.00	0.15–0.35	0.035	0.040	0.40–0.60	0.25	0.06	B 0.0005-0.003; Cu 0.35
	51B60	---	G51601	0.56–0.64	0.75–1.00	0.15–0.35	0.035	0.040	0.70–0.90	0.25	0.06	B 0.0005-0.003; Cu 0.35
ASTM A 322-91 (2001)	50B44	---	G50441	0.43–0.48	0.75–1.00	0.15–0.35	0.035	0.040	0.20–0.60	0.25	0.06	B 0.0005-0.003; Cu 0.35
	50B46	---	G50461	0.44–0.49	0.75–1.00	0.15–0.35	0.035	0.040	0.20–0.35	0.25	0.06	B 0.0005-0.003; Cu 0.35
	50B50	---	G50501	0.48–0.53	0.75–1.00	0.15–0.35	0.035	0.040	0.40–0.60	0.25	0.06	B 0.0005-0.003; Cu 0.35
	50B60	---	G50601	0.56–0.64	0.75–1.00	0.15–0.35	0.035	0.040	0.40–0.60	0.25	0.06	B 0.0005-0.003; Cu 0.35
	51B60	---	G51601	0.56–0.64	0.75–1.00	0.15–0.35	0.035	0.040	0.70–0.90	0.25	0.06	B 0.0005-0.003; Cu 0.35
SAE J404 JUN00	50B46	---	G50461	0.44–0.49	0.75–1.00	0.15–0.35	0.030	0.040	0.20–0.35	0.25	0.06	B 0.0005-0.003; Cu 0.35
	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
EN 10083-3:1995	27MnCrB5-2	1.7182	---	0.24-0.30	1.10-1.40	0.40	0.035	0.040	0.30-0.60	---	---	B 0.0008-0.0050
	33MnCrB5-2	1.7185	---	0.30-0.36	1.20-1.50	0.40	0.035	0.040	0.30-0.60	---	---	B 0.0008-0.0050
	39MnCrB5-2	1.7189	---	0.36-0.42	1.40-1.70	0.40	0.035	0.040	0.30-0.60	---	---	B 0.0008-0.0050

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

2.3.7 Chromium-Vanadium (Cr-V) Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	6150	---	G61500	0.48-0.53	0.70–0.90	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.06	V 0.15 min
ASTM A 322-91 (2001)	6150	---	G61500	0.48-0.53	0.70–0.90	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.06	V 0.15 min
SAE J404 JUN00	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
EN 10083-1:1991	51CrV4	1.8159	---	0.47-0.55	0.70-1.10	0.40	0.035	0.035	0.90-1.20	---	---	V 0.10-0.25
ISO 683-1:1987	51 CrV 4	---	---	0.47-0.55	0.60-1.00	0.10-0.40	0.035	0.035	0.80-1.10	---	---	V 0.10-0.25

2.4 Non-Comparable Carbon and Alloy Steels for General Use

ASTM A 29/A 29M-03 Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished												
Grade	1011	1013	1330	1335	1340	1345	1513	1518	1524	1525	1526	1527
UNS Number	G10110	G10130	G13300	G13350	G13400	G13450	G15300	G15180	G15240	G15250	G15260	G15270
Grade	1547	1548	1551	1552	1561	1566	1572	4012	4023	4024	4027	4028
UNS Number	G15470	G15480	G15510	G15520	G15610	G15660	G15720	G40120	G40230	G40240	G40270	G40280
Grade	4032	4037	4042	4047	4135	4142	4147	4161	4419	4422	4427	4615
UNS Number	G43320	G40370	G40420	G40470	G41350	G41420	G41470	G41670	G44190	G44220	G44270	G46150
Grade	4620	4621	4626	4715	4718	4720	4815	4817	4820	5015	5046	5115
UNS Number	G46200	G46210	G46260	G47150	G47180	G47200	G48150	G48170	G48200	G50150	G50460	G51150
Grade	5147	5150	5155	5160	6118	8115	8615	8617	8622	8625	8627	8630
UNS Number	G51470	G51500	G51550	G51600	G61180	G81150	G86150	G86170	G86220	G86250	G86270	G86300
Grade	8637	8642	8645	8650	8655	8660	8720	8740	8822	9254	9255	9259
UNS Number	G86370	G86420	G86450	G86500	G86550	G86600	G87200	G87400	G88200	G92540	G92550	G92590
Grade	9260	81B45	94B17	94B30	---	---	---	---	---	---	---	---
UNS Number	G92600	G81451	G94171	G94301	G47150	---	---	---	---	---	---	---
ASTM A 322-91 (2001) Steel Bars, Alloy, Standard Grades												
Grade	1330	1335	1340	1345	4023	4024	4027	4028	4037	4047	4142	4147
UNS Number	G13300	G13350	G13400	G13450	G40230	G40240	G40270	G40280	G40370	G40470	G41420	G41470
Grade	4161	4615	4620	4621	4626	4720	4815	4817	4820	5117	5150	5155
UNS Number	G41670	G46150	G46200	G46210	G46260	G47200	G48150	G48170	G48200	G51170	G51500	G51550
Grade	5160	6118	8615	8617	8622	8625	8627	8630	8637	8642	8645	8655
UNS Number	G51600	G61180	G86150	G86170	G86220	G86250	G86270	G86300	G86370	G86420	G86450	G86550
Grade	8720	8740	8822	9259	9260	81B45	94B17	94B30	---	---	---	---
UNS Number	G87200	G87400	G88200	G92590	G92600	G81451	G94171	G94301	---	---	---	---
ASTM A 355-89 (2000) Standard Specification for Steel Bars, Alloys, for Nitriding												
Grade	B	C	D	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 576-90b (2000) Steel Bars, Carbon, Hot-Wrought, Special Quality												
Grade	1513	1518	1524	1525	1526	1527	1547	1548	1551	1552	1561	1566
UNS Number	G15300	G15180	G15240	G15250	G15260	G15270	G15470	G15480	G15510	G15520	G15610	G15660
Grade	1572	1109	1110	1116	1117	1118	1119	1132	1137	1139	1140	1141
UNS Number	G15720	G11090	G11100	G11160	G11170	G11180	G11190	G11320	G11370	G11390	G11400	G11410
Grade	1144	1145	1146	1151	1211	1212	1213	1215	12L14	---	---	---
UNS Number	G11440	G11450	G11460	G11510	G12110	G12120	G12130	G12150	---	---	---	---

2.4 Non-Comparable Carbon and Alloy Steels for General Use (Continued)

SAE J403 NOV01 Chemical Compositions of SAE Carbon Steels (Hot Rolled and Cold Finished Bars Only)												
Grade	1524	1526	1527	1548	1552	1566	1009	1013	1019	1033	1037	1074
UNS Number	G15240	G15260	G15270	G15480	G15520	G15660	G10090	G10130	G10190	G10330	G10370	G10740
Grade	1075	1084	1085	1536	1547	---	---	---	---	---	---	---
UNS Number	G10750	G10840	G10850	G15360	G15470	---	---	---	---	---	---	---
SAE J404 JUN00 Chemical Compositions of SAE Alloy Steels (Hot Rolled and Cold Finished Bars Only)												
Grade	1330	1335	1340	1345	4023	4027	4037	4047	4135	4142	4615	4617
UNS Number	G13300	G13350	G13400	G13450	G40230	G40270	G40370	G40470	G41350	G41420	G46180	G46170
Grade	4620	4820	5115	5150	5160	E52100	8615	8617	8622	8625	8627	8630
UNS Number	G46200	G48200	G51150	G51500	G51600	G52986	G86150	G86170	G86220	G86250	G86270	G86300
Symbol of Class	8637	8645	8655	8720	8740	8822	9254	9259	9260	---	---	---
UNS Number	G86370	G86450	G86550	G87200	G87400	G88200	G92540	G92590	G92600	---	---	---
JIS G 4103:1979 Nickel Chromium Molybdenum Steels												
Symbol of Class	SNCM 431	SNCM 447	SNCM 616	SNCM 625	SNCM 630	SNCM 815	---	---	---	---	---	---
Previous Symbol	SNCM 1	SNCM 9	SNCM 26	SNCM 2	SNCM 5	SNCM 25	---	---	---	---	---	---
JIS G 4105:1979 Chromium Molybdenum Steels												
Symbol of Class	SCM 415	---	---	---	---	---	---	---	---	---	---	---
Previous Symbol	SCM 21	---	---	---	---	---	---	---	---	---	---	---
JIS G 4053:2003 Low-alloyed Steels for Machine Structural Use												
Symbol of Class	SNC 236	SNC 415	SNC 631	SNC 836	SCM 415	SNCM 431	SNCM 447	SNCM 616	SNCM 625	SNCM 630	SNCM 815	---
Previous Symbol	---	---	---	---	---	---	---	---	---	---	---	---
EN 10083-1:1991 Quenched and Tempered Steels – Technical Delivery Conditions for Special Steels												
Steel Name	36 CrNiMo 4	34 CrNiMo 6	30 CrNiMo 8	36 NiCrMo 16	38Cr2	38CrS2	46Cr4	46CrS4	---	---	---	---
Steel Number	1.6511	1.6582	1.6580	1.6773	1.7003	1.7023	1.7033	1.7025	---	---	---	---
EN 10083-3:1995 Quenched and Tempered Steels – Technical Delivery Conditions for Boron Steels												
Steel Name	20MnB5	30MnB5	38MnB5	---	---	---	---	---	---	---	---	---
Steel Number	1.5530	1.5531	1.5532	---	---	---	---	---	---	---	---	---
EN 10084:1998 Case Hardening Steels - Technical Delivery Conditions												
Steel Name	16MnCr5	16MnCrS5	16MnCrB5	20MnCr5	20MnCrS5	16NiCr4	16NiCrS4	10NiCr5-4	18NiCr5-4	17CrNi6-6	17NiCrMo6-4	17NiCrMoS6-4
Steel Number	1.7131	1.7139	1.7160	1.7147	1.7149	1.5714	1.5715	1.5805	1.5810	1.5918	1.6566	1.6569
Steel Name	18CrNiMo7-6	---	---	---	---	---	---	---	---	---	---	---
Steel Number	1.6657	---	---	---	---	---	---	---	---	---	---	---
EN 10085:2001 Nitriding Steels												
Steel Name	24CrMo13-6	31CrMo12	31CrMoV9	33CrMoV12-9	40CrMoV13-9	---	---	---	---	---	---	---
Steel Number	1.8516	1.8515	1.8519	1.8522	1.8523	---	---	---	---	---	---	---

2.4 Non-Comparable Carbon and Alloy Steels for General Use (Continued)

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													
Type of Steel	36 CrNiMo 4	36 CrNiMo 6	31 CrNiMo 8	20 MnCr 5	20 MnCrS 5	---	---	---	---	---	---	---	---
ISO 683-10:1987 Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels – Part 10: Wrought Nitriding Steels													
Type of Steel	31 CrMo 12	33 CrAlMo 5 4	---	---	---	---	---	---	---	---	---	---	---
ISO 683-11:1987 Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels – Part 11: Wrought Case-Hardening Steels													
Type of Steel	16 MnCr 5	16 MnCrS 5	18 CrNiMo 7	---	---	---	---	---	---	---	---	---	---

Chapter 3

STRUCTURAL STEEL PLATES

ASTM Standards

ASTM A 36/A 36M-03a	Carbon Structural Steel
ASTM A 242/A 242M-03a	High-Strength Low-Alloy Structural Steel
ASTM A 283/A 283M-03	Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 514/A 514M-00a	High- Yield- Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 529/A 529M-03	High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 572/A 572M-03a	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 573/A 573M-00a	Structural Carbon Steel Plates of Improved Toughness
ASTM A 588/A 588M-03a	High-Strength Low-Alloy Structural Steel With 50 ksi [345 MPa] Minimum Yield Point to 4 in. [100 mm] Thick
ASTM A 606-01	Steel, Sheet and Strip, High- Strength, Low-Alloy, Hot- Rolled and Cold- Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 633/A 633M-01	Normalized High-Strength Low-Alloy Structural Steel Plates
ASTM A 656/A 656M-03	Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability
ASTM A 678/A 678M-00a	Quenched-and-Tempered Carbon and High-Strength Low-Alloy Structural Steel Plates
ASTM A 709/A 709M-03a	Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges
ASTM A 710/A 710M-02	Precipitation-Strengthened Low-Carbon Nickel-Copper-Chromium-Molybdenum-Columbium Alloy Structural Steel Plates
ASTM A 852/A 852M-03	Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi [485 MPa] Minimum Yield Strength to 4 in. [100 mm] Thick
ASTM A 871/A 871M-03	High-Strength Low-Alloy Structural Steel Plate with Atmospheric Corrosion Resistance
ASTM A 1011/A 1011M-03	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

JIS Standards

JIS G 3101:1995	Rolled Steels for General Structure
JIS G 3106:1999	Rolled Steels for Welded Structure
JIS G 3136:1994	Rolled Steels for Building Structure
JIS G 3128:1999	High Yield Strength Steel Plates for Welded Structure
JIS G 3114:1998	Hot-Rolled Atmospheric Corrosion Resisting Steels for Welded Structure
JIS G 3125:1987	Superior Atmospheric Corrosion Resisting Rolled Steels

CEN Standards

EN 10025:1993	Hot Rolled Products of Non-Alloy Structural Steels - Technical Delivery Conditions
EN 10113-2:1993 A1: 1998	Hot-Rolled Products in Weldable Fine Grain Structural Steels - Part 2: Delivery Conditions for Normalized/Normalized Rolled Steels
EN 10113-3:1993	Hot-Rolled Products in Weldable Fine Grain Structural Steels - Part 3: Delivery Conditions for Thermomechanical Rolled Steels
EN 10137-2:1995	Plates and Wide Flats Made of High Yield Strength Structural Steels in the Quenched and Tempered or Precipitation Hardened Conditions - Part 2: Delivery Conditions for Quenched and Tempered Steels
EN 10137-3:1995	Plates and Wide Flats Made of High Yield Strength Structural Steels in The Quenched and Tempered or Precipitation Hardened Conditions - Part 3: Delivery Conditions for Precipitation Hardened Steels
EN 10155:1993	Structural Steels with Improved Atmospheric Corrosion Resistance - Technical Delivery Conditions

ISO Standards

ISO 630:1995	Structural Steels - Plates, Wide Flats, Bars, Sections and Profiles
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 4952:2003	Structural Steels with Improved Atmospheric Corrosion Resistance - Second Edition
ISO 5952:1998	Continuously Hot-Rolled Steel Sheet of Structural Quality with Improved Atmospheric Corrosion Resistance

CSA Standards

CSA G40.21-04	Structural Quality Steel - Plates, Sheet, Floor Plates, Bars, and Welded Shapes

Heat Treatment Terms Applicable to this Chapter

Standard	Heat Treatment Terms
ASTM A 36/A 36M-03a	---
ASTM A 242/A 242M-03a	---
ASTM A 283/A 283M-03	---
ASTM A 514/A 514M-00a	QT: quenched and tempered
ASTM A 529/A 529M-03	---
ASTM A 572/A 572M-03a	---
ASTM A 573/A 573M-00a	---
ASTM A 588/A 588M-03a	---
ASTM A 606-01	HR: hot-rolled (as-rolled); CR: cold-rolled; A: annealed; N: normalized
ASTM A 633/A 633M-01	N: normalized; N+N: double normalized
ASTM A 656/A 656M-03	HR: hot-rolled
ASTM A 678/A 678M-00a	QT: quenched and tempered
ASTM A 709/A 709M-03a	---; QT: quenched and tempered
ASTM A 710/A 710M-02	PH: precipitation heat treatment; N+PH: normalized followed by precipitation heat treatment; Q+PH: quenched followed by precipitation heat treatment
ASTM A 852/A 852M-03	QT: quenched and tempered
ASTM A 871/A 871M-03	HR: hot-rolled (as rolled); N: normalized; QT: quenched and tempered
ASTM A 1011/A 1011M-03	HR: hot-rolled
JIS G 3101:1995	HR: hot-rolled
JIS G 3106:1999	HR: hot-rolled
JIS G 3114:1998	HR: hot-rolled
JIS G 3125:1987	CR: cold-rolled; HR: hot-rolled
JIS G 3128:1999	QT: quenched and tempered
JIS G 3136:1994	HR: hot-rolled
EN 10025:1993	HR: hot-rolled; N: normalized rolled
EN 10113-2:1998	N: normalized or normalized rolled treatment
EN 10113-3:1993	TMCP: thermomechanically rolled
EN 10137-2:1995	QT: quenched and tempered
EN 10137-3:1995	PH: precipitation hardened
EN 10155:1993	HR: hot-rolled; N: normalized or normalized rolled
ISO 630:1995	AR: as rolled; N: normalized or equivalent (obtained by controlled rolling); AD: as delivered
ISO 4950-2:1995	N: normalized; NT: normalized and tempered; CTR: controlled rolled condition
ISO 4950-3:1995	QT: quenched and tempered
ISO 4952:2003	AR: as rolled; N: normalized or equivalent (obtained by controlled rolling)
ISO 5952:1998	HR: hot-rolled
CSA G40.21-98	---: not specified; AR: as-rolled; QT: quenched and tempered

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ISO 630:1995	E 185	---	---	AR	≤ 16	---	185	---	300-540	---	18	---
					16 < t ≤ 40	---	175	---				
ASTM A 283/A 283M-03	A	---	---	---	---	---	165	24	310-415	45-60	30	---
EN 10025:1993	S185	1.0035	---	HR	< 3	---	185	---	310-540	---	---	---
					3 ≤ t ≤ 16	---	185	---	290-510	---	16	---
					16 < t ≤ 40	---	175	---	290-510	---	---	---
					40 < t ≤ 100	---	---	---	290-510	---	---	---
JIS G 3101:1995	SS330	---	---	HR	≤ 16	---	205	---	330-430	---	21	---
					16 < t ≤ 40	---	195	---			26	
					> 40	---	175	---			28	
ASTM A 1011/A 1011M-03	30 [205]	---	K02502	HR	0.65 ≤ t < 1.6	0.025 ≤ t < 0.064	205	30	340	49	21	---
					1.6 ≤ t < 2.5	0.064 ≤ t < 0.097					24	
					2.5 ≤ t < 6.0	0.097 ≤ t < 0.230					25	

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ISO 630:1995	E 235 A	---	---	AR	≤ 16	---	235	---	340-470	---	26	---
					16 < t ≤ 40	---	225	---			26	
					40 < t ≤ 63	---	215	---			25	
					63 < t ≤ 80	---	215	---			24	
					80 < t ≤ 100	---	215	---			24	
					100 < t ≤ 150	---	195	---			22	
					150 < t ≤ 200	---	185	---			21	
	E 235 B	---	---	AR	≤ 16	---	235	---	340-470	---	26	---
					16 < t ≤ 25	---	225	---				
	E 235 B NF	---	---	AR	≤ 16	---	235	---	340-470	---	26	27 J at 20°C
					16 < t ≤ 40	---	225	---			26	
					40 < t ≤ 63	---	215	---			25	
					63 < t ≤ 80	---	215	---			24	
					80 < t ≤ 100	---	215	---			24	
					100 < t ≤ 150	---	195	---			22	
					150 < t ≤ 200	---	185	---			21	
	E 235 C	---	---	AR	≤ 16	---	235	---	340-470	---	26	27 J at 0°C
					16 < t ≤ 40	---	225	---			26	
					40 < t ≤ 63	---	215	---			25	
					63 < t ≤ 80	---	215	---			24	
					80 < t ≤ 100	---	215	---			24	
					100 < t ≤ 150	---	195	---			22	
					150 < t ≤ 200	---	185	---			21	
	E 235 D	---	---	D_1: N D_2: AD	≤ 16	---	235	---	340-470	---	26	27 J at -20°C
					16 < t ≤ 40	---	225	---			26	
					40 < t ≤ 63	---	215	---			25	
					63 < t ≤ 80	---	215	---			24	
					80 < t ≤ 100	---	215	---			24	
					100 < t ≤ 150	---	195	---			22	
					150 < t ≤ 200	---	185	---			21	
ASTM A 283/A 283M-03	B	---	---	---	---	---	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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 1011/A 1011M-03	33 [230]	---	K02502	HR	0.65 ≤ t < 1.6	0.025 ≤ t < 0.064	230	33	360	52	18	---
					1.6 ≤ t < 2.5	0.064 ≤ t < 0.097					22	
					2.5 ≤ t < 6.0	0.097 ≤ t < 0.230					23	
EN 10025:1993	S235JR	1.0037	---	HR	< 3	---	235	---	360-510	---	---	---
					3 ≤ t ≤ 16	---	235	---	340-470	---	24	27 J at 20°C
					16 < t ≤ 40	---	225	---			---	---
					40 < t ≤ 100	---	---	---			---	---
	S235JRG1	1.0036	---	HR	< 3	---	235	---	360-510	---	---	---
					3 ≤ t ≤ 16	---	235	---	340-470	---	24	27 J at 20°C
					16 < t ≤ 40	---	225	---			---	---
					40 < t ≤ 100	---	---	---			---	---
	S235JRG2	1.0038	---	HR	< 3	---	235	---	360-510	---	---	---
					3 ≤ t ≤ 16	---	235	---	340-470	---	24	27 J at 20°C
					16 < t ≤ 40	---	225	---			24	
					40 < t ≤ 63	---	215	---			23	
					63 < t ≤ 80	---	215	---			22	
					80 < t ≤ 100	---	215	---			22	
					100 < t ≤ 150	---	195	---			22	
					150 < t ≤ 200	---	185	---	320-470	---	21	23 J at 20°C
					200 < t ≤ 250	---	175	---			21	
	S235J0	1.0114	---	HR	< 3	---	235	---	360-510	---	---	---
					3 ≤ t ≤ 16	---	235	---	340-470	---	24	27 J at 0°C
					16 < t ≤ 40	---	225	---			24	
					40 < t ≤ 63	---	215	---			23	
					63 < t ≤ 80	---	215	---			22	
					80 < t ≤ 100	---	215	---			22	
					100 < t ≤ 150	---	195	---			22	
					150 < t ≤ 200	---	185	---	320-470	---	21	23 J at 0°C
					200 < t ≤ 250	---	175	---			21	

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10025:1993 (Continued)	S235J2G3	1.0116	---	N	< 3	---	235	---	360-510	---	---	---
					3 ≤ t ≤ 16	---	235	---	340-510	---	24	27 J at -20°C
					16 < t ≤ 40	---	225	---			24	
					40 < t ≤ 63	---	215	---			23	
					63 < t ≤ 80	---	215	---			22	
					80 < t ≤ 100	---	215	---			22	
					100 < t ≤ 150	---	195	---	340-470	---	22	
					150 < t ≤ 200	---	185	---	320-470	---	21	23 J at -20°C
					200 < t ≤ 250	---	175	---			21	
	S235J2G4	1.0117	---	HR	< 3	---	235	---	360-510	---	---	---
					3 ≤ t ≤ 16	---	235	---	340-470	---	24	27 J at -20°C
					16 < t ≤ 40	---	225	---			24	
					40 < t ≤ 63	---	215	---			23	
					63 < t ≤ 80	---	215	---			22	
					80 < t ≤ 100	---	215	---			22	
					100 < t ≤ 150	---	195	---			22	
					150 < t ≤ 200	---	185	---	320-470	---	21	23 J at -20°C
					200 < t ≤ 250	---	175	---			21	
ASTM A 1011/A 1011M-03	36 [250] Type 1	---	K02502	HR	0.65 ≤ t < 1.6	0.025 ≤ t < 0.064	250	36	365	53	17	---
					1.6 ≤ t < 2.5	0.064 ≤ t < 0.097					21	
					2.5 ≤ t < 6.0	0.097 ≤ t < 0.230					22	

3.1 Carbon Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 283/A 283M-03	C	---	K02401	---	---	---	205	30	380-515	55-75	25	---
ASTM A 1011/A 1011M-03	40 [275]	---	K02502	HR	0.65 ≤ t < 1.6	0.025 ≤ t < 0.064	275	40	380	55	15	---
					1.6 ≤ t < 2.5	0.064 ≤ t < 0.097					20	
					2.5 ≤ t < 6.0	0.097 ≤ t < 0.230					21	
ASTM A 36/A 36M-03a	---	---	K02595 K02596 K02597 K02598 K02599	---	---	---	250	36	400-550	58-80	23	---
ASTM A 1011/A 1011M-03	36 [250] Type 2	---	K02502	HR	0.65 ≤ t < 1.6	0.025 ≤ t < 0.064	250	36	400-550	58-80	16.0	---
					1.6 ≤ t < 2.5	0.064 ≤ t < 0.097					20.0	
					2.5 ≤ t < 6.0	0.097 ≤ t < 0.230					21.0	
ASTM A 573/A 573M-00a	58 [400]	---	K02301	---	≤ 40	≤ 1.5	220	32	400-490	58-71	24	---
ASTM A 709/A 709M-03a	36 [250]	---	---	---	≤ 100	≤ 4	250	36	400-550	58-80	23	---
JIS G 3101:1995	SS400	---	---	HR	≤ 16	---	245	---	400-510	---	17	---
					16 < t ≤ 40	---	235	---			21	
					> 40	---	215	---			23	
JIS G 3106:1999	SM400A	---	---	HR	≤ 16	---	245	---	400-510	---	18	---
					16 < t ≤ 40	---	235	---			22	
					40 < t ≤ 75	---	215	---			24	
					75 < t ≤ 100	---	215	---			24	
					100 < t ≤ 160	---	205	---			24	
					160 < t ≤ 200	---	195	---			24	
	SM400B	---	---	HR	≤ 16	---	245	---	400-510	---	18	27 J at 0°C
					16 < t ≤ 40	---	235	---			22	
					40 < t ≤ 75	---	215	---			24	
					75 < t ≤ 100	---	215	---			24	
					100 < t ≤ 160	---	205	---			24	
					160 < t ≤ 200	---	195	---			24	

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3106:1999 (Continued)	SM400C	---	---	HR	≤ 16	---	245	---	400-510	---	18	47 J at 0°C
					16 < t ≤ 40	---	235	---			22	
					40 < t ≤ 75	---	215	---			24	
					75 < t ≤ 100	---	215	---			24	
					100 < t ≤ 200	---	---	---			24	
JIS G 3136:1994	SN400A	---	---	HR	≤ 16	---	235	---	400-510	---	17	---
					16 < t ≤ 40	---	235	---			21	
					40 < t ≤ 100	---	215	---			23	
	SN400B	---	---	HR	≤ 16	---	235-355	---	400-510	---	18	27 J at 0°C
					16 < t ≤ 40	---	235-355	---			22	
					40 < t ≤ 100	---	215-335	---			24	
	SN400C	---	---	HR	≤ 16	---	---	---	400-510	---	18	27 J at 0°C
					16 < t ≤ 40	---	235-355	---			22	
					40 < t ≤ 100	---	215-335	---			24	

3.1 Carbon Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ISO 630:1995	E 275 A	---	---	AR	≤ 16	---	275	---	410-540	---	22	---
					16 < t ≤ 40	---	265	---				
					40 < t ≤ 63	---	255	---			21	
					63 < t ≤ 80	---	245	---			20	
					80 < t ≤ 100	---	235	---			20	
					100 < t ≤ 150	---	225	---			18	
					150 < t ≤ 200	---	215	---			17	
	E 275 B	---	---	AR	≤ 16	---	275	---	410-540	---	22	27 J at 20°C
					16 < t ≤ 40	---	265	---				
					40 < t ≤ 63	---	255	---			21	
					63 < t ≤ 80	---	245	---			20	
					80 < t ≤ 100	---	235	---			20	
					100 < t ≤ 150	---	225	---			18	
					150 < t ≤ 200	---	215	---			17	
	E 275 C	---	---	AR	≤ 16	---	275	---	410-540	---	22	27 J at 0°C
					16 < t ≤ 40	---	265	---				
					40 < t ≤ 63	---	255	---			21	
					63 < t ≤ 80	---	245	---			20	
					80 < t ≤ 100	---	235	---			20	
					100 < t ≤ 150	---	225	---			18	
					150 < t ≤ 200	---	215	---			17	
	E 275 D	---	---	D_1: N D_2: AD	≤ 16	---	275	---	410-540	---	22	27 J at -20°C
					16 < t ≤ 40	---	265	---				
					40 < t ≤ 63	---	255	---			21	
					63 < t ≤ 80	---	245	---			20	
					80 < t ≤ 100	---	235	---			20	
					100 < t ≤ 150	---	225	---			18	
					150 < t ≤ 200	---	215	---			17	
ASTM A 283/A 283M-03	D	---	K02702	---	---	---	230	33	415-550	60-80	23	---
ASTM A 1011/A 1011M-03	45 [310]	---	K02507	HR	0.65 ≤ t < 1.6	0.025 ≤ t < 0.064	310	45	415	60	13.0	---
					1.6 ≤ t < 2.5	0.064 ≤ t < 0.097					18.0	
					2.5 ≤ t < 6.0	0.097 ≤ t < 0.230					19.0	

3.1 Carbon Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10025:1993	S275JR	1.0044	---	HR	< 3	---	275	---	430-580	---	---	---
					3 ≤ t ≤ 16	---	275	---	410-560	---	20	27 J at 20°C
					16 < t ≤ 40	---	265	---			20	
					40 < t ≤ 63	---	255	---			19	
					63 < t ≤ 80	---	245	---			18	
					80 < t ≤ 100	---	235	---			18	
					100 < t ≤ 150	---	225	---	400-540	---	18	
					150 < t ≤ 200	---	215	---	380-540	---	17	23 J at 20°C
					200 < t ≤ 250	---	205	---			17	
	S275J0	1.0143	---	HR	< 3	---	275	---	430-580	---	---	---
					3 ≤ t ≤ 16	---	275	---	410-560	---	20	27 J at 0°C
					16 < t ≤ 40	---	265	---			20	
					40 < t ≤ 63	---	255	---			19	
					63 < t ≤ 80	---	245	---			18	
					80 < t ≤ 100	---	235	---			18	
					100 < t ≤ 150	---	225	---	400-540	---	18	
					150 < t ≤ 200	---	215	---	380-540	---	17	23 J at 0°C
					200 < t ≤ 250	---	205	---			17	
	S275J2G3	1.0144	---	N	< 3	---	275	---	430-580	---	---	---
					3 ≤ t ≤ 16	---	275	---	410-560	---	20	27 J at -20°C
					16 < t ≤ 40	---	265	---			20	
					40 < t ≤ 63	---	255	---			19	
					63 < t ≤ 80	---	245	---			18	
					80 < t ≤ 100	---	235	---			18	
					100 < t ≤ 150	---	225	---	400-540	---	18	
					150 < t ≤ 200	---	215	---	380-540	---	17	23 J at -20°C
					200 < t ≤ 250	---	205	---			17	

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10025:1993 (Continued)	S275J2G4	1.0145	---	HR	< 3	---	275	---	430-580	---	---	---
					3 ≤ t ≤ 16	---	275	---	410-560	---	20	27 J at -20°C
					16 < t ≤ 40	---	265	---			20	
					40 < t ≤ 63	---	255	---			19	
					63 < t ≤ 80	---	245	---			18	
					80 < t ≤ 100	---	235	---			18	
					100 < t ≤ 150	---	225	---	400-540	---	18	
					150 < t ≤ 200	---	215	---	380-540	---	17	23 J at -20°C
					200 < t ≤ 250	---	205	---			17	
ASTM A 1011/A 1011M-03	50 [340]	---	K02507	HR	0.65 ≤ t < 1.6	0.025 ≤ t < 0.064	340	50	450	65	11.0	---
					1.6 ≤ t < 2.5	0.064 ≤ t < 0.097					16.0	
					2.5 ≤ t < 6.0	0.097 ≤ t < 0.230					17.0	
ASTM A 573/A 573M-00a	65 [450]	---	K02404	---	≤ 40	≤ 1.5	240	35	450-530	65-77	23	---

3.1 Carbon Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 529/A 529M-03	50 [345]	---	K02703	---	≤ 25	≤ 1	345	50	485-690	70-100	21	---
	55 [380]	---	K02703	---	≤ 25	≤ 1	380	55			20	
ASTM A 1011/A 1011M-03	55 [380]	---	K02507	HR	0.65 ≤ t < 1.6	0.025 ≤ t < 0.064	380	55	480	70	9.0	---
					1.6 ≤ t < 2.5	0.064 ≤ t < 0.097					14.0	
					2.5 ≤ t < 6.0	0.097 ≤ t < 0.230					15.0	
ASTM A 573/A 573M-00a	70 [485]	---	K02701	---	≤ 40	≤ 1.5	290	42	485-620	70-90	21	---
ASTM A 678/A 678M-00a	A	---	K01600	QT	≤ 20	≤ ¾	345	50	485-620	70-90	22	---
					20 < t ≤ 40	¾ < t ≤ 1½						
JIS G 3101:1995	SS490	---	---	HR	≤ 16	---	285	---	490-610	---	15	---
					16 < t ≤ 40	---	275	---			19	
					> 40	---	255	---			21	
JIS G 3106:1999	SM490A	---	---	HR	≤ 16	---	325	---	490-610	---	17	---
					16 < t ≤ 40	---	315	---			21	
					40 < t ≤ 75	---	295	---			23	
					75 < t ≤ 100	---	295	---			23	
					100 < t ≤ 160	---	285	---			23	
					160 < t ≤ 200	---	275	---			23	
	SM490B	---	---	HR	≤ 16	---	325	---	490-610	---	17	27 J at 0°C
					16 < t ≤ 40	---	315	---			21	
					40 < t ≤ 75	---	295	---			23	
					75 < t ≤ 100	---	295	---			23	
					100 < t ≤ 160	---	285	---			23	
					160 < t ≤ 200	---	275	---			23	
	SM490C	---	---	HR	≤ 16	---	325	---	490-610	---	17	47 J at 0°C
					16 < t ≤ 40	---	315	---			21	
					40 < t ≤ 75	---	295	---			23	
					75 < t ≤ 100	---	295	---			23	
					100 < t ≤ 200	---	---	---			23	

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3.1 Carbon Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3106:1999 (Continued)	SM490YA	---	---	HR	≤ 16	---	365	---	490-610	---	15	---
					16 < t ≤ 40	---	355	---			19	
					40 < t ≤ 75	---	335	---			21	
					75 < t ≤ 100	---	325	---			21	
	SM490YB	---	---	HR	≤ 16	---	365	---	490-610	---	15	27 J at 0°C
					16 < t ≤ 40	---	355	---			19	
					40 < t ≤ 75	---	335	---			21	
					75 < t ≤ 100	---	325	---			21	
JIS G 3136:1994	SN490B	---	---	HR	≤ 16	---	325-445	---	490-610	---	17	27 J at 0°C
					16 < t ≤ 40	---	325-445	---			21	
					40 < t ≤ 100	---	295-415	---			23	
	SN490C	---	---	HR	≤ 16	---	---	---	490-610	---	17	27 J at 0°C
					16 < t ≤ 40	---	325-445	---			21	
					40 < t ≤ 100	---	295-415	---			23	
EN 10025:1993	E 295	1.0050	---	HR	< 3	---	295	---	490-660	---	---	---
					3 ≤ t ≤ 16	---	295	---	470-610	---	18	
					16 < t ≤ 40	---	285	---			18	
					40 < t ≤ 63	---	275	---			17	
					63 < t ≤ 80	---	265	---			16	
					80 < t ≤ 100	---	255	---			16	
					100 < t ≤ 150	---	245	---	450-610	---	15	
					150 < t ≤ 200	---	235	---	440-610	---	14	
					200 < t ≤ 250	---	225	---			14	
ISO 630:1995	E 355 C	---	---	AR	≤ 16	---	355	---	490-640	---	22	27 J at 0°C
					16 < t ≤ 40	---	345	---			22	
					40 < t ≤ 63	---	335	---			21	
					63 < t ≤ 80	---	325	---			20	
					80 < t ≤ 100	---	315	---			20	
					100 < t ≤ 150	---	295	---			18	
					150 < t ≤ 200	---	285	---			17	

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3.1 Carbon Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ISO 630:1995 (Continued)	E 355 D	---	---	D_1: N D_2: AD	≤ 16	---	355	---	490-640	---	22	27 J at -20°C
					16 < t ≤ 40	---	345	---			22	
					40 < t ≤ 63	---	335	---			21	
					63 < t ≤ 80	---	325	---			20	
					80 < t ≤ 100	---	315	---			20	
					100 < t ≤ 150	---	295	---			18	
					150 < t ≤ 200	---	285	---			17	

3.1 Carbon Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10025:1993	S355JR	1.0045	---	HR	< 3	---	355	---	510-680	---	---	---
					3 ≤ t ≤ 16	---	355	---	490-630	---	20	27 J at 20°C
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---			18	
					100 < t ≤ 150	---	295	---	470-630	---	18	
					150 < t ≤ 200	---	285	---	450-630	---	17	23 J at 20°C
					200 < t ≤ 250	---	275	---			17	
	S355J0	1.0553	---	HR	< 3	---	355	---	510-680	---	---	---
					3 ≤ t ≤ 16	---	355	---	490-630	---	20	27 J at 0°C
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---			18	
					100 < t ≤ 150	---	295	---	470-630	---	18	
					150 < t ≤ 200	---	285	---	450-630	---	17	23 J at 0°C
					200 < t ≤ 250	---	275	---			17	
	S355J2G3	1.0570	---	N	< 3	---	355	---	510-680	---	---	---
					3 ≤ t ≤ 16	---	355	---	490-630	---	20	27 J at -20°C
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---			18	
					100 < t ≤ 150	---	295	---	470-630	---	18	
					150 < t ≤ 200	---	285	---	450-630	---	17	23 J at -20°C
					200 < t ≤ 250	---	275	---			17	

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3.1 Carbon Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10025:1993 (Continued)	S355J2G4	1.0577	---	HR	< 3	---	355	---	510-680	---	---	---
					3 ≤ t ≤ 16	---	355	---	490-630	---	20	27 J at -20°C
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---			18	
					100 < t ≤ 150	---	295	---	470-630	---	18	
					150 < t ≤ 200	---	285	---	450-630	---	17	23 J at -20°C
					200 < t ≤ 250	---	275	---			17	
	S355K2G3	1.0595	---	HR	< 3	---	355	---	510-680	---	---	---
					3 ≤ t ≤ 16	---	355	---	490-630	---	20	40 J at -20°C
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---			18	
					100 < t ≤ 150	---	295	---	470-630	---	18	
					150 < t ≤ 200	---	285	---	450-630	---	17	33 J at -20°C
					200 < t ≤ 250	---	275	---			17	
	S355K2G4	1.0596	---	HR	< 3	---	355	---	510-680	---	---	---
					3 ≤ t ≤ 16	---	355	---	490-630	---	20	40 J at -20°C
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---			18	
					100 < t ≤ 150	---	295	---	470-630	---	18	
					150 < t ≤ 200	---	285	---	450-630	---	17	33 J at -20°C
					200 < t ≤ 250	---	275	---			17	

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3106:1999	SM520B	---	---	HR	≤ 16	---	365	---	520-640	---	15	27 J at 0°C
					16 < t ≤ 40	---	355	---			19	
					40 < t ≤ 75	---	335	---			21	
					75 < t ≤ 100	---	325	---			21	
	SM520C	---	---	HR	≤ 16	---	365	---	520-640	---	15	47 J at 0°C
					16 < t ≤ 40	---	355	---			19	
					40 < t ≤ 75	---	335	---			21	
					75 < t ≤ 100	---	325	---			21	
JIS G 3101:1995	SS540	---	---	HR	≤ 16	---	400	---	540	---	13	---
					16 < t ≤ 40	---	390	---			17	
					> 40	---	---	---			---	
ASTM A 678/A 678M-00a	B	---	K02002	QT	t ≤ 20	t ≤ ¾	415	60	550-690	80-100	22	---
					20 < t ≤ 40	¾ < t ≤ 1½						
					40 < t ≤ 50	1½ < t ≤ 2						
					50 < t ≤ 65	2 < t ≤ 2½						

3.1 Carbon Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3106:1999	SM570	---	---	HR	≤ 16	---	460	---	570-720	---	19	47 J at -5°C
					16 < t ≤ 20	---	450	---			26	
					20 < t ≤ 40	---	450	---			20	
					40 < t ≤ 75	---	430	---			20	
					75 < t ≤ 100	---	420	---			20	
EN 10025:1993	E 335	1.0060	---	HR	< 3	---	335	---	590-770	---	---	---
					3 ≤ t ≤ 16	---	335	---	570-710	---	14	
					16 < t ≤ 40	---	325	---			14	
					40 < t ≤ 63	---	315	---			13	
					63 < t ≤ 80	---	305	---			12	
					80 < t ≤ 100	---	295	---			12	
					100 < t ≤ 150	---	275	---	550-710	---	11	
					150 < t ≤ 200	---	265	---	540-710	---	10	
					200 < t ≤ 250	---	255	---			10	
ASTM A 678/A 678M-00a	C	---	K02204	QT	t ≤ 20	t ≤ ¾	515	75	655-790	95-115	19	---
					20 < t ≤ 40	¾ < t ≤ 1½	485	70	620-760	90-110		
					40 < t ≤ 50	1½ < t ≤ 2	450	65	585-720	85-105		
EN 10025:1993	E 360	1.0070	---	HR	< 3	---	360	---	690-900	---	---	---
					3 ≤ t ≤ 16	---	360	---	670-830	---	10	
					16 < t ≤ 40	---	355	---			10	
					40 < t ≤ 63	---	345	---			9	
					63 < t ≤ 80	---	335	---			8	
					80 < t ≤ 100	---	325	---			8	
					100 < t ≤ 150	---	305	---	650-830	---	7	
					150 < t ≤ 200	---	295	---	640-830	---	6	
					200 < t ≤ 250	---	285	---			6	

3.1 Carbon Steels for Structural Steel Plates

3.1B Chemical Composition of Carbon Steels for Structural Steel Plates

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 630:1995	E 185	---	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 283/A 283M-03	A	---	---	≤ 40	≤ 1.5	0.14	0.90	0.40	0.035	0.04	---	---	---	---
				> 40	> 1.5	0.14	0.90	0.15-0.40	0.035	0.04	---	---	---	---
EN 10025:1993	S185	1.0035	---	≤ 16	---	---	---	---	---	---	---	---	---	---
JIS G 3101:1995	SS330	---	---	---	---	---	---	---	0.050	0.050	---	---	---	---
ASTM A 1011/A 1011M-03	30 [205]	---	K02502	≤ 6.0	≤ 0.229	0.25	0.90	report value	0.035	0.04	0.15	0.20	0.06	Cb 0.008; V 0.008; Al report value; Cu see standard; Cu + Ni + Cr + Mo 0.50; Cr + Mo see standard
ISO 630:1995	E 235 A	---	---	---	---	0.22	---	---	0.050	0.050	---	---	---	---
	E 235 B	---	---	≤ 16	---	0.17	1.40	0.40	0.045	0.045	---	---	---	---
				16 < t ≤ 25	---	0.20	1.40	0.40	0.045	0.045	---	---	---	---
				≤ 40	---	0.17	1.40	0.40	0.045	0.045	---	---	---	Non-rimming
				> 40	---	0.20	1.40	0.40	0.045	0.045	---	---	---	Non-rimming
	E 235 C	---	---	---	---	0.17	1.40	0.40	0.040	0.040	---	---	---	Non-rimming
	E 235 D	---	---	---	---	0.17	1.40	0.40	0.035	0.035	---	---	---	Fine-grained
ASTM A 283/A 283M-03	B	---	---	≤ 40	≤ 1.5	0.17	0.90	0.40	0.035	0.04	---	---	---	---
				> 40	> 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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 1011/A 1011M-03	33 [230]	---	K02502	≤ 6.0	≤ 0.229	0.25	0.90	report value	0.035	0.04	0.15	0.20	0.06	Cb 0.008; V 0.008; Al report value; Cu see standard; Cu + Ni + Cr + Mo 0.50; Cr + Mo see standard
EN 10025:1993	S235JR	1.0037	---	≤ 16	---	0.17	1.40	---	0.045	0.045	---	---	---	N 0.009
				16 < t ≤ 40	---	0.20	1.40	---	0.045	0.045	---	---	---	N 0.009
	S235JRG1	1.0036	---	≤ 16	---	0.17	1.40	---	0.045	0.045	---	---	---	N 0.007
				16 < t ≤ 40	---	0.20	1.40	---	0.045	0.045	---	---	---	N 0.007
	S235JRG2	1.0038	---	≤ 16	---	0.17	1.40	---	0.045	0.045	---	---	---	N 0.009
				16 < t ≤ 40	---	0.17	1.40	---	0.045	0.045	---	---	---	N 0.009
				> 40	---	0.20	1.40	---	0.045	0.045	---	---	---	N 0.009
	S235J0	1.0114	---	≤ 16	---	0.17	1.40	---	0.040	0.040	---	---	---	N 0.009
				16 < t ≤ 40	---	0.17	1.40	---	0.040	0.040	---	---	---	N 0.009
				> 40	---	0.17	1.40	---	0.040	0.040	---	---	---	N 0.009
	S235J2G3	1.0116	---	≤ 16	---	0.17	1.40	---	0.035	0.035	---	---	---	---
				16 < t ≤ 40	---	0.17	1.40	---	0.035	0.035	---	---	---	---
				> 40	---	0.17	1.40	---	0.035	0.035	---	---	---	---
	S235J2G4	1.0117	---	≤ 16	---	0.17	1.40	---	0.035	0.035	---	---	---	---
				16 < t ≤ 40	---	0.17	1.40	---	0.035	0.035	---	---	---	---
				> 40	---	0.17	1.40	---	0.035	0.035	---	---	---	---
ASTM A 1011/A 1011M-03	36 [250] Type 1	---	K02502	≤ 6.0	≤ 0.229	0.25	0.90	report value	0.035	0.04	0.15	0.20	0.06	Cb 0.008; V 0.008; Al report value; Cu see standard; Cu + Ni + Cr + Mo 0.50; Cr + Mo see standard

3.1 Carbon Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 283/A 283M-03	C	---	K02401	≤ 40	≤ 1.5	0.24	0.90	0.40	0.035	0.04	---	---	---	---
				> 40	> 1.5	0.24	0.90	0.15-0.40	0.035	0.04	---	---	---	---
ASTM A 1011/A 1011M-03	40 [275]	---	K02502	≤ 6.0	≤ 0.229	0.25	0.90	report value	0.035	0.04	0.15	0.20	0.06	Cb 0.008; V 0.008; Al report value; Cu see standard; Cu + Ni + Cr + Mo 0.50; Cr + Mo see standard
ASTM A 36/A 36M-03a	---	---	K02595	≤ 20	≤ ¾	0.25	---	0.40	0.04	0.05	---	---	---	---
			K02596	20 < t ≤ 40	¾ < t ≤ 1½	0.25	0.80-1.20	0.40	0.04	0.05	---	---	---	---
			K02597	40 < t ≤ 65	1½ < t ≤ 2½	0.26	0.80-1.20	0.15-0.40	0.04	0.05	---	---	---	---
			K02598	65 < t ≤ 100	2½ < t ≤ 4	0.27	0.85-1.20	0.15-0.40	0.04	0.05	---	---	---	---
			K02599-	> 100	> 4	0.29	0.85-1.20	0.15-0.40	0.04	0.05	---	---	---	---
ASTM A 1011/A 1011M-03	36 [250] Type 2	---	K02502	≤ 6.0	≤ 0.229	0.25	1.35	report value	0.035	0.04	0.15	0.20	0.06	Cb 0.008; V 0.008; Si, Al report value; Cu see standard; Cu + Ni + Cr + Mo 0.50; Cr + Mo see standard
ASTM A 573/A 573M-00a	58 [400]	---	K02301	≤ 13	≤ ½	0.23	0.60-0.90	0.10-0.35	0.035	0.04	---	---	---	---
				13 < t ≤ 40	½ < t ≤ 1½	0.23	0.60-0.90	0.10-0.35	0.035	0.04	---	---	---	---
ASTM A 709/A 709M-03a	36 [250]	---	---	≤ 20	≤ ¾	0.25	---	0.40	0.04	0.05	---	---	---	---
				20 < t ≤ 40	¾ < t ≤ 1½	0.25	0.80-1.20	0.40	0.04	0.05	---	---	---	---
				40 < t ≤ 65	1½< t ≤2½	0.26	0.80-1.20	0.15-0.40	0.04	0.05	---	---	---	---
				65 < t ≤ 100	2½ < t ≤ 4	0.27	0.85-1.20	0.15-0.40	0.04	0.05	---	---	---	---
JIS G 3101:1995	SS400	---	---	---	---	---	---	---	0.050	0.050	---	---	---	---
JIS G 3106:1999	SM400A	---	---	≤ 50	---	0.23	2.5xC min	---	0.035	0.035	---	---	---	---
				50 < t ≤ 200	---	0.25	2.5xC min	---	0.035	0.035	---	---	---	---
	SM400B	---	---	≤ 50	---	0.20	0.60-1.40	0.35	0.035	0.035	---	---	---	---
				50 < t ≤ 200	---	0.22	0.60-1.40	0.35	0.035	0.035	---	---	---	---
	SM400C	---	---	≤ 100	---	0.18	1.40	0.35	0.035	0.035	---	---	---	---
JIS G 3136:1994	SN400A	---	---	6 ≤ t ≤ 100	---	0.24	---	---	0.050	0.050	---	---	---	---
	SN400B	---	---	6 ≤ t ≤ 50	---	0.20	0.60-1.40	0.35	0.030	0.015	---	---	---	---
				50 < t ≤ 100	---	0.22	0.60-1.40	0.35	0.030	0.015	---	---	---	---
	SN400C	---	---	16 ≤ t ≤ 50	---	0.20	0.60-1.40	0.35	0.020	0.008	---	---	---	---
				50 < t ≤ 100	---	0.22	0.60-1.40	0.35	0.020	0.008	---	---	---	---

3.1 Carbon Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 630:1995	E 275 A	---	---	---	---	0.24	---	---	0.050	0.050	---	---	---	---
	E 275 B	---	---	≤ 40	---	0.21	1.50	0.40	0.045	0.045	---	---	---	Non-rimming
				> 40	---	0.22	1.50	0.40	0.045	0.045	---	---	---	Non-rimming
	E 275 C	---	---	---	---	0.20	1.50	0.40	0.040	0.040	---	---	---	Non-rimming
	E 275 D	---	---	---	---	0.20	1.50	0.40	0.035	0.035	---	---	---	Fine-grained
ASTM A 283/A 283M-03	D	---	K02702	≤ 40	≤ 1.5	0.27	0.90	0.40	0.035	0.04	---	---	---	---
				> 40	> 1.5	0.27	0.90	0.15-0.40	0.035	0.04	---	---	---	---
ASTM A 1011/A 1011M-03	45 [310]	---	K02507	≤ 6.0	≤ 0.229	0.25	1.35	report value	0.035	0.04	0.15	0.20	0.06	Cb 0.008; V 0.008; Al report value; Cu see standard; Cu + Ni + Cr + Mo 0.50; Cr + Mo see standard
EN 10025:1993	S275JR	1.0044	---	≤ 16	---	0.21	1.50	---	0.045	0.045	---	---	---	N 0.009
				16 < t ≤ 40	---	0.21	1.50	---	0.045	0.045	---	---	---	N 0.009
				> 40	---	0.22	1.50	---	0.045	0.045	---	---	---	N 0.009
	S275J0	1.0143	---	≤ 16	---	0.18	1.50	---	0.040	0.040	---	---	---	N 0.009
				16 < t ≤ 40	---	0.18	1.50	---	0.040	0.040	---	---	---	N 0.009
				> 40	---	0.18	1.50	---	0.040	0.040	---	---	---	N 0.009
	S275J2G3	1.0144	---	≤ 16	---	0.18	1.50	---	0.035	0.035	---	---	---	---
				16 < t ≤ 40	---	0.18	1.50	---	0.035	0.035	---	---	---	---
				> 40	---	0.18	1.50	---	0.035	0.035	---	---	---	---
	S275J2G4	1.0145	---	≤ 16	---	0.18	1.50	---	0.035	0.035	---	---	---	---
				16 < t ≤ 40	---	0.18	1.50	---	0.035	0.035	---	---	---	---
				> 40	---	0.18	1.50	---	0.035	0.035	---	---	---	---
ASTM A 1011/A 1011M-03	50 [340]	---	K02507	≤ 6.0	≤ 0.229	0.25	1.35	report value	0.035	0.04	0.15	0.20	0.06	Cb 0.008; V 0.008; Al report value; Cu see standard; Cu + Ni + Cr + Mo 0.50; Cr + Mo see standard
ASTM A 573/A 573M-00a	65 [450]	---	K02404	≤ 13	≤ ½	0.24	0.85-1.20	0.15-0.40	0.035	0.04	---	---	---	---
				13 < t ≤ 40	½ < t ≤ 1½	0.26	0.85-1.20	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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 529/A 529M-03	50 [345]	---	K02703	≤ 25	≤ 1	0.27	1.35	0.40	0.04	0.05	---	---	---	---
	55 [380]	---	K02703	≤ 25	≤ 1	0.27	1.35	0.40	0.04	0.05	---	---	---	---
ASTM A 1011/A 1011M-03	55 [380]	---	K02507	≤ 6.0	≤ 0.229	0.25	1.35	report value	0.035	0.04	0.15	0.20	0.06	Cb 0.008; V 0.008; Al report value; Cu see standard; Cu + Ni + Cr + Mo 0.50; Cr + Mo see standard
ASTM A 573/A 573M-00a	70 [485]	---	K02701	≤ 13	≤ ½	0.27	0.85-1.20	0.15-0.40	0.035	0.04	---	---	---	---
				13 < t ≤ 40	½ < t ≤ 1½	0.28	0.85-1.20	0.15-0.40	0.035	0.04	---	---	---	---
ASTM A 678/A 678M-00a	A	---	K01600	≤ 40	≤ 1½	0.16	0.90-1.50	0.15-0.50	0.035	0.04	---	---	---	---
JIS G 3101:1995	SS490	---	---	---	---	---	---	---	0.050	0.050	---	---	---	---
JIS G 3106:1999	SM490A	---	---	≤ 50	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
				50< t ≤ 200	---	0.22	1.60	0.55	0.035	0.035	---	---	---	---
	SM490B	---	---	≤ 50	---	0.18	1.60	0.55	0.035	0.035	---	---	---	---
				50< t ≤ 200	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
	SM490C	---	---	≤ 100	---	0.18	1.60	0.55	0.035	0.035	---	---	---	---
	SM490YA	---	---	≤ 100	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
	SM490YB	---	---	≤ 100	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
JIS G 3136:1994	SN490B	---	---	6 ≤ t ≤ 50	---	0.18	1.60	0.55	0.030	0.015	---	---	---	---
				50 < t ≤ 100	---	0.20	1.60	0.55	0.030	0.015	---	---	---	---
	SN490C	---	---	16 ≤ t ≤ 50	---	0.18	1.60	0.55	0.020	0.008	---	---	---	---
				50 < t ≤ 100	---	0.20	1.60	0.55	0.020	0.008	---	---	---	---
EN 10025:1993	E295	1.0050	---	---	---	---	---	---	0.045	0.045	---	---	---	N 0.009
ISO 630:1995	E 355 C	---	---	≤ 30	---	0.20	1.60	0.55	0.040	0.040	---	---	---	non-rimming
				> 30	---	0.22	1.60	0.55	0.040	0.040	---	---	---	non-rimming
	E 355 D	---	---	≤ 30	---	0.20	1.60	0.55	0.035	0.035	---	---	---	fine-grained
				> 30	---	0.22	1.60	0.55	0.035	0.035	---	---	---	fine-grained

3.1 Carbon Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10025:1993	S355JR	1.0045	---	≤ 16	---	0.24	1.60	0.55	0.045	0.045	---	---	---	N 0.009
				16 < t ≤ 40	---	0.24	1.60	0.55	0.045	0.045	---	---	---	N 0.009
				> 40	---	0.24	1.60	0.55	0.045	0.045	---	---	---	N 0.009
	S355J0	1.0553	---	≤ 16	---	0.20	1.60	0.55	0.040	0.040	---	---	---	N 0.009
				16 < t ≤ 40	---	0.20	1.60	0.55	0.040	0.040	---	---	---	N 0.009
				> 40	---	0.22	1.60	0.55	0.040	0.040	---	---	---	N 0.009
	S355J2G3	1.0570	---	≤ 16	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
				16 < t ≤ 40	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
				> 40	---	0.22	1.60	0.55	0.035	0.035	---	---	---	---
	S355J2G4	1.0577	---	≤ 16	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
				16 < t ≤ 40	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
				> 40	---	0.22	1.60	0.55	0.035	0.035	---	---	---	---
	S355K2G3	1.0595	---	≤ 16	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
				16 < t ≤ 40	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
				> 40	---	0.22	1.60	0.55	0.035	0.035	---	---	---	---
	S355K2G4	1.0596	---	≤ 16	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
				16 < t ≤ 40	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
				> 40	---	0.22	1.60	0.55	0.035	0.035	---	---	---	---
JIS G 3106:1999	SM520B	---	---	≤ 100	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
	SM520C	---	---	≤ 100	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
JIS G 3101:1995	SS540	---	---	---	---	0.30	1.60	---	0.040	0.040	---	---	---	---
ASTM A 678/A 678M-00a	B	---	K02002	≤ 40	≤ 1½	0.20	0.70-1.35	0.15-0.50	0.035	0.04	---	---	---	---
				40 < t ≤ 65	1½ < t ≤ 2½	0.20	1.00-1.60	0.15-0.50	0.035	0.04	---	---	---	---
JIS G 3106:1999	SM570	---	---	≤ 100	---	0.18	1.60	0.55	0.035	0.035	---	---	---	----
EN 10025:1993	E 335	1.0060	---	---	---	---	---	---	0.045	0.045	---	---	---	N 0.009
ASTM A 678/A 678M-00a	C	---	K02204	≤ 40	≤ 1½	0.22	1.00-1.60	0.20-0.50	0.035	0.04	---	---	---	---
				40 < t ≤ 65	1½ < t ≤ 2½	0.22	1.00-1.60	0.20-0.50	0.035	0.04	---	---	---	---
EN 10025:1993	E 360	1.0070	---	---	---	---	---	---	0.045	0.045	---	---	---	N 0.009

3.2 Alloy Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
CSA G40.21-04	260WT (38WT)	---	---	---	≤ 65	≤ 2½	260	38	410-590	60-85	23	see standard for impact data
					65 < t ≤ 100	2½ < t ≤ 4	250	36				
					100 < t ≤ 150	4 < t ≤ 6	250	36				
	260W (38W)	---	---	---	≤ 65	≤ 2½	260	38	410-590	60-85	23	---
					65 < t ≤ 100	2½ < t ≤ 4	250	36				
					100 < t ≤ 150	4 < t ≤ 6	250	36				
					150 < t ≤ 200	6 < t ≤ 8	250	36				
ASTM A 1011/A 1011M-03	45 [310] Class 1	---	---	HR	< 2.5	< .097	310	45	410	60	23.0	---
					> 2.5	> .097					25.0	
	50 [340] Class 2	---	---	HR	< 2.5	< .097	340	50	410	60	20.0	---
					> 2.5	> .097					22.0	
ASTM A 572/A 572M-03a	42 [290]	---	---	---	≤ 150	≤ 6	290	42	415	60	24	---
ASTM A 656/A 656M-03	50 [345]	---	---	HR	≤ 50	≤ 2	345	50	415	60	23	---
ASTM A 633/A 633M-01	A	---	K01802	N	≤ 65	≤ 2.5	290	42	430-570	63-83	23	see standard for supplementary impact testing
					65 < t ≤ 100	2.5 < t ≤ 4						
ASTM A 709/A 709M-03a	50 [345]	---	---	---	≤ 100	≤ 4	345	50	450	65	21	---
ASTM A 572/A 572M-03a	50 [345]	---	---	---	≤ 100	≤ 4	345	50	450	65	21	---
ASTM A 1011/A 1011M-03	50 [340] Class 1	---	---	HR	< 2.5	< .097	340	50	450	65	20.0	---
					> 2.5	> .097					22.0	
	55 [380] Class 2	---	---	HR	< 2.5	< .097	380	55	450	65	18.0	---
					> 2.5	> .097					20.0	
EN 10113-3:1993	S355M	1.8823	---	TMCP	t ≤ 16	---	355	---	450-610	---	22	see standard for impact data
					16 < t ≤ 40	---	345	---				
					40 < t ≤ 63	---	335	---				
	S355ML	1.8834	---	TMCP	t ≤ 16	---	355	---	450-610	---	22	see standard for impact data
					16 < t ≤ 40	---	345	---				
					40 < t ≤ 63	---	335	---				
CSA G40.21-04	300WT (44WT)	---	---	---	≤ 65	≤ 2½	300	44	450-620	65-90	23	see standard for impact data
					65 < t ≤ 100	2½ < t ≤ 4	280	40				
					100 < t ≤ 150	4 < t ≤ 6	280	40				
	300W (44W)	---	---	---	≤ 65	≤ 2½	300	44	450-620	65-90	23	---
					65 < t ≤ 100	2½ < t ≤ 4	280	40				
					100 < t ≤ 150	4 < t ≤ 6	280	40				
					150 < t ≤ 200	6 < t ≤ 8	280	40				

3.2 Alloy Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10113-2:1998	S355N	1.0545	---	N	t ≤ 16	---	355	---	470-630	---	22	see standard for impact data
					16 < t ≤ 40	---	345	---				
					40 < t ≤ 63	---	335	---				
					63 < t ≤ 80	---	325	---				
					80 < t ≤ 100	---	315	---				
					100 < t ≤ 150	---	295	---	450-600	---		
	S355NL	1.0546	---	N	t ≤ 16	---	355	---	470-630	---	22	see standard for impact data
					16 < t ≤ 40	---	345	---				
					40 < t ≤ 63	---	335	---				
					63 < t ≤ 80	---	325	---				
					80 < t ≤ 100	---	315	---				
					100 < t ≤ 150	---	295	---	450-600	---		
ASTM A 242/A 242M-03a	---	---	K11510	---	t ≤ 20	t ≤ ¾	345	50	480	70	21	---
					20 < t ≤ 40	¾ < t ≤ 1½	315	46	460	67		
					40 < t ≤ 100	1½ < t ≤ 4	290	42	435	63		
ASTM A 1011/A 1011M-03	55 [380] Class 1	---	---	HR	< 2.5	< .097	380	55	480	70	18.0	---
					> 2.5	> .097					20.0	
	60 [410] Class 2	---	---	HR	< 2.5	< .097	410	60	480	70	16.0	---
					> 2.5	> .097					18.0	
CSA G40.21-04	350WT (50WT)	---	---	---	≤ 65	≤ 2½	350	50	480-650	70-95	22	see standard for impact data
					65 < t ≤ 150	2½ < t ≤ 6	320	46				
	350W (50W)	---	---	---	≤ 65	≤ 2½	350	50	450-650	65-95	22	---
					65 < t ≤ 100	2½ < t ≤ 4	320	46				
					100 < t ≤ 150	4 < t ≤ 6	320	46				
	380W (55W)	---	---	---	≤ 65	≤ 2½	380	55	480-650	70-95	21	---
ASTM A 572/A 572M-03a	55 [380]	---	---	---	≤ 50	≤ 2	380	55	485	70	20	---
ASTM A 656/A 656M-03	60 [415]	---	---	HR	≤ 40	≤ 1½	415	60	485	70	20	---
ASTM A 588/A 588M-03a	A B C K	---	K11430 K12043 K11538 ---	---	t ≤ 100	t ≤ 4	345	50	485	70	21	---
					100 < t ≤ 125	4 < t ≤ 5	315	46	460	67		
					125 < t ≤ 200	5 < t ≤ 8	290	42	435	63		

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 633/A 633M-01	C	---	K12000	N	≤ 65	≤ 2.5	345	50	485-620	70-90	23	see standard for supplementary impact testing
					65 < t ≤ 100	2.5 < t ≤ 4	315	46	450-590	65-85		
	D	---	K12037	N	≤ 65	≤ 2.5	345	50	485-620	70-90	23	see standard for supplementary impact testing
					65 < t ≤ 100	2.5 < t ≤ 4	315	46	450-590	65-85		
EN 10113-3:1993	S420M	1.8825	---	TMCP	t ≤ 16	---	420	---	500-660	---	19	see standard for impact data
					16 < t ≤ 40	---	400	---				
					40 < t ≤ 63	---	390	---				
	S420ML	1.8836	---	TMCP	t ≤ 16	---	420	---	500-660	---	19	see standard for impact data
					16 < t ≤ 40	---	400	---				
					40 < t ≤ 63	---	390	---				
ASTM A 572/A 572M-03a	60 [415]	---	---	---	≤ 32	≤ 1¼	415	60	520	75	18	---
ASTM A 1011/A 1011M-03	60 [410] Class 1	---	---	HR	< 2.5	< .097	410	60	520	75	16.0	---
					> 2.5	> .097					18.0	
	65 [450] Class 2	---	---	HR	< 2.5	< .097	410	60	520	75	16.0	---
					> 2.5	> .097					18.0	
CSA G40.21-04	400WT (60WT)	---	---	AR	≤ 65	≤ 2½	400	60	520-690	75-100	20	see standard for impact data
	400W (60W)	---	---	---	≤ 65	≤ 2½	400	60	520-690	75-100	18	---
ASTM A 572/A 572M-03a	65 [450]	---	---	---	≤ 32	≤ 1¼	450	65	550	80	17	---
ASTM A 633/A 633M-01	E	---	K12202	N < 3 in. N+N > 3 in. (75 mm)	t ≤ 100	t ≤ 4	415	60	550-690	80-100	23	see standard for supplementary impact testing
					100 < t ≤ 150	4 < t ≤ 6	380	55	515-655	75-95		
ASTM A 656/A 656M-03	70 [485]	---	---	HR	≤ 25	≤ 1	485	70	550	80	17	---
ASTM A 1011/A 1011M-03	65 [450] Class 1	---	---	HR	< 2.5	< .097	450	65	550	80	14.0	---
					> 2.5	> .097					16.0	
	70 [480] Class 2	---	---	HR	< 2.5	< .097	480	70	550	80	12.0	---
					> 2.5	> .097					14.0	

3.2 Alloy Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
CSA G40.21-04	260WT (38WT)	---	---	---	---	0.20	0.80-1.50	0.15-0.40	0.03	0.04	---	---	---	grain refining elements 0.10
	260W (38W)	---	---	≤ 40	≤ 1½	0.20	0.50-1.50	0.40	0.04	0.05	---	---	---	grain refining elements 0.10
				> 40	> 1½			0.15-0.40						
				>100	> 4	0.22								
ASTM A 572/A 572M-03a	42 [290] Type 1	---	---	≤ 40	≤ 1½	0.21	1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
				40 < t ≤ 150	1½ < t ≤ 6			0.15-0.40						
	42 [290] Type 2	---	---	≤ 40	≤ 1½	0.21	1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15
				40 < t ≤ 150	1½ < t ≤ 6			0.15-0.40						
	42 [290] Type 3	---	---	≤ 40	≤ 1½	0.21	1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05; V 0.01-0.15; Cb + V 0.02-0.15
				40 < t ≤ 150	1½ < t ≤ 6			0.15-0.40						
	42 [290] Type 4	---	---	≤ 40	≤ 1½	0.21	1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15; N 0.015 V:N > 4:1
				40 < t ≤ 150	1½ < t ≤ 6			0.15-0.40						
	42 [290] Type 5	---	---	≤ 40	≤ 1½	0.21	1.35	0.40	0.04	0.05	---	---	---	Ti 0.006-0.04; N 0.003-0.015; V 0.06
				40 < t ≤ 150	1½ < t ≤ 6			0.15-0.40						
ASTM A 656/A 656M-03	50 [345] Type 3	---	---	---	---	0.18	1.65	0.60	0.025	0.035	---	---	---	V 0.08; N 0.020; Cb 0.008-0.10
	50 [345] Type 7	---	---	---	---	0.18	1.65	0.60	0.025	0.035	---	---	---	V 0.15; N 0.020; Cb 0.10
ASTM A 633/A 633M-01	A	---	K01802	≤ 100	≤ 4	0.18	1.00-1.35	0.15-0.50	0.035	0.04	---	---	---	Cb 0.05
ASTM A 709/A 709M-03a	50 [345] Type 1	---	---	≤ 40	≤ 1½	0.23	1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
				40 < t ≤ 100	1½ < t ≤ 4	0.23	1.35	0.15-0.40	0.04	0.05	---	---	---	
	50 [345] Type 2	---	---	≤ 40	≤ 1½	0.23	1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15
				40 < t ≤ 100	1½ < t ≤ 4	0.23	1.35	0.15-0.40	0.04	0.05	---	---	---	
	50 [345] Type 3	---	---	≤ 40	≤ 1½	0.23	1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05; V 0.01-0.15; Cb + V 0.02-0.15
				40 < t ≤ 100	1½ < t ≤ 4	0.23	1.35	0.15-0.40	0.04	0.05	---	---	---	
	50 [345] Type 4	---	---	≤ 40	≤ 1½	0.23	1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15; N 0.015 V:N > 4:1
				40 < t ≤ 100	1½ < t ≤ 4	0.23	1.35	0.15-0.40	0.04	0.05	---	---	---	
	50 [345] Type 5	---	---	≤ 40	≤ 1½	0.23	1.35	0.40	0.04	0.05	---	---	---	Ti 0.006-0.04; V 0.01-0.15; N 0.015
				40 < t ≤ 100	1½ < t ≤ 4	0.23	1.35	0.15-0.40	0.04	0.05	---	---	---	

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 572/A 572M-03a	50 [345] Type 1	---	---	≤ 40	≤ 1½	0.23	1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
				40 < t ≤ 100	1½ < t ≤ 4			0.15-0.40						
	50 [345] Type 2	---	---	≤ 40	≤ 1½	0.23	1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15
				40 < t ≤ 100	1½ < t ≤ 4			0.15-0.40						
	50 [345] Type 3	---	---	≤ 40	≤ 1½	0.23	1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05; V 0.01-0.15; Cb + V 0.02-0.15
				40 < t ≤ 100	1½ < t ≤ 4			0.15-0.40						
	50 [345] Type 4	---	---	≤ 40	≤ 1½	0.23	1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15; N 0.015 V:N > 4:1
				40 < t ≤ 100	1½ < t ≤ 4			0.15-0.40						
	50 [345] Type 5	---	---	≤ 40	≤ 1½	0.23	1.35	0.40	0.04	0.05	---	---	---	Ti 0.006-0.04; N 0.003-0.015; V 0.06
				40 < t ≤ 100	1½ < t ≤ 4			0.15-0.40						
EN 10113-3:1993	S355M	1.8823	---	≤ 63	---	0.14	1.60	0.50	0.035	0.030	---	0.30	0.20	Nb 0.05; V 0.10; Al 0.02 min; Ti 0.05; N 0.015
	S355ML	1.8834	---	≤ 63	---	0.14	1.60	0.50	0.030	0.025	---	0.30	0.20	Nb 0.05; V 0.10; Al 0.02 min; Ti 0.05; N 0.015
CSA G40.21-04	300WT (44WT)	---	---	---	---	0.22	0.80-1.50	0.15-0.40	0.03	0.04	---	---	---	grain refining elements 0.10
	300W (44W)	---	---	≤ 40	≤ 1½	0.22	0.50-1.50	0.40	0.04	0.05	---	---	---	grain refining elements 0.10
				> 40	> 1½			0.15-0.40						
				>100	> 4	0.23								

3.2 Alloy Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10113-2:1998	S355N	1.0545	---	≤ 150	---	0.20	0.90-1.65	0.50	0.035	0.030	0.30	0.30	0.10	Nb 0.05; V 0.05; Al 0.02 min; Ti 0.03; Cu 0.35; N 0.015
	S355NL	1.0546	---	≤ 150	---	0.18	0.90-1.65	0.50	0.030	0.025	0.30	0.50	0.10	Nb 0.05; V 0.12; Al 0.02 min; Ti 0.03; Cu 0.35; N 0.015
ASTM A 242/A 242M-03a	1	---	K11510	≤ 100	≤ 4	0.15	1.00	---	0.15	0.05	---	---	---	Cu 0.20
CSA G40.21-04	350WT (50WT)	---	---	---	---	0.22	0.80-1.50	0.15-0.40	0.03	0.04	---	---	---	grain refining elements 0.10
	350W (50W)	---	---	≤ 40	≤ 1½	0.23	0.50-1.50	0.40	0.04	0.05	---	---	---	grain refining elements 0.10
				> 40	> 1½			0.15-0.40						
ASTM A 572/A 572M-03a	55 [380] Type 1	---	---	≤ 40	≤ 1½	0.25	1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
				40 < t ≤ 50	1½ < t ≤ 2			0.15-0.40						
	55 [380] Type 2	---	---	≤ 40	≤ 1½	0.25	1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15
				40 < t ≤ 50	1½ < t ≤ 2			0.15-0.40						
	55 [380] Type 3	---	---	≤ 40	≤ 1½	0.25	1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05; V 0.01-0.15; Cb + V 0.02-0.15
				40 < t ≤ 50	1½ < t ≤ 2			0.15-0.40						
	55 [380] Type 4	---	---	≤ 40	≤ 1½	0.25	1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15; N 0.015
				40 < t ≤ 50	1½ < t ≤ 2			0.15-0.40						
	55 [380] Type 5	---	---	≤ 40	≤ 1½	0.25	1.35	0.40	0.04	0.05	---	---	---	Ti 0.006-0.04; N 0.003-0.015; V 0.06
				40 < t ≤ 50	1½ < t ≤ 2			0.15-0.40						
ASTM A 656/A 656M-03	60 [415] Type 3	---	---	≤ 40	≤ 1½	0.18	1.65	0.60	0.025	0.035	---	---	---	V 0.08; N 0.020; Cb 0.008-0.10
	60 [415] Type 7	---	---	≤ 40	≤ 1½	0.18	1.65	0.60	0.025	0.035	---	---	---	V 0.15; N 0.020; Cb 0.10
ASTM A 588/A 588M-03a	A	---	K11430	≤ 200	≤ 8	0.19	0.80-1.25	0.30-0.65	0.04	0.05	0.40-0.65	0.40	---	Cu 0.25-0.40; V 0.02-0.10
	B	---	K12043	≤ 200	≤ 8	0.20	0.75-1.35	0.15-0.50	0.04	0.05	0.40-0.70	0.50	---	Cu 0.20-0.40; V 0.01-0.10
	C	---	K11538	≤ 200	≤ 8	0.15	0.80-1.35	0.15-0.40	0.04	0.05	0.30-0.50	0.25-0.50	---	Cu 0.20-0.50; V 0.01-0.10
	K	---	---	≤ 200	≤ 8	0.17	0.50-1.20	0.25-0.50	0.04	0.05	0.40-0.70	0.40	0.10	Cu 0.30-0.50; Cb 0.005-0.05
ASTM A 633/A 633M-01	C	---	K12000	≤ 100	≤ 4	0.20	1.15-1.50	0.15-0.50	0.035	0.04	---	---	---	Cb 0.01-0.05
	D	---	K12037	≤ 40	≤ 1½	0.20	0.70-1.35	0.15-0.50	0.035	0.04	0.25	0.25	0.08	Cu 0.35
				40 < t ≤ 100	1½ < t ≤ 4	0.20	1.00-1.60	0.15-0.50	0.035	0.04	0.25	0.25	0.08	Cu 0.35
EN 10113-3:1993	S420M	1.8825	---	≤ 63	---	0.16	1.70	0.50	0.035	0.030	---	0.30	0.20	Nb 0.05; V 0.12; Al 0.02 min; Ti 0.05; N 0.020
	S420ML	1.8836	---	≤ 63	---	0.16	1.70	0.50	0.030	0.025	---	0.30	0.20	Nb 0.05; V 0.12; Al 0.02 min; Ti 0.05; N 0.020

3.2 Alloy Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 572/A 572M-03a	60 [415] Type 1	---	---	32	1¼	0.26	1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
	60 [415] Type 2	---	---	32	1¼	0.26	1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15
	60 [415] Type 3	---	---	32	1¼	0.26	1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05; V 0.01-0.15; Cb + V 0.02-0.15
	60 [415] Type 4	---	---	32	1¼	0.26	1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15; N 0.015
	60 [415] Type 5	---	---	32	1¼	0.26	1.35	0.40	0.04	0.05	---	---	---	Ti 0.006-0.04; N 0.003-0.015; V 0.06
CSA G40.21-04	400WT (60WT)	---	---	---	---	0.22	0.80-1.50	0.15-0.40	0.03	0.04	---	---	---	grain refining elements 0.10
	400W (60W)	---	---	≤ 40	≤ 1½	0.23	0.50-1.50	0.40	0.04	0.05	---	---	---	grain refining elements 0.10
				> 40	> 1½			0.15-0.40						
ASTM A 572/A 572M-03a	65 [450] Type 1	---	---	≤ 13	≤ ½	0.26	1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
				> 13-32	> ½-1¼	0.23	1.65	0.40	0.04	0.05	---	---	---	
	65 [450] Type 2	---	---	≤ 13	≤ ½	0.26	1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15
				> 13-32	> ½-1¼	0.23	1.65	0.40	0.04	0.05	---	---	---	
	65 [450] Type 3	---	---	≤ 13	≤ ½	0.26	1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05; V 0.01-0.15; Cb + V 0.02-0.15
				> 13-32	> ½-1¼	0.23	1.65	0.40	0.04	0.05	---	---	---	
	65 [450] Type 4	---	---	≤ 13	≤ ½	0.26	1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15; N 0.015
				> 13-32	> ½-1¼	0.23	1.65	0.40	0.04	0.05	---	---	---	
	65 [450] Type 5	---	---	≤ 13	≤ ½	0.26	1.35	0.40	0.04	0.05	---	---	---	Ti 0.006-0.04; N 0.003-0.015; V 0.06
				> 13-32	> ½-1¼	0.23	1.65	0.40	0.04	0.05	---	---	---	
ASTM A 633/A 633M-01	E	---	K12202	≤ 150	≤ 6	0.22	1.15-1.50	0.15-0.50	0.035	0.04	---	---	---	V 0.04-0.11; N 0.03
ASTM A 656/A 656M-03	70 [485] Type 3	---	---	≤ 25	≤ 1	0.18	1.65	0.60	0.025	0.035	---	---	---	V 0.08; N 0.020; Cb 0.008-0.10
	70 [485] Type 7	---	---	≤ 25	≤ 1	0.18	1.65	0.60	0.025	0.035	---	---	---	V 0.15; N 0.020; Cb 0.10

3.2 Alloy Steels for Structural Steel Plates

3.2.2A Mechanical Properties of Alloy Steels for Structural Steel Plates

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ISO 4950-2:1995	E 355 DD	---	---	N or NT or CTR	t ≤ 16	---	355	---	470-630	---	22	39 J at -20°C
					16 < t ≤ 35	---	345	---				
					35 < t ≤ 50	---	335	---				
					50 < t ≤ 70	---	325	---				
					70 < t ≤ 100	---	305	---	450-610	---		
					100 < t ≤ 125	---	295	---	440-600	---		
					125 < t ≤ 150	---	285	---	430-590	---		
	E 355 E	---	---	N or NT or CTR	t ≤ 16	---	355	---	470-630	---	22	27 J at -50°C
					16 < t ≤ 35	---	345	---				
					35 < t ≤ 50	---	335	---				
					50 < t ≤ 70	---	325	---				
					70 < t ≤ 100	---	305	---	450-610	---		
					100 < t ≤ 125	---	295	---	440-600	---		
					125 < t ≤ 150	---	285	---	430-590	---		
ASTM A 709/A 709M-03a	50W [345W] Type A, B, C	---	---	---	≤ 100	≤ 4	345	50	485	70	21	---
ASTM A 710/A 710M-02	Grade A Class 2	---	K20747	N + PH	≤ 25	≤ 1	450	65	495	72	20	---
					25 < t ≤ 30	1 < t ≤ 1¼	415	60				
					30 < t ≤ 50	1¼ < t ≤ 2						
					50 < t ≤ 100	2 < t ≤ 4	380	55	450	65		
					> 100	> 4	345	50	415	60		

3.2 Alloy Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10137-2:1996	S460Q	1.8908	---	QT	3 ≤ t ≤ 50	---	460	---	550-720	---	17	see standard for impact data
					50 < t ≤ 100	---	440	---				
					100 < t ≤ 150	---	400	---	500-670	---		
	S460QL	1.8906	---	QT	3 ≤ t ≤ 50	---	460	---	550-720	---	17	see standard for impact data
					50 < t ≤ 100	---	440	---				
					100 < t ≤ 150	---	400	---	500-670	---		
	S460QL1	1.8916	---	QT	3 ≤ t ≤ 50	---	460	---	550-720	---	17	see standard for impact data
					50 < t ≤ 100	---	440	---				
					100 < t ≤ 150	---	400	---	500-670	---		
ISO 4950-3:1995	E 460 DD	---	---	QT	t ≤ 50	---	460	---	570-720	---	17	39 J at -20°C
					50 < t ≤ 70	---	440	---				
	E 460 E	---	---	QT	t ≤ 50	---	460	---	570-720	---	17	27 J at -50°C
					50 < t ≤ 70	---	440	---				
ASTM A 709/A 709M-03a	HPS 70W [HPS 485W]	---	---	QT	≤ 100	≤ 4	485	70	585-760	85-110	19	---
ASTM A 710/A 710M-02	Grade A Class 3	---	K20747	Q + PH	t ≤ 30	≤ 1¼	550	80	585	85	20	---
					30 < t ≤ 50	1¼ < t ≤ 2	515	75	585	85		
					50 < t ≤ 100	2 < t ≤ 4	450	65	515	75		
					> 100	> 4	415	60	485	70		
EN 10137-2:1996	S500Q	1.8924	---	QT	3 ≤ t ≤ 50	---	500	---	590-770	---	17	see standard for impact data
					50 < t ≤ 100	---	480	---				
					100 < t ≤ 150	---	440	---	540-720	---		
	S500QL	1.8909	---	QT	3 ≤ t ≤ 50	---	500	---	590-770	---	17	see standard for impact data
					50 < t ≤ 100	---	480	---				
					100 < t ≤ 150	---	440	---	540-720	---		
	S500QL1	1.8984	---	QT	3 ≤ t ≤ 50	---	500	---	590-770	---	17	see standard for impact data
					50 < t ≤ 100	---	480	---				
					100 < t ≤ 150	---	440	---	540-720	---		
CSA G40.21-04	480WT (70WT)	---	---	---	≤ 65	≤ 2½	480	70	590-790	85-115	17	see standard for impact data

3.2 Alloy Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10137-3:1996	S500A	1.8980	---	PH	3 ≤ t ≤ 50	---	500	---	600-700	---	17	see standard for impact data
					50 < t ≤ 70	---	480	---				
	S500AL	1.8990	---	PH	3 ≤ t ≤ 50	---	500	---	600-700	---	17	see standard for impact data
					50 < t ≤ 70	---	480	---				
ASTM A 710/A 710M-02	Grade A Class 1	---	K20747	PH	≤ 8	≤ 5⁄16	585	85	620	90	20	L: 27 J at -45°C T: 20 J at -45°C
					8 < t ≤ 20	5⁄16 < t ≤ ¾	550	80				
ASTM A 852/A 852M-03	---	---	K12043	QT	≤ 100	≤ 4	485	70	620-760	90-110	19	27 J at 10°C
CSA G40.21-04	550WT (80WT)	---	---	---	≤ 65	≤ 2½	550	80	620-860	90-125	15	see standard for impact data
EN 10137-2:1996	S550Q	1.8904	---	QT	3 ≤ t ≤ 50	---	550	---	640-820	---	16	see standard for impact data
					50 < t ≤ 100	---	530	---				
					100 < t ≤ 150	---	490	---	590-770	---		
	S550QL	1.8926	---	QT	3 ≤ t ≤ 50	---	550	---	640-820	---	16	see standard for impact data
					50 < t ≤ 100	---	530	---				
					100 < t ≤ 150	---	490	---	590-770	---		
	S550QL1	1.8986	---	QT	3 ≤ t ≤ 50	---	550	---	640-820	---	16	see standard for impact data
					50 < t ≤ 100	---	530	---				
					100 < t ≤ 150	---	490	---	590-770	---		
EN 10137-3:1996	S550A	1.8991	---	PH	3 ≤ t ≤ 50	---	550	---	650-820	---	16	see standard for impact data
					50 < t ≤ 70	---	530	---				
	S550AL	1.8992	---	PH	3 ≤ t ≤ 50	---	550	---	650-820	---	16	see standard for impact data
					50 < t ≤ 70	---	530	---				

3.2 Alloy Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10137-2:1996	S620Q	1.8914	---	QT	3 ≤ t ≤ 50	---	620	---	700-890	---	15	see standard for impact data
					50 < t ≤ 100	---	580	---				
					100 < t ≤ 150	---	560	---	650-830	---		
	S620QL	1.8927	---	QT	3 ≤ t ≤ 50	---	620	---	700-890	---	15	see standard for impact data
					50 < t ≤ 100	---	580	---				
					100 < t ≤ 150	---	560	---	650-830	---		
	S620QL1	1.8987	---	QT	3 ≤ t ≤ 50	---	620	---	700-890	---	15	see standard for impact data
					50 < t ≤ 100	---	580	---				
					100 < t ≤ 150	---	560	---	650-830	---		
EN 10137-3:1996	S620A	1.8993	---	PH	3 ≤ t ≤ 50	---	620	---	710-880	---	15	see standard for impact data
					50 < t ≤ 70	---	580	---				
	S620AL	1.8994	---	PH	3 ≤ t ≤ 50	---	620	---	710-880	---	15	see standard for impact data
					50 < t ≤ 70	---	580	---				
ASTM A 514/A 514M-00a	all grades	---	---	QT	≤ 65	≤ 2½	690	100	760-895	110-130	18	---
					65 < t ≤ 150	2½ < t ≤ 6	620	90	690-895	100-130	16	
ASTM A 709/A 709M-03a	100 [690]	---	---	QT	≤ 65	≤ 2½	690	100	760-895	110-130	18	---
					65 < t ≤ 100	2½ < t ≤ 4	620	90	690-895	100-130	16	
	100W [690W]	---	---	QT	≤ 65	≤ 2½	690	100	760-895	110-130	18	---
					65 < t ≤ 100	2½ < t ≤ 4	620	90	690-895	100-130	16	
EN 10137-3:1996	S690A	1.8995	---	PH	3 ≤ t ≤ 50	---	690	---	760-930	---	14	see standard for impact data
					50 < t ≤ 70	---	650	---				
	S690AL	1.8996	---	PH	3 ≤ t ≤ 50	---	690	---	760-930	---	14	see standard for impact data
					50 < t ≤ 70	---	650	---				
EN 10137-2:1996	S690Q	1.8931	---	QT	3 ≤ t ≤ 50	---	690	---	770-940	---	14	see standard for impact data
					50 < t ≤ 100	---	650	---	760-930	---		
					100 < t ≤ 150	---	630	---	710-900	---		
	S690QL	1.8928	---	QT	3 ≤ t ≤ 50	---	690	---	770-940	---	14	see standard for impact data
					50 < t ≤ 100	---	650	---	760-930	---		
					100 < t ≤ 150	---	630	---	710-900	---		
	S690QL1	1.8988	---	QT	3 ≤ t ≤ 50	---	690	---	770-940	---	14	see standard for impact data
					50 < t ≤ 100	---	650	---	760-930	---		
					100 < t ≤ 150	---	630	---	710-900	---		

3.2 Alloy Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3128:1999	SHY 685	---	---	QT	≤ 50	---	685	---	780-930	---	see standard	47 J at -20°C
					50 < t ≤ 100	---	665	---	760-910	---		
	SHY 685 N	---	---	QT	≤ 50	---	685	---	780-930	---	see standard	47 J at -20°C
					50 < t ≤ 100	---	665	---	760-910	---		
	SHY 685 NS	---	---	QT	≤ 50	---	685	---	780-930	---	see standard	47 J at -40°C
					50 < t ≤ 100	---	665	---	760-910	---		
CSA G40.21-04	700Q (100Q)	---	---	QT	t ≤ 65	t ≤ 2½	700	100	760-895	110-130	18	---
					65 < t ≤ 100	2½ < t ≤ 4	620	90				
	700QT (100QT)	---	---	QT	t ≤ 65	t ≤ 2½	700	100	760-895	110-130	18	see standard for impact data
					65 < t ≤ 100	2½ < t ≤ 4	620	90				

3.2 Alloy Steels for Structural Steel Plates

3.2.2B Chemical Composition of Alloy Steels for Structural Steel Plates

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 4950-2:1995	E 355 DD	---	---	---	---	0.18	0.9-1.6	0.50	0.030	0.030	0.25	0.30	0.10	Nb 0.015-0.060; V 0.02-0.10; Al 0.020 min; Ti 0.02-0.20; Cu 0.35
	E 355 E	---	---	---	---	0.18	0.9-1.6	0.50	0.025	0.025	0.25	0.30	0.10	Nb 0.015-0.060; V 0.02-0.10; Al 0.020 min; Ti 0.02-0.20; Cu 0.35
ASTM A 709/A 709M-03a	50W [345W] Type A	---	---	---	---	0.19	0.80-1.25	0.30-0.65	0.04	0.05	0.40-0.65	0.40	---	Cu 0.25-0.40; V 0.02-0.10
	50W [345W] Type B	---	---	---	---	0.20	0.75-1.35	0.15-0.50	0.04	0.05	0.40-0.70	0.50	---	Cu 0.20-0.40; V 0.01-0.10
	50W [345W] Type C	---	---	---	---	0.15	0.80-1.35	0.15-0.40	0.04	0.05	0.30-0.50	0.25-0.50	---	Cu 0.20-0.50; V 0.01-0.10
ASTM A 710/A 710M-02	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
EN 10137-2:1996	S460Q	1.8908	---	---	---	0.20	1.70	0.80	0.025	0.015	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S460QL	1.8906	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S460QL1	1.8916	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
ISO 4950-3:1995	E 460 DD	---	---	---	---	0.20	0.7-1.7	0.55	0.035	0.035	see std	see std	see std	see standard
	E 460 E	---	---	---	---	0.20	0.7-1.7	0.55	0.030	0.030	see std	see std	see std	see standard
ASTM A 709/A 709M-03a	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	N 0.015; Cu 0.25-0.40; V 0.04-0.08; Al 0.010-0.040
ASTM A 710/A 710M-02	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 1.00-0.30; Cb 0.02 min
EN 10137-2:1996	S500Q	1.8924	---	---	---	0.20	1.70	0.80	0.025	0.015	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S500QL	1.8909	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S500QL1	1.8984	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
CSA G40.21-04	480WT (70WT)	---	---	≤ 65	≤ 2½	0.26	0.80-1.50	0.15-0.40	0.03	0.04	---	---	---	grain refining elements 0.10; N 0.01-0.02 if N < 0.25 Va

3.2 Alloy Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10137-3:1996	S500A	1.8980	---	3 ≤ t ≤ 70	---	0.03-0.12	0.30-1.80	0.50	0.025	0.015	0.3	2	0.5	N 0.015; Cu 2; Nb 0.060; Ti 0.10; V 0.10; Al 0.080
	S500AL	1.8990	---	3 ≤ t ≤ 70	---	0.03-0.12	0.30-1.80	0.50	0.020	0.010	0.3	2	0.5	N 0.015; Cu 2; Nb 0.060; Ti 0.10; V 0.10; Al 0.080
ASTM A 710/A 710M-02	Grade A Class 1	---	K20747	≤ 20	≤ ¾	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
ASTM A 852/A 852M-03	---	---	K12043	≤ 100	≤ 4	0.19	0.80-1.35	0.20-0.65	0.035	0.04	0.40-0.70	0.50	---	Cu 0.20-0.40; V 0.02-0.10
CSA G40.21-04	550WT (80WT)	---	---	≤ 65	≤ 2½	0.15	1.75	0.15-0.40	0.03	0.04	---	---	---	grain refining elements 0.15; N 0.01-0.02 if N < 0.25 Va
EN 10137-2:1996	S550Q	1.8904	---	---	---	0.20	1.70	0.80	0.025	0.015	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S550QL	1.8926	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S550QL1	1.8986	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
EN 10137-3:1996	S550A	1.8991	---	3 ≤ t ≤ 70	---	0.03-0.12	0.30-1.80	0.50	0.025	0.015	0.3	2	0.5	N 0.015; Cu 2; Nb 0.060; Ti 0.10; V 0.10; Al 0.080
	S550AL	1.8992	---	3 ≤ t ≤ 70	---	0.03-0.12	0.30-1.80	0.50	0.020	0.010	0.3	2	0.5	N 0.015; Cu 2; Nb 0.060; Ti 0.10; V 0.10; Al 0.080

3.2 Alloy Steels for Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10137-2:1996	S620Q	1.8914	---	---	---	0.20	1.70	0.80	0.025	0.015	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S620QL	1.8927	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S620QL1	1.8987	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
EN 10137-3:1996	S620A	1.8993	---	3 ≤ t ≤ 70	---	0.03-0.12	0.30-1.80	0.50	0.025	0.015	0.3	2	0.5	N 0.015; Cu 2; Nb 0.060; Ti 0.10; V 0.10; Al 0.080
	S620AL	1.8994	---	3 ≤ t ≤ 70	---	0.03-0.12	0.30-1.80	0.50	0.020	0.010	0.3	2	0.5	N 0.015; Cu 2; Nb 0.060; Ti 0.10; V 0.10; Al 0.080
ASTM A 514/A 514M-00a	A	---	K11856	≤ 32	≤ 1¼	0.15-0.21	0.80-1.10	0.40-0.80	0.035	0.035	0.50-0.80	---	0.18-0.28	Zr 0.05-0.15; B 0.0025
	B	---	K11630	≤ 32	≤ 1¼	0.12-0.21	0.70-1.00	0.20-0.35	0.035	0.035	0.40-0.65	---	0.15-0.25	V 0.03-0.08; Ti 0.01-0.03; B 0.0005-0.005
	C	---	K11511	≤ 32	≤ 1¼	0.10-0.20	1.10-1.50	0.15-0.30	0.035	0.035	---	---	0.15-0.30	B 0.001-0.005
	E	---	K21604	≤ 150	≤ 6	0.12-0.20	0.40-0.70	0.20-0.40	0.035	0.035	1.40-2.00	---	0.40-0.60	Ti 0.01-0.10; B 0.001-0.005
	F	---	K11576	≤ 65	≤ 2½	0.10-0.20	0.60-1.00	0.15-0.35	0.035	0.035	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
	H	---	K11646	≤ 50	≤ 2	0.12-0.21	0.95-1.30	0.20-0.35	0.035	0.035	0.40-0.65	0.30-0.70	0.20-0.30	V 0.03-0.08; B 0.0005-0.005
	J	---	K11625	≤ 32	≤ 1¼	0.12-0.21	0.45-0.70	0.20-0.35	0.035	0.035	---	---	0.50-0.65	B 0.001-0.005
	K	---	---	≤ 50	≤ 2	0.10-0.20	1.10-1.50	0.15-0.30	0.035	0.035	---	---	0.45-0.55	B 0.001-0.005
	M	---	K11683	≤ 50	≤ 2	0.12-0.21	0.45-0.70	0.20-0.35	0.035	0.035	---	1.20-1.50	0.45-0.60	B 0.001-0.005
	P	---	K21650	≤ 150	≤ 6	0.12-0.21	0.45-0.70	0.20-0.35	0.035	0.035	0.85-1.20	1.20-1.50	0.45-0.60	B 0.001-0.005
	Q	---	---	≤ 150	≤ 6	0.14-0.21	0.95-1.30	0.15-0.35	0.035	0.035	1.00-1.50	1.20-1.50	0.40-0.60	V 0.03-0.08
	R	---	---	≤ 65	≤ 2½	0.15-0.20	0.85-1.15	0.20-0.35	0.035	0.035	0.35-0.65	0.90-1.10	0.15-0.25	V 0.03-0.08
	S	---	---	≤ 65	≤ 2½	0.11-0.21	1.10-1.50	0.15-0.45	0.035	0.020	---	---	0.10-0.60	V 0.06; B 0.001-0.005; Cb0.06
	T	---	---	≤ 50	≤ 2	0.08-0.14	1.20-1.50	0.40-0.60	0.035	0.010	---	---	0.45-0.60	V 0.03-0.08; B 0.001-0.005
ASTM A 709/A 709M-03a	Gr. 100 [690] & 100W [690W] Type A	---	---	≤ 32	≤ 1¼	0.15-0.21	0.80-1.10	0.40-0.80	0.035	0.035	0.50-0.80	---	0.18-0.28	Zr 0.05-0.15; B 0.0025
	Gr. 100 [690] & 100W [690W] Type B	---	---	≤ 32	≤ 1¼	0.12-0.21	0.70-1.00	0.20-0.35	0.035	0.035	0.40-0.65	---	0.15-0.25	V 0.03-0.08; Ti 0.01-0.03; B 0.0005-0.005
	Gr. 100 [690] & 100W [690W] Type C	---	---	≤ 32	≤ 1¼	0.10-0.20	1.10-1.50	0.15-0.30	0.035	0.035	---	---	0.15-0.30	B 0.001-0.005

Note: This section continued on next page

3.2 Alloy Steels for Structural Steel Plates

3.2.2B Chemical Composition of Alloy Steel Structural Steel Plate (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 709/A 709M-03a (Continued)	Gr. 100 [690] & 100W [690W] Type E	---	---	≤ 100	≤ 4	0.12-0.20	0.40-0.70	0.20-0.40	0.035	0.035	1.40-2.00	---	0.40-0.60	Ti 0.01-0.10; B 0.001-0.005
	Gr. 100 [690] & 100W [690W] Type F	---	---	≤ 65	≤ 2½	0.10-0.20	0.60-1.00	0.15-0.35	0.035	0.035	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
	Gr. 100 [690] & 100W [690W] Type H	---	---	≤ 50	≤ 2	0.12-0.21	0.95-1.30	0.20-0.35	0.035	0.035	0.40-0.65	0.30-0.70	0.20-0.30	V 0.03-0.08; B 0.0005-0.005
	Gr. 100 [690] & 100W [690W] Type J	---	---	≤ 32	≤ 1¼	0.12-0.21	0.45-0.70	0.20-0.35	0.035	0.035	---	---	0.50-0.65	B 0.001-0.005
	Gr. 100 [690] & 100W [690W] Type M	---	---	≤ 50	≤ 2	0.12-0.21	0.45-0.70	0.20-0.35	0.035	0.035	---	1.20-1.50	0.45-0.60	B 0.001-0.005
	Gr. 100 [690] & 100W [690W] Type P	---	---	≤ 100	≤ 4	0.12-0.21	0.45-0.70	0.20-0.35	0.035	0.035	0.85-1.20	1.20-1.50	0.45-0.60	B 0.001-0.005
	Gr. 100 [690] & 100W [690W] Type Q	---	---	≤ 100	≤ 4	0.14-0.21	0.95-1.30	0.15-0.35	0.035	0.035	1.00-1.50	1.20-1.50	0.40-0.60	V 0.03-0.08
EN 10137-3:1996	S690A	1.8995	---	3 ≤ t ≤ 70	---	0.03-0.12	0.30-1.80	0.50	0.025	0.015	0.3	2	0.5	N 0.015; Cu 2; Nb 0.060; Ti 0.10; V 0.10; Al 0.080
	S690AL	1.8996	---	3 ≤ t ≤ 70	---	0.03-0.12	0.30-1.80	0.50	0.020	0.010	0.3	2	0.5	N 0.015; Cu 2; Nb 0.060; Ti 0.10; V 0.10; Al 0.080
EN 10137-2:1996	S690Q	1.8931	---	---	---	0.20	1.70	0.80	0.025	0.015	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S690QL	1.8928	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S690QL1	1.8988	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
JIS G 3128:1999	SHY 685	---	---	6 ≤ t ≤ 100	---	0.18	1.50	0.55	0.03	0.025	1.20	---	0.60	Cu 0.50; V 0.10; B 0.005
	SHY 685 N	---	---	6 ≤ t ≤ 100	---	0.18	1.50	0.55	0.030	0.025	0.80	0.30-1.50	0.60	Cu 0.50; V 0.10; B 0.005
	SHY 685 NS	---	---	6 ≤ t ≤ 100	---	0.14	1.50	0.55	0.015	0.015	0.80	0.30-1.50	0.60	Cu 0.50; V 0.05; B 0.005
CSA G40.21-04	700Q (100Q)	---	---	---	---	0.20	1.50	0.15-0.40	0.03	0.04	---	---	---	B 0.0005-0.005
	700QT (100QT)	---	---	---	---	0.20	1.50	0.15-0.40	0.03	0.04	---	---	---	B 0.0005-0.005

3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ISO 5952:1998	Gr. HSA 235W Class B, D	---	---	HR	< 3	---	235	---	360-510	---	20	---
					≥ 3	---	235	---	340-470	---	22	---
EN 10155:1993	S235J0W	1.8958	---	HR	t ≤ 3	---	235	---	360-510	---	---	27 J at 0°C
					3 < t ≤ 16	---	235	---	340-470	---	26	
					16 < t ≤ 40	---	225	---			26	
					40 < t ≤ 63	---	215	---			25	
					63 < t ≤ 80	---	215	---			24	
					80 < t ≤ 100	---	215	---			24	
	S235J2W	1.8961	---	N	t ≤ 3	---	235	---	360-510	---	---	27 J at -20°C
					3 < t ≤ 16	---	235	---	340-470	---	24	
					16 < t ≤ 40	---	225	---			24	
					40 < t ≤ 63	---	215	---			23	
					63 < t ≤ 80	---	215	---			22	
					80 < t ≤ 100	---	215	---			22	
ISO 4952:2003	Gr. Fe 235W Quality B	---	---	AR	t < 16	---	235	---	340-470	---	26	27 J at 20°C
					16 < t ≤ 40	---	225	---			26	
					40 < t ≤ 63	---	215	---			25	
	Gr. Fe 235W Quality C	---	---	AR	t < 16	---	235	---	340-470	---	26	27 J at 0°C
					16 < t ≤ 40	---	225	---			26	
					40 < t ≤ 63	---	215	---			25	
	Gr. Fe 235W Quality D	---	---	AR or N	t < 16	---	235	---	340-470	---	26	27 J at -20°C
					16 < t ≤ 40	---	225	---			26	
					40 < t ≤ 63	---	215	---			25	

3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ISO 5952:1998	Gr. HSA 245W Class B, D	---	---	HR	< 3	---	245	---	400-540	---	20	---
					≥ 3	---	245	---	400-540	---	22	---
JIS G 3114:1998	SMA400AW	---	---	HR	≤ 16	---	245 max	---	400-540	---	17	---
					16 < t ≤ 40	---	235 max	---			21	
					40 < t ≤ 100	---	215 max	---			23	
					100 < t ≤ 160	---	205 max	---				
					160 < t ≤ 200	---	195 max	---				
	SMA400BW	---	---	HR	≤ 16	---	245 max	---	400-540	---	17	27 J at 0°C
					16 < t ≤ 40	---	235 max	---			21	
					40 < t ≤ 100	---	215 max	---			23	
					100 < t ≤ 160	---	205 max	---				
					160 < t ≤ 200	---	195 max	---				
	SMA400CW	---	---	HR	≤ 16	---	245 max	---	400-540	---	17	47 J at 0°C
					16 < t ≤ 40	---	235 max	---			21	
					40 < t ≤ 100	---	215 max	---			23	
	SMA400AP	---	---	HR	≤ 16	---	245 max	---	400-540	---	17	---
					16 < t ≤ 40	---	235 max	---			21	
					40 < t ≤ 100	---	215 max	---			23	
					100 < t ≤ 160	---	205 max	---				
					160 < t ≤ 200	---	195 max	---				
	SMA400BP	---	---	HR	≤ 16	---	245 max	---	400-540	---	17	27 J at 0°C
					16 < t ≤ 40	---	235 max	---			21	
					40 < t ≤ 100	---	215 max	---			23	
					100 < t ≤ 160	---	205 max	---				
					160 < t ≤ 200	---	195 max	---				
	SMA400CP	---	---	HR	≤ 16	---	245 max	---	400-540	---	17	47 J at 0°C
					16 < t ≤ 40	---	235 max	---			21	
					40 < t ≤ 100	---	215 max	---			23	

3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
JIS G 3125:1987	SPA-C	---	---	CR	---	---	315	---	450	---	26	---
ISO 4952:2003	Gr. Fe 355W Quality 2B	---	---	AR	t < 16	---	355	---	470 - 630	---	22	27 J at 20°C
					16 < t ≤ 40	---	345	---			22	
					40 < t ≤ 63	---	335	---			21	
	Gr. Fe 355W Quality 2C	---	---	AR	t < 16	---	355	---	470 - 630	---	22	27 J at 0°C
					16 < t ≤ 40	---	345	---			22	
					40 < t ≤ 63	---	335	---			21	
	Gr. Fe 355W Quality 2D	---	---	AR or N	t < 16	---	355	---	470 - 630	---	22	27 J at -20°C
					16 < t ≤ 40	---	345	---			22	
					40 < t ≤ 63	---	335	---			21	
ASTM A 606-01	Type 2 and Type 4	---	---	HR	---	---	340	50	480	70	22	---
				HR, A or N	---	---	310	45	450	65	22	---
				CR	---	---	310	45	450	65	22	---
ISO 4952:2003	Gr. Fe 355W Quality 1A	---	---	AR	t < 12	---	355	---	470 - 630	---	21	---
	Gr. Fe 355W Quality 1D	---	---	AR or N	t < 12	---	355	---	470 - 630	---	21	27 J at -20°C
CSA G40.21-04	350R (50R)	---	---	---	≤ 65	≤ 2½	350	50	480-650	70-95	21	---
	350A (50A)	---	---	---	≤ 100	≤ 4	350	50	480-650	70-95	21	
	350AT (50AT)	---	---	---	≤ 100	≤ 4	350	50	480-650	70-95	21	see standard for impact data
JIS G 3125:1987	SPA-H	---	---	HR	≤ 6.0	---	345	---	480	---	22	---
					> 6.0	---	355	---			15	
JIS G 3114:1998	SMA490AW	---	---	HR	≤ 16	---	365 max	---	490-610	---	15	---
					16 < t ≤ 40	---	355 max	---			19	
					40 < t ≤ 75	---	335 max	---			21	
					75 < t ≤ 100	---	325 max	---			21	
					100 < t ≤ 160	---	305 max	---			21	
					160 < t ≤ 200	---	295 max	---			21	

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3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3114:1998 (Continued)	SMA490AP	---	---	HR	≤ 16	---	365 max	---	490-610	---	15	---
					16 < t ≤ 40	---	355 max	---			19	
					40 < t ≤ 75	---	335 max	---			21	
					75 < t ≤ 100	---	325 max	---			21	
					100 < t ≤ 160	---	305 max	---			21	
					160 < t ≤ 200	---	295 max	---			21	
	SMA490BW	---	---	HR	≤ 16	---	365 max	---	490-610	---	15	27 J at 0°C
					16 < t ≤ 40	---	355 max	---			19	
					40 < t ≤ 75	---	335 max	---			21	
					75 < t ≤ 100	---	325 max	---			21	
					100 < t ≤ 160	---	305 max	---			21	
					160 < t ≤ 200	---	295 max	---			21	
	SMA490BP	---	---	HR	≤ 16	---	365 max	---	490-610	---	15	27 J at 0°C
					16 < t ≤ 40	---	355 max	---			19	
					40 < t ≤ 75	---	335 max	---			21	
					75 < t ≤ 100	---	325 max	---			21	
					100 < t ≤ 160	---	305 max	---			21	
					160 < t ≤ 200	---	295 max	---			21	
	SMA490CW	---	---	HR	≤ 16	---	365 max	---	490-610	---	15	47 J at 0°C
					16 < t ≤ 40	---	355 max	---			19	
					40 < t ≤ 75	---	335 max	---			21	
					75 < t ≤ 100	---	325 max	---			21	
	SMA490CP	---	---	HR	≤ 16	---	365 max	---	490-610	---	15	47 J at 0°C
					16 < t ≤ 40	---	355 max	---			19	
					40 < t ≤ 75	---	335 max	---			21	
					75 < t ≤ 100	---	325 max	---			21	
ISO 5952:1998	Gr. HSA 365W Class B, D	---	---	HR	< 3	---	365	---	490-610	---	15	---
					≥ 3	---	365	---			19	

3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10155:1993	S355J0WP	1.8945	---	HR	t ≤ 3	---	355	---	510-680	---	---	27 J at 0°C
					3 < t ≤ 16		355		490-630		20	
					16 < t ≤ 40		345				20	
					40 < t ≤ 100		345				---	
	S355J2WP	1.8946	---	N	t ≤ 3	---	355	---	510-680	---	---	27 J at 0°C
					3 < t ≤ 16		355		490-630		20	
					16 < t ≤ 40		345				20	
					40 < t ≤ 100		345				---	
	S355J0W	1.8959	---	HR	t ≤ 3	---	355	---	510-680	---	---	27 J at 0°C
					3 < t ≤ 16	---	355	---	490-630	---	20	
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---			18	
	S355J2G1W	1.8963	---	N	t ≤ 3	---	355	---	510-680	---	---	27 J at -20°C
					3 < t ≤ 16	---	355	---	490-630	---	20	
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---			18	
	S355J2G2W	1.8965	---	HR	t ≤ 3	---	355	---	510-680	---	---	27 J at -20°C
					3 < t ≤ 16	---	355	---	490-630	---	20	
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---			18	
	S355K2G1W	1.8966	---	N	t ≤ 3	---	355	---	510-680	---	---	40 J at -20°C
					3 < t ≤ 16	---	355	---	490-630	---	20	
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---			18	

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3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10155:1993 (Continued)	S355K2G2W	1.8967	---	HR	t ≤ 3	---	355	---	510-680	---	---	40 J at -20°C
					3 < t ≤ 16	---	355	---	490-630	---	20	
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---			18	
ISO 5952:1998	Gr. HSA355W1 Class A, D	---	---	HR	< 3	---	355	---	510-680	---	15	---
					≥ 3	---			490-630	---	19	
	Gr. HSA355W2 Class C, D	---	---	HR	< 3	---	355	---	510-680	---	18	---
					≥ 3	---			490-630	---	22	
ASTM A 871/A 871M-03	60 [415]	---	---	HR, N or QT	≤ 12	≤ ½	415	60	520	75	18	20 J at -18°C
					> 12	> ½	415	60	520	75	18	20 J at -29°C
CSA G40.21-04	400A (60A)	---	---	---	≤ 65	≤ 2½	400	60	520-690	75-100	21	---
	400AT (60AT)	---	---	---	≤ 65	≤ 2½	400	60	520-690	75-100	21	see standard for impact data
ASTM A 871/A 871M-03	65 [450]	---	---	HR, N or QT	≤ 12	≤ ½	450	65	550	80	17	20 J at -18°C
					> 12	> ½	450	65	550	80	17	20 J at -29°C
JIS G 3114:1998	SMA570W	---	---	HR	≤ 16	---	460 max	---	570-720	---	19	47 J at -5°C
					16 < t ≤ 40	---	450 max	---			26	
					40 < t ≤ 75	---	430 max	---			20	
					75 < t ≤ 100	---	420 max	---			20	
	SMA570P	---	---	HR	≤ 16	---	460 max	---	570-720	---	19	47 J at -5°C
					16 < t ≤ 40	---	450 max	---			26	
					40 < t ≤ 75	---	430 max	---			20	
					75 < t ≤ 100	---	420 max	---			20	
CSA G40.21-04	480A (70A)	---	---	---	≤ 65	≤ 2½	480	70	590-790	85-115	17	---
	480AT (70AT)	---	---	---	≤ 65	≤ 2½	480	70	590-790	85-115	17	see standard for impact data
	550A (80A)	---	---	---	≤ 65	≤ 2½	550	80	620-860	90-125	15	---
	550AT (80AT)	---	---	---	≤ 65	≤ 2½	550	80	620-860	90-125	15	see standard for impact data

3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 5952:1998	Gr. HSA 235W Class B	---	---	---	---	0.13	0.20-0.60	0.10-0.40	0.040	0.035	0.40-0.80	0.65	---	Cu 0.25-0.55
	Gr. HSA 235W Class D	---	---	---	---	0.13	0.20-0.60	0.10-0.40	0.040	0.035	0.40-0.80	0.65	---	Cu 0.25-0.55; Al 0.020 min
EN 10155:1993	S235J0W	1.8958	---	≤ 100	---	0.13	0.20-0.60	0.40	0.040	0.040	0.40-0.80	0.65	---	N 0.009; Cu 0.25-0.55
	S235J2W	1.8961	---	≤ 100	---	0.13	0.20-0.60	0.40	0.040	0.035	0.40-0.80	0.65	---	Cu 0.25-0.55; N binding el.
ISO 4952:2003	Gr. Fe 235W Quality B	---	---	---	---	0.13	0.20-0.60	0.10-0.40	0.040	0.035	0.40-0.80	0.65	---	Cu 0.20-0.55
	Gr. Fe 235W Quality C	---	---	---	---	0.13	0.20-0.60	0.10-0.40	0.040	0.035	0.40-0.80	0.65	---	Cu 0.20-0.55; grain-refining el.
	Gr. Fe 235W Quality D	---	---	---	---	0.13	0.20-0.60	0.10-0.40	0.040	0.035	0.40-0.80	0.65	---	Cu 0.20-0.55; grain-refining el.
ISO 5952:1998	HSA 245W-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 Total
	HSA 245W-D	---	---	---	---	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; Al 0.020 min; Mo+Nb+Ti+V+Zr 0.15 Total
JIS G 3114:1998	SMA400AW	---	---	≤ 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
	SMA400BW	---	---	≤ 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
	SMA400CW	---	---	≤ 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
	SMA400AP	---	---	≤ 200	---	0.18	1.25	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35
	SMA400BP	---	---	≤ 200	---	0.18	1.25	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35
	SMA400CP	---	---	≤ 100	---	0.18	1.25	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35

3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3125:1987	SPA-C	---	---	0.6 ≤ t ≤ 2.3	---	0.12	0.20-0.50	0.25-0.75	0.070-0.150	0.040	0.30-1.25	0.65	---	Cu 0.25-0.60
ISO 4952:2003	Gr. Fe 355W Quality 2B	---	---	---	---	0.19	0.50-1.50	0.50	0.040	0.035	0.40-0.80	0.65	0.30	Cu 0.20-0.55; Zr 0.15
	Gr. Fe 355W Quality 2C	---	---	---	---	0.19	0.50-1.50	0.50	0.040	0.035	0.40-0.80	0.65	0.30	Cu 0.20-0.55; Zr 0.15; grain-refining elements
	Gr. Fe 355W Quality 2D	---	---	---	---	0.19	0.50-1.50	0.50	0.040	0.035	0.40-0.80	0.65	0.30	Cu 0.20-0.55; Zr 0.15; grain-refining elements
ASTM A 606-01	2	---	---	---	---	0.22	1.25	---	---	0.04	---	---	---	Cu 0.20 min; others as required
	4	---	---	---	---	0.22	1.25	---	---	0.04	---	---	---	Others as required
ISO 4952:2003	Gr. Fe 355W Quality 1A	---	---	---	---	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
	Gr. Fe 355W Quality 1D	---	---	---	---	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; grain-refining elements
CSA G40.21-04	350R (50R)	---	---	---	---	0.16	0.75	0.75	0.05-0.15	0.04	0.30-1.25	0.90	---	grain refining elements 0.10; Cu 0.20-0.60
	350A (50A)	---	---	---	---	0.20	0.75-1.35	0.15-0.50	0.03	0.04	0.70	0.90	---	grain refining elements 0.10; Cu 0.20-0.60
	350AT (50AT)	---	---	---	---	0.20	0.75-1.35	0.15-0.50	0.03	0.04	0.70	0.90	---	grain refining elements 0.10; Cu 0.20-0.60
JIS G 3125:1987	SPA-H	---	---	≤ 16	---	0.12	0.20-0.50	0.25-0.75	0.070-0.150	0.040	0.30-1.25	0.65	---	Cu 0.25-0.60
JIS G 3114:1998	SMA490AW	---	---	≤ 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
	SMA490AP	---	---	≤ 200	---	0.18	1.40	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35
	SMA490BW	---	---	≤ 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
	SMA490BP	---	---	≤ 200	---	0.18	1.40	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35
	SMA490CW	---	---	≤ 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
	SMA490CP	---	---	≤ 100	---	0.18	1.40	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35
ISO 5952:1998	Gr. 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 Total
	Gr. HSA 365W Class D	---	---	---	---	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; Al 0.020 min; Mo+Nb+Ti+V+Zr 0.15 Total

3.3 Structural Steels with Improved Atmospheric Corrosion Resistance

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10155:1993	S355J0WP	1.8945	---	≤ 12	---	0.12	1.0	0.75	0.06-0.15	0.040	0.30-1.25	0.65	---	N 0.009; Cu 0.25-0.55
	S355J2WP	1.8946	---	≤ 12	---	0.12	1.0	0.75	0.06-0.15	0.035	0.30-1.25	0.65	---	Cu 0.25-0.55; N binding el.
	S355J0W	1.8959	---	≤ 100	---	0.16	0.50-1.50	0.50	0.040	0.040	0.40-0.80	0.65	---	N 0.009; Cu 0.25-0.55; Mo 0.30; Zr 0.15
	S355J2G1W	1.8963	---	≤ 100	---	0.16	0.50-1.50	0.50	0.035	0.035	0.40-0.80	---	---	Cu 0.25-0.55; N binding el.
	S355J2G2W	1.8965	---	≤ 100	---	0.16	0.50-1.50	0.50	0.035	0.035	0.40-0.80	---	---	Cu 0.25-0.55; N binding el.
	S355K2G1W	1.8966	---	≤ 100	---	0.16	0.50-1.50	0.50	0.035	0.035	0.40-0.80	---	---	Cu 0.25-0.55; N binding el.
	S355K2G2W	1.8967	---	≤ 100	---	0.16	0.50-1.50	0.50	0.035	0.035	0.40-0.80	---	---	Cu 0.25-0.55; N binding el.
ISO 5952:1998	HSA 355W1-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
	HSA 355W1-D	---	---	---	---	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; Al 0.020 min
	HSA 355W2-C	---	---	---	---	0.16	0.50-1.50	0.50	0.035	0.035	0.40-0.80	0.65	0.30	Cu 0.25-0.55; Zr 0.15
	HSA 355W2-D	---	---	---	---	0.16	0.50-1.50	0.50	0.035	0.035	0.40-0.80	0.65	0.30	Cu 0.25-0.55; Zr 0.15; Al 0.020 min
ASTM A 871/A 871M-03	Gr. 65 Type I	---	---	---	---	0.19	0.80-1.35	0.30-0.65	0.04	0.05	0.40-0.70	0.40	---	Cu 0.25-0.40; V 0.02-0.10
	Gr. 65 Type II	---	---	---	---	0.20	0.75-1.35	0.15-0.50	0.04	0.05	0.40-0.70	0.50	---	Cu 0.20-0.40; V 0.01-0.10
	Gr. 65 Type III	---	---	---	---	0.15	0.80-1.35	0.15-0.40	0.04	0.05	0.30-0.50	0.25-0.50	---	Cu 0.20-0.50; V 0.01-0.10
	Gr. 65 Type IV	---	---	---	---	0.17	0.50-1.20	0.25-0.50	0.04	0.05	0.40-0.70	0.40	0.10	Cu 0.30-0.50; Cb 0.005-0.05
CSA G40.21-04	400A (60A)	---	---	---	---	0.20	0.75-1.35	0.15-0.50	0.03	0.04	0.70	0.90	---	grain refining elements 0.10; Cu 0.20-0.60
	400AT (60AT)	---	---	---	---	0.20	0.75-1.35	0.15-0.50	0.03	0.04	0.70	0.90	---	grain refining elements 0.10; Cu 0.20-0.60
ASTM A 871/A 871M-03	Gr. 65 Type I	---	---	---	---	0.19	0.80-1.35	0.30-0.65	0.04	0.05	0.40-0.70	0.40	---	Cu 0.25-0.40; V 0.02-0.10
	Gr. 65 Type II	---	---	---	---	0.20	0.75-1.35	0.15-0.50	0.04	0.05	0.40-0.70	0.50	---	Cu 0.20-0.40; V 0.01-0.10
	Gr. 65 Type III	---	---	---	---	0.15	0.80-1.35	0.15-0.40	0.04	0.05	0.30-0.50	0.25-0.50	---	Cu 0.20-0.50; V 0.01-0.10
	Gr. 65 Type IV	---	---	---	---	0.17	0.50-1.20	0.25-0.50	0.04	0.05	0.40-0.70	0.40	0.10	Cu 0.30-0.50; Cb 0.005-0.05
JIS G 3114:1998	SMA570W	---	---	≤ 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
	SMA570P	---	---	≤ 100	---	0.18	1.40	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35
CSA G40.21-04	480A (70A)	---	---	---	---	0.20	1.00-1.60	0.15-0.50	0.025	0.035	0.70	0.25-0.50	---	grain refining elements 0.12; Cu 0.20-0.60
	480AT (70AT)	---	---	---	---	0.20	1.00-1.60	0.15-0.50	0.025	0.035	0.70	0.25-0.50	---	grain refining elements 0.12; Cu 0.20-0.60
	550A (80A)	---	---	---	---	0.15	1.75	0.15-0.50	0.025	0.035	0.70	0.25-0.50	---	grain refining elements 0.15; Cu 0.20-0.60
	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

3.4 Non-Comparable Carbon Steels for Structural Steel Plates

ASTM A 678/A 678M-00a Quenched-and-Tempered Carbon and High-Strength Low-Alloy Structural Steel Plates													
Grade, Class, Type Symbol or Name	D	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K12202	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 709/A 709M-03a Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges													
Grade, Class, Type Symbol or Name	50S [345S]	HPS 50W [HPS 345W]	---	---	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 1011/A 1011M-03 Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability													
Grade, Class, Type Symbol or Name	45 [310] Class 2	70 [480] Class 1	CS Type A	CS Type B	CS Type C	DS Type A	DS Type B	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---	---
ISO 4950-2:1995 High Yield Strength Flat Steel Products - Part 2: Products Supplied in the Normalized or Controlled Rolled Condition													
Grade, Class, Type Symbol or Name	E 460 CC	E 460 DD	E 460 E	---	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---	---
ISO 4950-3:1995 High Yield Strength Flat Steel Products - Part 3: Products Supplied in the Heat-treated (Quenched + Tempered) Condition													
Grade, Class, Type Symbol or Name	E 550 DD	E 550 E	E 690 DD	E 690 E	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---	---

3.5 Non-Comparable Alloy Steels for Structural Steel Plates

ASTM A 656/A 656M-03 Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability												
Grade, Class, Type Symbol or Name	80	---	---	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 710/A 710M-02 Precipitation-Strengthened Low-Carbon Nickel-Copper-Chromium-Molybdenum-Columbium Alloy Structural Steel Plates												
Grade, Class, Type Symbol or Name	Grade B	---	---	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
CSA G40.21-04 Structural Quality Steel												
Grade, Class, Type Symbol or Name	480W (70W)	550W (80W)	---	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
EN 10113-2:1998 Hot-rolled Products in Weldable Fine Grain Structural Steels - Part 2: Delivery Conditions for Normalized/Normalized Rolled Steels												
Grade, Class, Type Symbol or Name	S275N	S275NL	S420N	S420NL	S460N	S460NL	---	---	---	---	---	---
Steel Number	1.0490	1.0491	1.8902	1.8912	1.8901	1.8903	---	---	---	---	---	---
EN 10113-3:1993 Hot-rolled Products in Weldable Fine Grain Structural Steels - Part 3: Delivery Conditions for Thermomechanical Rolled Steels												
Grade, Class, Type Symbol or Name	S275M	S275ML	S460M	S460ML	---	---	---	---	---	---	---	---
Steel Number	1.8818	1.8819	1.8827	1.8838	---	---	---	---	---	---	---	---
EN 10137-2:1996 Plates and Wide Flats Made of High Yield Strength Structural Steels in the Quenched and Tempered or Precipitation Hardened Conditions - Part 2: Delivery Conditions for Quenched and Tempered Steels												
Grade, Class, Type Symbol or Name	S890Q	S890QL	S890QL1	S960Q	S960QL	---	---	---	---	---	---	---
Steel Number	1.8940	1.8983	1.8925	1.8941	1.8933	---	---	---	---	---	---	---

Chapter 4

PRESSURE VESSEL STEEL PLATES

ASTM Standards

ASTM A 202/A 202M-03	Pressure Vessel Plates, Alloy Steel, Chromium-Manganese-Silicon
ASTM A 203/A 203M-97 (2003)	Pressure Vessel Plates, Alloy Steel, Nickel
ASTM A 204/A 204M-03	Pressure Vessel Plates, Alloy Steel, Molybdenum
ASTM A 225/A 225M-03	Pressure Vessel Plates, Alloy Steel, Manganese-Vanadium-Nickel
ASTM A 240/A 240M-03c	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A 285/A 285M-03	Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength
ASTM A 299/A 299M-02	Pressure Vessel Plates, Carbon Steel, Manganese-Silicon
ASTM A 302/A 302M-03	Pressure Vessel Plates, Alloy Steel, Manganese-Molybdenum and Manganese-Molybdenum-Nickel
ASTM A 353/A 353M-93 (1999)	Pressure Vessel Plates, Alloy Steel, 9 Percent Nickel, Double-Normalized and Tempered
ASTM A 387/A 387M-03	Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
ASTM A 455/A 455M-03	Pressure Vessel Plates, Carbon Steel, High Strength Manganese
ASTM A 515/A 515M-03	Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516/A 516M-01	Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 517/A 517M-93 (1999)	Pressure Vessel Plates, Alloy Steel, High-Strength, Quenched and Tempered,
ASTM A 533/A 533M-93 (1999)	Pressure Vessel Plates, Alloy Steel, Quenched and Tempered, Manganese-Molybdenum and Manganese-Molybdenum-Nickel
ASTM A 537/A 537M-95 (2000)	Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel
ASTM A 542/A 542M-99	Pressure Vessel Plates, Alloy Steel, Quenched-and-Tempered, Chromium-Molybdenum, and Chromium-Molybdenum-Vanadium
ASTM A 543/A 543M-93 (1999)	Pressure Vessel Plates, Alloy Steel, Quenched and Tempered Nickel-Chromium-Molybdenum
ASTM A 553/A 553M-95 (2000)	Pressure Vessel Plates, Alloy Steel, Quenched and Tempered 8 and 9 Percent Nickel
ASTM A 562/A 562M-90 (2001)	Pressure Vessel Plates, Carbon Steel, Manganese-Titanium for Glass or Diffused Metallic Coatings
ASTM A 612/A 612M-03	Pressure Vessel Plates, Carbon Steel, High Strength, for Moderate and Lower Temperature Service
ASTM A 645/A 645M-99a	Pressure Vessel Plates, Five Percent Nickel Alloy Steel, Specially Heat Treated
ASTM A 662/A 662M-03	Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service
ASTM A 724/A 724M-99	Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, Quenched and Tempered, for Welded Layered Pressure Vessels
ASTM A 734/A 734 M-87a (2003)	Pressure Vessel Plates, Alloy Steel and High-Strength Low-Alloy Steel, Quenched-and-Tempered
ASTM A 735/A 735M-03	Pressure Vessel Plates, Low-Carbon Manganese-Molybdenum-Columbium Alloy Steel, for Moderate and Lower Temperature Service
ASTM A 736/A 736M-03	Pressure Vessel Plates, Low-Carbon Age-Hardening Nickel-Copper-Chromium-Molybdenum-Columbium and Nickel-Copper-Manganese-Molybdenum-Columbium Alloy Steel
ASTM A 737/A 737M-99	Pressure Vessel Plates, High-Strength, Low-Alloy Steel
ASTM A 738/A 738M-03a	Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service
ASTM A 782/A 782M-90 (2001)	Pressure-Vessel Plates, Quenched-and-Tempered, Manganese-Chromium-Molybdenum-Silicon Zirconium Alloy Steel
ASTM A 832/A 832M-99	Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum-Vanadium
ASTM A 841/A 841M-03a	Steel Plates for Pressure Vessels, Produced by Thermo-Mechanical Control Process (TMCP)
ASTM A 844/A 844M-93 (1999)	Steel Plates, 9 % Nickel Alloy, for Pressure Vessels, Produced by the Direct-Quenching Process

JIS Standards

JIS G 3103:1987	Carbon Steel and Molybdenum Alloy Steel Plates for Boilers and Other Pressure Vessels
JIS G 3115:2000	Steel Plates for Pressure Vessels for Intermediate Temperature Service
JIS G 3115-1:1995	Steel Plates for Pressure Vessels for Intermediate Temperature Service-Part 1: Thicker Plates
JIS G 3118:2000	Carbon Steel Plates for Pressure Vessels for Intermediate and Moderate Temperature Service
JIS G 3119:1987	Manganese-Molybdenum Alloy and Manganese-Molybdenum-Nickel Alloy Steel Plates for Boilers and Other Pressure Vessels
JIS G 3120:1987	Manganese-Molybdenum and Manganese-Molybdenum-Nickel Alloy Steel Plates Quenched and Tempered for Pressure Vessels
JIS G 3124:1987	High Strength Steel Plates for Pressure Vessel for Intermediate and Moderate Temperature Service
JIS G 3126:2000	Carbon Steel Plates for Pressure Vessels for Low Temperature Service
JIS G 3127:2000	Nickel Steel Plates for Pressure Vessels for Low Temperature Service
JIS G 4109:1987	Chromium-Molybdenum Alloy Steel Plates for Boilers and Pressure Vessels
JIS G 4110:1993	High Strength Chromium-Molybdenum Alloy Steel Plates for Pressure Vessels Under High-Temperature Service

CEN Standards

EN 10028-2:2003	Flat Products Made of Steels for Pressure Purposes - Part 2: Non-Alloy and Alloy Steels With Specified Elevated Temperature Properties
EN 10028-3:2003	Flat Products Made of Steels for Pressure Purposes - Part 3: Weldable Fine Grain Steels, Normalized
EN 10028-4:2003	Flat Products Made of Steels for Pressure Purposes - Part 4: Nickel Alloy Steels With Specified Low Temperature Properties
EN 10028-5:2003	Flat Products Made of Steels for Pressure Purposes - Part 5: Weldable Fine Grain Steels, Thermomechanically Rolled
EN 10028-6:2003	Flat Products Made of Steels for Pressure Purposes - Part 6: Weldable Fine Grain Steels, Quenched and Tempered
EN 10028-7:2000	Flat Products Made of Steels for Pressure Purposes - Part 7: Stainless Steels

ISO Standards

ISO 9328-2:1991	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 9328-3:1991	Steel Plates and Strips for Pressure Purposes - Technical Delivery Conditions - Part 3: Nickel-Alloyed Steels With Specified Low Temperature Properties
ISO 9328-4:1991	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 9328-5:1991	Steel Plates and Strips for Pressure Purposes - Technical Delivery Conditions - Part 5: Austenitic Steels

Heat Treatment Terms Applicable to this Chapter

Standard	Heat Treatment Terms
ASTM A 203/A 203M-97 (2003)	N: normalized; QT: quenched and tempered
ASTM A 204/A 204M-03	AR: as-rolled; N: normalized
ASTM A 240/A 240M-03c	See standard
ASTM A 302/A 302M-03	AR: as-rolled; N: normalized
ASTM A 353/A 353M-93 (1999)	NNT: double-normalized and tempered
ASTM A 387/A 387M-03	A: annealed; NT: normalized and tempered
ASTM A 515/A 515M-03	AR: as-rolled; N: normalized
ASTM A 516/A 516M-03	AR: as-rolled; N: normalized
ASTM A 533/A 533M-93 (1999)	QT: quenched and tempered
ASTM A 537/A 537M-95	N: normalized; QT: quenched and tempered
ASTM A 553/A 553M-93	QT: quenched and tempered
ASTM A 612/A 612M-03	AR: as-rolled
ASTM A 662/A 662M-03	AR: as-rolled; N: normalized
ASTM A 737/A 737M-99	N: normalized
ASTM A 738/A 738M-03a	N: normalized; QT: quenched and tempered
ASTM A 841/A 841M-03a	TMCP: thermo-mechanical control process
ASTM A 844/A 844M-93 (1999)	Direct QT: direct quenched and tempered (quenched directly after rolling)
JIS G 3103:1987	AR: as-rolled; N: normalized
JIS G 3115:2000	AR: as-rolled
JIS G 3115-1:1995	AR: as-rolled
JIS G 3118:2000	AR: as-rolled; N: normalized
JIS G 3119:1987	AR: as-rolled; N: normalized
JIS G 3120:1987	QT: quenched and tempered
JIS G 3124:1987	R: as-rolled; N: normalized; NT: normalized and tempered; P: annealed
JIS G 3126:2000	N: normalized; QT: quench hardened and tempered; TMCP: thermo-mechanical control process
JIS G 3127:2000	N: normalized; QT: quench hardened and tempered; NNT: double normalized and tempered
JIS G 4109:1987	A: annealed; NT: normalized and tempered
JIS G 4110:1993	NT: normalized and tempered; QT: quench and tempered
EN 10028-2:2003	N: normalized; T: tempered; QA: air quenched; QL: liquid quenched
EN 10028-3:2003	N: normalized
EN 10028-4:2003	N: normalized; NT: normalized and tempered; NNT: double normalized and tempered; QT: quenched and tempered; HT640: NNT or QT (tempering at specified temperature); HT680: quenched followed by tempering at specified temperature
EN 10028-5:2003	TMCP: thermo-mechanical control process
EN 10028-6:2003	QT: quenched and tempered
EN 10028-7:2000	CR St, A: cold-rolled strip, annealed; HR St, A: hot-rolled strip, annealed; AT: solution annealed; HR Pl, A: hot-rolled plate, annealed; HR Pl, QT: hot-rolled plate, quenched and tempered
ISO 9328-2:1991	N: normalized; NT: normalized and tempered
ISO 9328-3:1991	N: normalized; NT: normalized and tempered; NNT: double-normalized and tempered; QT: quenched and tempered
ISO 9328-4:1991	N: normalized; N(+T): normalized and (if appropriate) tempered
ISO 9328-5:1991	Q: quenched

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10028-2:2003	P235GH	1.0345	---	N	≤ 16	---	235	---	360-480	---	24	27 J at 0°C
					16 < t ≤ 40	---	225	---		---	24	
					40 < t ≤ 60	---	215	---		---	24	
					60 < t ≤ 100	---	200	---		---	24	
					100 < t ≤ 150	---	185	---	350-480	---	24	
					150 < t ≤ 250	---	170	---	340-480	---	24	
ISO 9328-2:1991	P 235 PH 235	---	---	N	3 ≤ t ≤ 16	---	235	---	360-480	---	25	27 J at 0°C
					16 < t ≤ 40	---	225	---		---	25	
					40 < t ≤ 60	---	215	---		---	25	
					60 < t ≤ 100	---	200	---		---	24	
					100 < t ≤ 150	---	185	---	350-480	---	24	

4.1 Carbon Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10028-3:2003	P275NH	1.0487	---	N	≤ 16	---	275	---	390-510	---	24	see standard for impact data
					16 < t ≤ 40	---	265	---				
					40 < t ≤ 60	---	255	---				
					60 < t ≤ 100	---	235	---	370-490	---	23	
					100 < t ≤ 150	---	225	---	360-480			
					150 < t ≤ 250	---	215	---	350-470			
JIS G 3115:2000	SPV235	---	---	AR	6 ≤ t ≤ 50	---	235	---	400-510	---	≤16 mm: 17 >16 mm: 21 >40 mm: 24	47 J at 0°C
					50 < t ≤ 100	---	215	---				
					100 < t ≤ 150	---	195	---				
JIS G 3103:1987	SB 410	---	---	AR	6 ≤ t ≤ 50	---	225	---	410-550	---	≤ 50 mm: 21 > 50 mm: 25	---
				N	50 < t ≤ 200	---						
JIS G 3118:2000	SGV410	---	---	AR	6 ≤ t ≤ 38	---	225	---	410-490	---	≤ 50 mm: 21 > 50 mm: 25	---
				N	38 < t ≤ 200	---						
EN 10028-2:2003	P265GH	1.0425	---	N	≤ 16	---	265	---	410-530	---	22	27 J at 0°C
					16 < t ≤ 40	---	255	---		---	22	
					40 < t ≤ 60	---	245	---		---	22	
					60 < t ≤ 100	---	215	---		---	22	
					100 < t ≤ 150	---	200	---	400-530	---	22	
					150 < t ≤ 250	---	185	---	390-530	---	22	
ISO 9328-2:1991	P 265 PH 265	---	---	N	3 ≤ t ≤ 16	---	265	---	410-530	---	24	27 J at 0°C
					16 < t ≤ 40	---	255	---			24	
					40 < t ≤ 60	---	245	---			23	
					60 < t ≤ 100	---	215	---			22	
					100 < t ≤ 150	---	200	---	400-530	---	22	
ASTM A 515/A 515M-03	60 [415]	---	K02401	AR	≤ 50	≤ 2	220	32	415-550	60-80	25	---
				N	> 50	> 2						
ASTM A 516/A 516M-03	60 [415]	---	K02100	AR	≤ 40	≤ 1.5	220	32	415-550	60-80	25	---
				N	> 40	> 1.5						
ISO 9328-4:1991	P 315 TN PH 315 TN PL 315 TN	---	---	N	≤ 35	---	315	---	440-560	---	23	see standard for impact data
					35 < t ≤ 50	---	305	---				
					50 < t ≤ 70	---	295	---				

4.1 Carbon Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 515/A 515M-03	65 [450]	---	K02800	AR	≤ 50	≤ 2	240	35	450-585	65-85	23	---
				N	> 50	> 2						
ASTM A 516/A 516M-03	65 [450]	---	K02403	AR	≤ 40	≤ 1.5	240	35	450-585	65-85	23	---
				N	> 40	> 1.5						
JIS G 3103:1987	SB 450	---	---	AR	6 ≤ t ≤ 50	---	245	---	450-590	---	≤ 50 mm: 19 > 50 mm: 23	---
				N	50 < t ≤ 200	---						
JIS G 3118:2000	SGV450	---	---	AR	6 ≤ t ≤ 38	---	245	---	450-540	---	≤ 50 mm: 19 > 50 mm: 23	---
				N	38 < t ≤ 200	---						
EN 10028-2:2003	P295GH	1.0481	---	N	≤ 16	---	295	---	460-580	---	21	27 J at 0°C
					16 < t ≤ 40	---	290	---		---	21	
					40 < t ≤ 60	---	285	---		---	21	
					60 < t ≤ 100	---	260	---		---	21	
					100 < t ≤ 150	---	235	---	440-570	---	21	
					150 < t ≤ 250	---	220	---	430-570	---	21	
ISO 9328-2:1991	P 290 PH 290	---	---	N	3 ≤ t ≤ 16	---	290	---	460-580	---	22	27 J at 0°C
					16 < t ≤ 40	---	285	---		---	22	
					40 < t ≤ 60	---	280	---		---	22	
					60 < t ≤ 100	---	255	---		---	21	
					100 < t ≤ 150	---	230	---	440-570	---	21	
JIS G 3103:1987	SB 480	---	---	AR	6 ≤ t ≤ 50	---	265	---	480-620	---	≤ 50 mm: 17 > 50 mm: 21	---
				N	50 < t ≤ 200	---						
JIS G 3118:2000	SGV480	---	---	AR	6 ≤ t ≤ 38	---	265	---	480-590	---	≤ 50 mm: 17 > 50 mm: 21	---
				N	38 < t ≤ 200	---						
ASTM A 515/A 515M-03	70 [485]	---	K03101	AR	≤ 50	≤ 2	260	38	485-620	70-90	21	---
				N	> 50	> 2						
ASTM A 516/A 516M-03	70 [485]	---	K02700	AR	≤ 40	≤ 1.5	260	38	485-620	70-90	21	---
				N	> 40	> 1.5						
ASTM A 537/A 537M-95 (2000)	1	---	K12437	N	≤ 65	≤ 2½	345	50	485-620	70-90	22	---
					65 < t ≤ 100	2½ < t ≤ 4	310	45	450-585	65-85		
ASTM A 737/A 737M-99	B	---	K12001	N	---	---	345	50	485-620	70-90	23	---

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3115:2000	SPV315	---	---	AR	6 ≤ t ≤ 50	---	315	---	490-610	---	≤16 mm: 16 >16 mm: 20 >40 mm: 23	47 J at 0°C
					50 < t ≤ 100	---	295	---				
					100 < t ≤ 150	---	275	---				
EN 10028-3:2003	P355N P355NH	1.0562 1.0565	---	N	≤ 16	---	355	---	490-630	---	22	see standard for impact data
					16 < t ≤ 40	---	345	---				
					40 < t ≤ 60	---	335	---				
					60 < t ≤ 100	---	315	---	470-610		21	
					100 < t ≤ 150	---	305	---	460-600			
					150 < t ≤ 250	---	295	---	450-590			
ISO 9328-2:1991	P 315 PH 315	---	---	N	3 ≤ t ≤ 16	---	315	---	490-610	---	21	27 J at 0°C
					16 < t ≤ 40	---	310	---		---	21	
					40 < t ≤ 60	---	305	---		---	21	
					60 < t ≤ 100	---	280	---		---	20	
					100 < t ≤ 150	---	255	---	470-600	---	20	

4.1 Carbon Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3124:1987	SEV 245	---	---	R, N, NT or P	≤ 50	---	370	---	510-650	---	16	31 J at 0°C
					50 < t ≤ 100	---	355	---			20	
					100 < t ≤ 125	---	345	---	500-640	---	20	
					125 < t ≤ 150	---	335	---	490-630	---	20	
EN 10028-2:2003	P355GH	1.0473	---	N	≤ 16	---	355	---	510-650	---	20	27 J at 0°C
					16 < t ≤ 40	---	345	---				
					40 < t ≤ 60	---	335	---				
					60 < t ≤ 100	---	315	---	490-630	---		
					100 < t ≤ 150	---	295	---	480-630	---		
					150 < t ≤ 250	---	280	---	470-630	---		
ISO 9328-2:1991	P 355	---	---	N	3 < t ≤ 16	---	355	---	510-650	---	21	27 J at 0°C
					16 < t ≤ 40	---	345	---		---	21	
					40 < t ≤ 60	---	335	---		---	21	
					60 < t ≤ 100	---	315	---	500-650	---	20	
					100 < t ≤ 150	---	295	---	490-640	---	20	
	PH 355	---	---	N	3 < t ≤ 16	---	355	---	510-650	---	21	27 J at 0°C
					16 < t ≤ 40	---	345	---		---	21	
					40 < t ≤ 60	---	335	---		---	21	
					60 < t ≤ 100	---	315	---	500-650	---	20	
					100 < t ≤ 150	---	295	---	490-640	---	20	
ASTM A 738/A 738M-03a	A	---	K12447	N or QT	≤ 65	≤ 2½	310	45	515-655	75-95	20	---
				QT	> 65	> 2½						
JIS G 3115:2000	SPV 355	---	---	AR	6 ≤ t ≤ 50	---	355	---	520-640	---	≤16 mm: 14 >16 mm: 18 >40 mm: 21	47 J at 0°C
					50 < t ≤ 100	---	335	---		---		
					100 < t ≤ 150	---	315	---		---		

4.1 Carbon Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 537/A 537M-95 (2000)	2	---	K12437	QT	≤ 65	≤ 2½	415	60	550-690	80-100	22	---
					65 < t ≤ 100	2½ < t ≤ 4	380	55	515-655	75-95	22	---
					100 < t ≤ 150	4 < t ≤ 6	315	46	485-620	70-90	20	---
	3	---	K12437	QT	≤ 65	≤ 2½	380	55	550-690	80-100	22	---
					65 < t ≤ 100	2½ < t ≤ 4	345	50	515-655	75-95	22	---
					100 < t ≤ 150	4 < t ≤ 6	275	40	485-620	70-90	20	---
ASTM A 737/A 737M-99	C	---	K12202	N	---	---	415	60	550-690	80-100	23	---
ASTM A 738/A 738M-03a	C	---	---	QT	≤ 65	≤ 2½	415	60	550-690	80-100	22	---
					65 < t ≤ 100	2½ < t ≤ 4	380	55	515-655	75-95	22	---
					> 100	> 4	315	46	485-620	70-90	20	---
JIS G 3115:2000	SPV410	---	---	TMCP	6 < t ≤ 50	---	410	---	550-670	---	see standard	47 J at -10°C
					50 < t ≤ 100	---	390	---				
					100 < t ≤ 150	---	370	---				
ASTM A 612/A 612M-03	---	---	K02900	AR	≤ 12.5	≤ ½	345	50	570-725	83-105	22	---
					12.5 < t ≤ 25	½ < t ≤ 1	345	50	560-695	81-101	22	---
JIS G 3115:2000	SPV450	---	---	QT	6 < t ≤ 50	---	450	---	570-700	---	see standard	47 J at -10°C
					50 < t ≤ 100	---	430	---				
					100 < t ≤ 150	---	410	---				
ASTM A 738/A 738M-03a	B	---	K12001	QT	---	---	415	60	585-705	85-102	20	---

4.1 Carbon Steels for Pressure Vessel Plates

4.1B Chemical Composition of Carbon Steel Pressure Plates

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10028-2:1992	P235GH	1.0345	---	---	---	0.16	0.60-1.20	0.35	0.025	0.015	0.30	0.30	0.08	Cu 0.30; Nb 0.020; Ti 0.03; V 0.02; Al ≥ 0.020; N 0.012; Cr+Cu+Mo+Ni 0.70
ISO 9328-2:1991	P 235 PH 235	---	---	---	---	0.17	0.40-1.20	0.35	0.035	0.030	0.30	0.30	0.08	Cu 0.30; Al ≥ 0.020; Cr+Cu+Mo+Ni 0.70
EN 10028-3:2003	P275NH	1.0487	---	---	---	0.16	0.80-1.50	0.40	0.025	0.015	0.30	0.30	0.08	Cu 0.30; Nb 0.05; Ti 0.03; V 0.05; N 0.012; Al ≥ 0.020; Nb+Ti+V 0.05; Cr+Cu+Mo0.45
JIS G 3115:2000	SPV235	---	---	≤ 100	---	0.18	1.40	0.15-0.35	0.030	0.030	---	---	---	---
				> 100	---	0.20	1.40	0.15-0.35	0.030	0.030	---	---	---	---
JIS G 3103:1987	SB 410	---	---	≤ 25	---	0.24	0.90	0.15-0.30	0.035	0.040	---	---	---	---
				25 < t ≤ 50	---	0.27	0.90	0.15-0.30	0.035	0.040	---	---	---	---
				50 < t ≤ 200	---	0.30	0.90	0.15-0.30	0.035	0.040	---	---	---	---
JIS G 3118:2000	SGV410	---	---	≤ 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	---	---	---	---
EN 10028-2:2003	P265GH	1.0425	---	---	---	0.20	0.80-1.40	0.40	0.025	0.015	0.30	0.30	0.08	Cu 0.30; Nb 0.020; Ti 0.03; V 0.02; Al ≥ 0.020; N 0.012; Cr+Cu+Mo+Ni 0.70
ISO 9328-2:1991	P 265 PH 265	---	---	---	---	0.20	0.50-1.40	0.35	0.035	0.030	0.30	0.30	0.08	Cu 0.30; Al ≥ 0.020; Cr+Cu+Mo+Ni 0.70
ASTM A 515/A 515M-03	60 [415]	---	K02401	≤ 25	≤ 1	0.24	0.90	0.15-0.40	0.035	0.035	---	---	---	---
				25 < t ≤ 50	1 < t ≤ 2	0.27	0.90	0.15-0.40	0.035	0.035	---	---	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.29	0.90	0.15-0.40	0.035	0.035	---	---	---	---
				100 < t ≤ 200	4 < t ≤ 8	0.31	0.90	0.15-0.40	0.035	0.035	---	---	---	---
				> 200	> 8	0.31	0.90	0.15-0.40	0.035	0.035	---	---	---	---
ASTM A 516/A 516M-03	60 [415]	---	K02100	≤ 12.5	≤ ½	0.21	0.60-0.90	0.15-0.40	0.035	0.035	---	---	---	---
				12.5 < t ≤ 50	½ < t ≤ 2	0.23	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.25	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				100 < t ≤ 200	4 < t ≤ 8	0.27	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				> 200	> 8	0.27	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
ISO 9328-4:1991	P 315 TN PH 315 TN	---	---	---	---	0.18	0.70-1.50	0.10-0.40	0.035	0.035	0.30	0.30	0.08	Cu 0.30; Nb 0.05; Ti 0.03; V 0.05; N 0.020; Al ≥ 0.020; Nb+Ti+V 0.05; Cr+Cu+Mo 0.45
	PL 315 TN	---	---	---	---	0.16	0.70-1.50	0.10-0.40	0.030	0.030				

4.1 Carbon Steels for Pressure Vessel Plates

4.1B Chemical Composition of Carbon Steel Pressure Plates (Continued)

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 515/A 515M-03	65 [450]	---	K02800	≤ 25	≤ 1	0.28	0.90	0.15-0.40	0.035	0.035	---	---	---	---
				25 < t ≤ 50	1 < t ≤ 2	0.31	0.90	0.15-0.40	0.035	0.035	---	---	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.33	0.90	0.15-0.40	0.035	0.035	---	---	---	---
				100 < t ≤ 200	4 < t ≤ 8	0.33	0.90	0.15-0.40	0.035	0.035	---	---	---	---
				> 200	> 8	0.33	0.90	0.15-0.40	0.035	0.035	---	---	---	---
ASTM A 516/A 516M-03	65 [450]	---	K02403	≤ 12.5	≤ ½	0.24	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				12.5 < t ≤ 50	½ < t ≤ 2	0.26	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.28	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				100 < t ≤ 200	4 < t ≤ 8	0.29	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				> 200	> 8	0.29	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
JIS G 3103:1987	SB 450	---	---	≤ 25	---	0.28	0.90	0.15-0.30	0.035	0.040	---	---	---	---
				25 < t ≤ 50	---	0.31	0.90	0.15-0.30	0.035	0.040	---	---	---	---
				50 < t ≤ 100	---	0.33	0.90	0.15-0.40	0.035	0.040	---	---	---	---
JIS G 3118:2000	SGV450	---	---	≤ 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	---	---	---	---
EN 10028-2:2003	P295GH	1.0481	---	---	---	0.08-0.20	0.90-1.50	0.40	0.025	0.015	0.30	0.30	0.08	Cu 0.30; Nb 0.020; Ti 0.03; V 0.02; Al ≥ 0.020; N 0.012; Cr+Cu+Mo+Ni 0.70
ISO 9328-2:1991	P 290	---	---	---	---	0.20	0.90-1.50	0.40	0.035	0.030	0.30	0.30	0.08	Cu 0.30; Al ≥ 0.020; Cr+Cu+Mo+Ni 0.70
	PH 290	---	---	---	---	0.14-0.20								
JIS G 3103:1987	SB 480	---	---	≤ 25	---	0.31	0.90	0.15-0.30	0.035	0.040	---	---	---	---
				25 < t ≤ 50	---	0.33	0.90	0.15-0.30	0.035	0.040	---	---	---	---
				50 < t ≤ 200	---	0.35	0.90	0.15-0.30	0.035	0.040	---	---	---	---
JIS G 3118:2000	SGV480	---	---	≤ 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	---	---	---	---

NOTE: This section continued on next page.

4.1 Carbon Steels for Pressure Vessel Plates

4.1B Chemical Composition of Carbon Steel Pressure Plates (Continued)

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 515/A 515M-03	70 [485]	---	K03101	≤ 25	≤ 1	0.31	1.20	0.15-0.40	0.035	0.035	---	---	---	---
				25 < t ≤ 50	1 < t ≤ 2	0.33	1.20	0.15-0.40	0.035	0.035	---	---	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.35	1.20	0.15-0.40	0.035	0.035	---	---	---	---
				100 < t ≤ 200	4 < t ≤ 8	0.35	1.20	0.15-0.40	0.035	0.035	---	---	---	---
				> 200	> 8	0.35	1.20	0.15-0.40	0.035	0.035	---	---	---	---
ASTM A 516/A 516M-03	70 [485]	---	K02700	≤ 12.5	≤ ½	0.27	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				12.5 < t ≤ 50	½ < t ≤ 2	0.28	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.30	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				100 < t ≤ 200	4 < t ≤ 8	0.31	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				> 200	> 8	0.31	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
ASTM A 537/A 537M-95 (2000)	1	---	K12437	≤ 40	≤ 1½	0.24	0.70-1.35	0.15-0.50	0.035	0.035	0.25	0.25	0.08	Cu 0.35
				> 40	> 1½		1.00-1.60							
ASTM A 737/A 737M-99	B	---	K12001	---	---	0.20	1.15-1.50	0.15-0.50	0.035	0.030	---	---	---	Cb 0.05
JIS G 3115:2000	SPV315	---	---	---	---	0.18	1.60	0.15-0.55	0.030	0.030	---	---	---	---
ISO 9328-2:1991	P 315	---	---	---	---	0.20	0.90-1.60	0.10-0.50	0.035	0.030	0.30	0.30	0.08	Cu 0.30; Al ≥ 0.020; Cr+Cu+Mo+Ni 0.70
	PH 315	---	---	---	---	0.15-0.20								

4.1 Carbon Steels for Pressure Vessel Plates

4.1B Chemical Composition of Carbon Steel Pressure Plates (Continued)

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3124:1987	SEV 245	---	---	6 ≤ t ≤ 150	---	0.20	0.80-1.60	0.15-0.60	0.035	0.035	---	---	0.35	Cu 0.35; Nb 0.05; V 0.10
EN 10028-2:2003	P355GH	1.0473	---	---	---	0.10-0.22	1.10-1.70	0.60	0.025	0.015	0.30	0.30	0.08	Cu 0.30; Nb 0.020; Ti 0.03; V 0.02; Al ≥ 0.020; N 0.012; Cr+Cu+Mo+Ni 0.70
ISO 9328-2:1991	P 355	---	---	---	---	0.22	0.90-1.60	0.10-0.50	0.035	0.030	0.30	0.30	0.08	Al 0.020; Cu 0.30
	PH 355	---	---	---	---	0.15-0.22	0.90-1.60	0.10-0.50	0.035	0.030	0.30	0.30	0.08	Al 0.020; Cu 0.30
ASTM A 738/A 738M-03a	A	---	K12447	≤ 65	≤ 2½	0.24	1.50	0.15-0.50	0.035	0.035	0.25	0.50	0.08	Cu 0.35; V 0.07; Cb 0.04; Cb+V 0.08
				> 65	> 2½	0.24	1.60	0.15-0.50	0.035	0.035	0.25	0.50	0.08	Cu 0.35; V 0.07; Cb 0.04; Cb+V 0.08
JIS G 3115:2000	SPV 355	---	---	---	---	0.20	1.60	0.15-0.55	0.030	0.030	---	---	---	---
ASTM A 537/A 537M-95 (2000)	2	---	K12437	≤ 40	≤ 1½	0.24	0.70-1.35	0.15-0.50	0.035	0.035	0.25	0.25	0.08	Cu 0.35
				> 40	> 1½		1.00-1.60							
	3	---	K12437	≤ 40	≤ 1½	0.24	0.70-1.35	0.15-0.50	0.035	0.035	0.25	0.25	0.08	Cu 0.35
				> 40	> 1½		1.00-1.60							
ASTM A 737/A 737M-99	C	---	K12202	---	---	0.22	1.15-1.50	0.10-0.55	0.035	0.030	---	---	---	V 0.04-0.11; N 0.03
ASTM A 738/A 738M-03a	C	---	---	≤ 65	≤ 2½	0.20	1.50	0.15-0.50	0.025	0.025	0.25	0.50	0.08	Cu 0.35; V 0.05
				> 65	> 2½		1.60							
JIS G 3115:2003	SPV410	---	---	---	---	0.18	1.60	0.15-0.75	0.030	0.030	---	---	---	---
ASTM A 612/A 612M-03	---	---	K02900	---	---	0.25	1.00-1.50	0.15-0.50	0.035	0.025	0.25	0.25	0.08	Cu 0.35; V 0.08
JIS G 3115:2003	SPV450	---	---	---	---	0.18	1.60	0.15-0.75	0.030	0.030	---	---	---	---
ASTM A 738/A 738M-03a	B	---	K12001	≤ 40	≤ 1½	0.20	0.90-1.50	0.15-0.55	0.030	0.030	0.30	0.60	0.20	Cu 0.35; V 0.07; Cb 0.04; Cb+V 0.08
				40 ≤ t ≤ 65	1½ ≤ t ≤ 2½	0.20	0.90-1.50	0.15-0.55	0.030	0.030	0.30	0.60	0.30	
				> 65	> 2½	0.20	0.90-1.60	0.15-0.55	0.030	0.030	0.30	0.60	0.30	

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ISO 9328-4:1991	P 255 TN PH 255 TN PL 255 TN	---	---	N	≤ 35	---	255	---	360-480	---	25	see standard for impact data
					35 < t ≤ 50	---	245	---				
					50 < t ≤ 70	---	235	---				
EN 10028-3:2003	P275NL1 P275NL2	1.0488 1.1104	---	N	≤ 16	---	275	---	390-510	---	24	see standard for impact data
					16 < t ≤ 40	---	265	---				
					40 < t ≤ 60	---	255	---				
					60 < t ≤ 100	---	235	---	370-490	---	23	
					100 < t ≤ 150	---	225	---	360-480			
					150 < t ≤ 250	---	215	---	350-470			
ISO 9328-4:1991	P 285 TN PH 285 TN PL 285 TN	---	---	N	≤ 35	---	285	---	390-510	---	24	see standard for impact data
					35 < t ≤ 50	---	275	---				
					50 < t ≤ 70	---	265	---				
ASTM A 662/A 662M-03	A	---	K01701	N	---	---	275	40	400-540	58-78	23	see standard for supplementary impact testing
JIS G 3126:2000	SLA 235 A, B	---	---	N	≤ 40	---	235	---	400-510	---	6-16 mm: 18 >16 mm: 22 >40 mm: 24	see standard for impact data
					>40	---	215	---				
	SLA 325 A	---	---	N	---	---	325	---	440-560	---	6-16 mm: 22 >16 mm: 30 >20 mm: 22	see standard for impact data
	SLA 325 B	---	---	QT	---	---	325	---	440-560	---		

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 662/A 662M-03	B	---	K02203	AR	≤ 40	≤ 1½	275	40	450-585	65-85	23	---
				N	> 40	> 1½						
	C	---	K02007	AR	≤ 40	≤ 1½	295	43	485-620	70-90	22	---
				N	> 40	> 1½						
ASTM A 841/A 841M-03a	A, B, C, Class 1	---	---	TMCP	≤ 65	≤ 2½	345	50	480-620	70-90	22	20 J at -40°C
					> 65	> 2½	310	45	450-585	65-85		
EN 10028-3:2003	P355N P355NH P355NL1 P355NL2	1.0562 1.0565 1.0566 1.1106	---	N	≤ 16	---	355	---	490-630	---	22	see standard for impact data
					16 < t ≤ 40	---	345	---				
					40 < t ≤ 60	---	335	---				
					60 < t ≤ 100	---	315	---	470-610		21	
					100 < t ≤ 150	---	305	---	460-600			
					150 < t ≤ 250	---	295	---	450-590			
ISO 9328-4:1991	P 355 TN PH 355 TN PL 355 TN PLH 355 TN	---	---	N(+T)	≤ 35		355	---	490-610	---	22	see standard for impact data
					35 < t ≤ 50		345	---				
					50 < t ≤ 70		325	---				
JIS G 3126:2000	SLA 365	---	---	QT	---	---	365	---	490-610	---	6-16 mm: 20 >16 mm: 28 >20 mm: 20	see standard for impact data
JIS G 3126:2000	SLA 410	---	---	QT or TMCP	---	---	410	---	520-640	---	6-16 mm: 18 >16 mm: 26 >20 mm: 18	see standard for impact data
ASTM A 841/A 841M-03a	A, B, C, Class 2	---	---	TMCP	≤ 65	≤ 2½	415	60	550-690	80-100	22	20 J at -40°C
					> 65	> 2½	380	55	515-655	75-95		

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

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 9328-4:1991	P 255 TN PH 255 TN	---	---	---	---	0.17	0.50-1.40	0.10-0.35	0.035	0.035	0.30	0.30	0.08	Cu 0.30; Nb 0.05; Ti 0.03; V 0.05; N 0.020; Al ≥ 0.020; Nb+Ti+V 0.05; Cr+Cu+Mo 0.45
	PL 255 TN	---	---	---	---	0.15			0.030	0.030				
EN 10028-3:2003	P275NL1	1.0488	---	---	---	0.16	0.80-1.50	0.40	0.025	0.015	0.30	0.30	0.08	Cu 0.30; Nb 0.05; Ti 0.03; V 0.05; N 0.012; Al ≥ 0.020; Nb+Ti+V 0.05; Cr+Cu+Mo 0.45
	P275NL2	1.1104	---	---	---				0.020	0.010				
ISO 9328-4:1991	P 285 TN PH 285 TN	---	---	---	---	0.18	0.50-1.40	0.10-0.40	0.035	0.035	0.30	0.30	0.08	Cu 0.30; Nb 0.05; Ti 0.03; V 0.05; N 0.020; Al ≥ 0.020; Nb+Ti+V 0.05; Cr+Cu+Mo 0.45
	PL 285 TN	---	---	---	---	0.16			0.030	0.030				
ASTM A 662/A 662M-03	A	---	K01701	---	---	0.14	0.90-1.35	0.15-0.40	0.035	0.035	---	---	---	---
JIS G 3126:2000	SLA 235 A,B	---	---	6 ≤ t ≤ 50	---	0.15	0.70-1.50	0.15-0.30	0.030	0.025	---	---	---	---
	SLA 325 A,B	---	---	6 ≤ t ≤ 32	---	0.16	0.80-1.60	0.15-0.55	0.030	0.025	---	---	---	---

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

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 662/A 662M-03	B	---	K02203	---	---	0.19	0.85-1.50	0.15-0.40	0.035	0.035	---	---	---	---
	C	---	K02007	---	---	0.20	1.00-1.60	0.15-0.50	0.035	0.035	---	---	---	---
ASTM A 841/A 841M-03a	A, Class 1	---	---	≤ 40	≤ 1½	0.20	0.70-1.35	0.15-0.50	0.030	0.030	0.25	0.25	0.08	Cu 0.35; V 0.06; Cb 0.03; Al ≥ 0.020
				> 40	> 1½		1.00-1.60							
	B, Class 1	---	---	≤ 40	≤ 1½	0.15	0.70-1.35	0.15-0.50	0.030	0.025	0.25	0.60	0.30	Cu 0.35; V 0.06; Cb 0.03; Al ≥ 0.020
				> 40	> 1½		1.00-1.60							
	C, Class 1	---	---	≤ 40	≤ 1½	0.10	0.70-1.60	0.15-0.50	0.030	0.015	0.25	0.25	0.08	Cu 0.35; V 0.06; Cb 0.06; Ti 0.006-0.02
				> 40	> 1½		1.00-1.60							
EN 10028-3:2003	P355N	1.0562	---	---	---	0.18	1.10-1.70	0.50	0.025	0.015	0.30	0.50	0.08	Cu 0.30; Nb 0.05; Ti 0.03; V 0.10; N 0.012; Al ≥ 0.020; Nb+Ti+V 0.12; Cr+Cu+Mo 0.45
	P355NH	1.0565	---	---	---									
	P355NL1	1.0566	---	---	---									
	P355NL2	1.1106	---	---	---				0.020	0.010				
ISO 9328-4:1991	P 355 TN PH 355 TN	---	---	---	---	0.20	0.90-1.7	0.10-0.50	0.035	0.035	0.30	0.30	0.08	Cu 0.30; Nb 0.05; Ti 0.03; N 0.020; V 0.10; Al ≥ 0.020; Nb+Ti+V 0.12; Cr+Cu+Mo 0.45
	PL 355 TN PLH 355 TN	---	---	---	---	0.18			0.030	0.030				
JIS G 3126:2000	SLA 365	---	---	6 ≤ t ≤ 32	---	0.18	0.80-1.60	0.15-0.55	0.030	0.025	---	---	---	---
JIS G 3126:2000	SLA 410	---	---	6 ≤ t ≤ 32	---	0.18	0.80-1.60	0.55	0.030	0.025	---	---	---	---
ASTM A 841/A 841M-03a	A, Class 2	---	---	≤ 40	≤ 1½	0.20	0.70-1.35	0.15-0.50	0.030	0.030	0.25	0.25	0.08	Cu 0.35; V 0.06; Cb 0.03; Al ≥ 0.020
				> 40	> 1½		1.00-1.60							
	B, Class 2	---	---	≤ 40	≤ 1½	0.15	0.70-1.35	0.15-0.50	0.030	0.025	0.25	0.60	0.30	Cu 0.35; V 0.06; Cb 0.03; Al ≥ 0.020
				> 40	> 1½		1.00-1.60							
	C, Class 2	---	---	≤ 40	≤ 1½	0.10	0.70-1.60	0.15-0.50	0.030	0.015	0.25	0.25	0.08	Cu 0.35; V 0.06; Cb 0.06; Ti 0.006-0.02
				> 40	> 1½		1.00-1.60							

4.3 ½Mo Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10028-2:2003	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	N 0.012; Cu 0.30; Al/N>2
ISO 9328-2:1991	16 Mo 3	---	---	---	---	0.12-0.20	0.40-0.90	0.35	0.035	0.030	0.30	---	0.25-0.35	Cu 0.30
EN 10028-2:2003	18MnMo4-5	1.5414	---	---	---	0.20	0.90-1.50	0.40	0.015	0.005	0.30	0.30	0.45-0.60	N 0.012; Cu 0.30
ASTM A 204/A 204M-03	A	---	K11820	≤ 25	≤ 1	0.18	0.90	0.15-0.40	0.035	0.035	---	---	0.45-0.60	---
				25 < t ≤ 50	1 < t ≤ 2	0.21								
				50 < t ≤ 100	2 < t ≤ 4	0.23								
				> 100	> 4	0.25								
JIS G 3103:1987	SB 450 M	---	---	≤ 25	---	0.18	0.90	0.15-0.30	0.035	0.040	---	---	0.45-0.60	---
				25 < t ≤ 50	---	0.21								
				50 < t ≤ 100	---	0.23								
				100 < t ≤ 150	---	0.25								
	SB 480 M	---	---	≤ 25	---	0.20	0.90	0.15-0.30	0.035	0.040	---	---	0.45-0.60	---
				25 < t ≤ 50	---	0.23								
				50 < t ≤ 100	---	0.25								
				100 < t ≤ 150	---	0.27								
ASTM A 204/A 204M-03	B	---	K12020	≤ 25	≤ 1	0.20	0.90	0.15-0.40	0.035	0.035	---	---	0.45-0.60	---
				25 < t ≤ 50	1 < t ≤ 2	0.23								
				50 < t ≤ 100	2 < t ≤ 4	0.25								
				> 100	> 4	0.27								
ASTM A 204/A 204M-03	C	---	K12320	≤ 25	≤ 1	0.23	0.90	0.15-0.40	0.035	0.035	---	---	0.45-0.60	---
				25 < t ≤ 50	1 < t ≤ 2	0.26								
				50 < t ≤ 100	2 < t ≤ 4	0.28								
				> 100	> 4	0.28								
ASTM A 302/A 302M-03	A	---	K12021	≤ 25	≤ 1	0.20	0.95-1.30	0.15-0.40	0.035	0.035	---	---	0.45-0.60	---
				25 < t ≤ 50	1 < t ≤ 2	0.23								
				> 50	> 2	0.25								
JIS G 3119:1987	SBV 1 A	---	---	≤ 25	---	0.20	0.95-1.30	0.15-0.30	0.035	0.040	---	---	0.45-0.60	---
				25 < t ≤ 50	---	0.23								
				50 < t ≤ 150	---	0.25								
JIS G 3124:1987	SEV 295	---	---	6 ≤ t ≤ 150	---	0.19	0.80-1.60	0.15-0.60	0.035	0.035	---	---	0.10-0.40	Cu 0.35; Nb 0.05; V 0.10

4.3 ½Mo Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3119:1987	SBV 1 B	---	---	≤ 25	---	0.20	1.15-1.50	0.15-0.30	0.035	0.040	---	---	0.45-0.60	---
				25 < t ≤ 50	---	0.23								
				50 < t ≤ 150	---	0.25								
ASTM A 302/A 302M-03	B	---	K12022	≤ 25	≤ 1	0.20	1.15-1.50	0.15-0.40	0.035	0.035	---	---	0.45-0.60	---
				25 < t ≤ 50	1 < t ≤ 2	0.23								
				> 50	> 2	0.25								
JIS G 3120:1987	SQV 1 A	---	---	---	---	0.25	1.15-1.50	0.15-0.30	0.035	0.040	---	---	0.45-0.60	---
ASTM A 533/A 533M-93 (1999)	Type A, Class 1	---	K12521	---	---	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	---	0.45-0.60	---
JIS G 3124:1987	SEV 345	---	---	6 ≤ t ≤ 150	---	0.19	0.80-1.70	0.15-0.60	0.035	0.035	---	---	0.15-0.50	Cu 0.35; Nb 0.05; V 0.10
JIS G 3120:1987	SQV 1 B	---	---	---	---	0.25	1.15-1.50	0.15-0.30	0.035	0.040	---	---	0.45-0.60	---
ASTM A 533/A 533M-93 (1999)	Type A, Class 2	---	K12521	---	---	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	---	0.45-0.60	---
	Type A, Class 3													

4.3 ½Mo Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10028-2:2003	16Mo3	1.5415	---	N, NT	≤ 16	---	275	---	440-590	---	22	31 J at 20°C
					16 < t ≤ 40	---	270	---	440-590	---		
					40 < t ≤ 60	---	260	---	440-590	---		
					60 < t ≤ 100	---	240	---	430-560	---		
					100 < t ≤ 150	---	220	---	420-570	---		
					150 < t ≤ 250	---	210	---	410-570	---		
ISO 9328-2:1991	16 Mo 3	---	---	N, NT	3 < t ≤ 16	---	280	---	450-600	---	24	31 J at 20°C
					16 < t ≤ 40	---	270	---		---	24	
					40 < t ≤ 60	---	260	---		---	23	
					60 < t ≤ 100	---	240	---	430-580	---	22	27 J at 20°C
					100 < t ≤ 150	---	220	---	420-570	---	19	
EN 10028-2:2003	18MnMo4-5	1.5414	---	NT	t ≤ 60	---	345	---	510-650	---	20	see standard for impact data
				NT	60 < t ≤ 150	---	325	---	510-650	---	20	
				QT	150 < t ≤ 250	---	310	---	480-620	---	20	
ASTM A 204/A 204M-03	A	---	K11820	AR	≤ 40	≤ 1.5	255	37	450-585	65-85	23	---
				N	> 40	> 1.5						
JIS G 3103:1987	SB 450 M	---	---	≤ 38: AR > 38: N	6 ≤ t ≤ 150	---	255	---	450-590	---	23	---
	SB 480M	---	---	≤ 38: AR > 38: N	6 ≤ t ≤ 150	---	275	---	480-620	---	21	---
ASTM A 204/A 204M-03	B	---	K12020	AR	≤ 40	≤ 1.5	275	40	485-620	70-90	21	---
				N	> 40	> 1.5						
ASTM A 204/A 204M-03	C		K12320	AR	≤ 40	≤ 1.5	295	43	515-655	75-95	20	---
				N	> 40	> 1.5						
ASTM A 302/A 302M-03	A	---	K12021	AR	≤ 50	≤ 2	310	45	515-655	75-95	19	---
				N	> 50	> 2						
JIS G 3119:1987	SBV 1 A	---	---	AR	≤ 50	---	315	---	520-660	---	19	---
				N	> 50	---						
JIS G 3124:1987	SEV 295	---	---	R, N, NT or P	≤ 50	---	420	---	540-690	---	15	31 J at 0°C
					50 < t ≤ 100	---	400	---			19	
					100 < t ≤ 125	---	390	---	530-680	---		
					125 < t ≤ 150	---	380	---	520-670	---		

4.3 ½Mo Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3119:1987	SBV 1 B	---	---	AR or N	≤ 50	---	345	---	550-690	---	18	---
					> 50	---						
ASTM A 302/A 302M-03	B	---	K12022	AR	≤ 50	≤ 2	345	50	550-690	80-100	18	---
				N	> 50	> 2						
JIS G 3120:1987	SQV 1 A	---	---	QT	---	---	345	---	550-690	---	18	see standard for impact data
ASTM A 533/A 533M-93 (1999)	Type A, Class 1	---	K12521	QT	> 6.5	> 0.25	345	50	550-690	80-100	18	---
JIS G 3124:1987	SEV 345	---	---	R, N, NT or P	≤ 50	---	430	---	590-740	---	14	31 J at 0°C
					50 < t ≤ 100	---					18	
					100 < t ≤ 125	---	420	---	580-730	---		
					125 < t ≤ 150	---	410	---	570-720	---		
JIS G 3120:1987	SQV 1 B	---	---	QT	---	---	480	---	620-790	---	16	see standard for impact data
ASTM A 533/A 533M-93 (1999)	Type A, Class 2	---	K12521	QT	> 6.5	> 0.25	485	70	620-795	90-115	16	---
	Type A, Class 3	---	K12521	QT	6.5 < t ≤ 65	0.25 < t ≤ 2½	570	83	690-860	100-125	16	---

4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

4.4.1A Chemical Composition of ¾Cr-½Mo Alloy Steels for Pressure Vessel Plates

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 387/A 387M-03	Grade 2 Class 1	---	K12143	---	---	0.05-0.21	0.55-0.80	0.15-0.40	0.035	0.035	0.50-0.80	---	0.45-0.60	---
JIS G 4109:1987	SCMV 1 Div 1	---	---	---	---	0.21	0.55-0.80	0.40	0.030	0.030	0.50-0.80	---	0.45-0.60	---
	SCMV 1 Div 2	---	---	---	---	0.21	0.55-0.80	0.40	0.030	0.030	0.50-0.80	---	0.45-0.60	---
ASTM A 387/A 387M-03	Grade 2 Class 2	---	K12143	---	---	0.05-0.21	0.55-0.80	0.15-0.40	0.035	0.035	0.50-0.80	---	0.45-0.60	---

4.4.1B Mechanical Properties of ¾Cr-½Mo Alloy Steels for Pressure Vessel Plates

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 387/A 387M-03	Grade 2 Class 1	---	K12143	A or NT	---	---	230	33	380-550	55-80	22	---
JIS G 4109:1987	SCMV 1 Div 1	---	---	A or NT	$6 \le t \le 50$	---	225	---	380-550	---	18	---
					$50 < t \le 200$	---					22	
	SCMV 1 Div 2	---	---	NT	$6 \le t \le 50$	---	315	---	480-620	---	18	---
					$50 < t \le 200$	---					22	
ASTM A 387/A 387M-03	Grade 2 Class 2	---	K12143	A or NT	---	---	310	45	485-620	70-90	22	---

4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 387/A 387M-03	Grade 12 Class 1	---	K11757	---	---	0.05-0.17	0.40-0.65	0.15-0.40	0.035	0.035	0.80-1.15	---	0.45-0.60	---
JIS G 4109:1987	SCMV 2 Div 1	---	---	---	---	0.17	0.40-0.65	0.40	0.030	0.030	0.80-1.15	---	0.45-0.60	---
ASTM A 387/A 387M-03	Grade 12, Class 2	---	K11757	---	---	0.05-0.17	0.40-0.65	0.15-0.40	0.035	0.035	0.80-1.15	---	0.45-0.60	---
JIS G 4109:1987	SCMV 2 Div 2	---	---	---	---	0.17	0.40-0.65	0.40	0.030	0.030	0.80-1.15	---	0.45-0.60	---
EN 10028-2:2003	13CrMo4-5	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
ISO 9328-2:1991	14 CrMo 4 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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 387/A 387M-03	Grade 12 Class 1	---	K11757	A or NT	---	---	230	33	380-550	55-80	22	**---**
JIS G 4109:1987	SCMV 2 Div. 1	---	---	A or NT	6 ≤ t ≤ 50	---	225	---	380-550	---	19	---
					50 < t ≤ 200	---					22	
ASTM A 387/A 387M-03	Grade 12, Class 2	---	K11757	A or NT	---	---	275	40	450-585	65-85	22	---
JIS G 4109:1987	SCMV 2 Div. 2	---	---	NT	6 ≤ t ≤ 50	---	275	---	450-590	---	18	---
					50 < t ≤ 200	---					22	
EN 10028-2:2003	13CrMo4-5	1.7335	---	NT	≤ 16	---	300	---	450-600	---	19	31 J at 20°C
					16 < t ≤ 60	---	290	---				
				NT	60 < t ≤ 100	---	270	---	440-590	---		27 J at 20°C
				NT or QT	100 < t ≤ 150	---	255	---	430-580	---		---
				QT	150 < t ≤ 250	---	245	---	420-570	---		---
ISO 9328-2:1991	14 CrMo 4 5	---	---	NT	3 ≤ t ≤ 16	---	300	---	450-600	---	20	31 J at 20°C
					16 < t ≤ 40	---						
					40 < t ≤ 60	---					19	
					60 < t ≤ 100	---	275	---	440-590	---	18	27 J at 20°C
					100 < t ≤ 150	---	255	---	430-580	---		

4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4109:1987	SCMV 3 Div 1	---	---	---	---	0.17	0.40-0.65	0.50-0.80	0.030	0.030	1.00-1.50	---	0.45-0.65	---
ASTM A 387/A 387M-03	Grade 11 Class 1	---	K11789	---	---	0.05-0.17	0.40-0.65	0.50-0.80	0.035	0.035	1.00-1.50	---	0.45-0.65	---
EN 10028-2:2003	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
ASTM A 387/A 387M-03	Grade 11 Class 2	---	K11789	---	---	0.05-0.17	0.40-0.65	0.50-0.80	0.035	0.035	1.00-1.50	---	0.45-0.65	---
JIS G 4109:1987	SCMV 3 Div 2	---	---	---	---	0.17	0.40-0.65	0.50-0.80	0.030	0.030	1.00-1.50	---	0.45-0.65	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 4109:1987	SCMV 3 Div. 1	---	---	A or NT	$6 \le t \le 50$	---	235	---	410-590	---	19	---
					$50 < t \le 200$	---					22	
ASTM A 387/A 387M-03	Grade 11 Class 1	---	K11789	A or NT	---	---	240	35	415-585	60-85	22	---
EN 10028-2:2003	13CrMoSi5-5	1.7336	---	NT	$t \le 60$	---	310	---	510-690	---	20	see standard for impact data
				NT	$60 < t \le 100$	---	300	---	480-660	---	20	
				QT	$t \le 60$	---	400	---	510-690	---	20	
				QT	$60 < t \le 100$	---	390	---	500-680	---	20	
				QT	$100 < t \le 250$	---	380	---	490-670	---	20	
ASTM A 387/A 387M-03	Grade 11 Class 2	---	K11789	A or NT	---	---	310	45	515-690	75-100	22	---
JIS G 4109:1987	SCMV 3 Div. 2	---	---	NT	$6 \le t \le 50$	---	315	---	520-690	---	18	---
					$50 < t \le 200$	---					22	

4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

4.4.4A Chemical Composition of 2¼Cr-1Mo Alloy Steels for Pressure Vessel Plates

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4109:1987	SCMV 4 Div 1	---	---	---	---	0.17	0.30-0.60	0.50	0.030	0.030	2.00-2.50	---	0.90-1.10	---
ASTM A 387/A 387M-03	Grade 22, Class 1	---	K21590	---	---	0.05-0.15	0.30-0.60	0.50	0.035	0.035	2.00-2.50	---	0.90-1.10	---
	Grade 22 L, Class 1	---				0.10								
EN 10028-2:2003	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
ISO 9328-2:1991	13 CrMo 9 10 T1	---	---	---	---	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
ASTM A 387/A 387M-03	Grade 22, Class 2	---	K21590	---	---	0.05-0.15	0.30-0.60	0.50	0.035	0.035	2.00-2.50	---	0.90-1.10	---
JIS G 4109:1987	SCMV 4 Div 2	---	---	---	---	0.17	0.30-0.60	0.50	0.030	0.030	2.00-2.50	---	0.90-1.10	---
ISO 9328-2:1991	13 CrMo 9 10 T2	---	---	---	---	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 4110:1993	SCMQ4E	---	---	---	---	0.17	0.30-0.60	0.50	0.015	0.015	2.00-2.50	---	0.90-1.10	V 0.03

4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

4.4.4B Mechanical Properties of 2¼Cr-1Mo Alloy Steels for Pressure Vessel Plates

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
JIS G 4109:1987	SCMV 4 Div 1	---	---	A or NT	6 ≤ t ≤ 300	---	205	---	410-590	---	18	---
ASTM A 387/A 387M-03	Grade 22, Class 1	---	K21590	A, or NT	---	---	205	30	415-585	60-85	18	---
	Grade 22 L, Class 1	---										
EN 10028-2:2003	10CrMo9-10	1.7380	---	NT	≤ 16	---	310	---	480-630	---	18	31 J at 20°C
					16 < t ≤ 40	---	300	---				
					40 < t ≤ 60	---	290	---				
				NT or QT	60 < t ≤ 100	---	280	---	470-620	---	17	27 J at 20°C
				QT	100 < t ≤ 150	---	260	---	460-610	---		
					150 < t ≤ 250	---	250	---	450-600	---		
ISO 9328-2:1991	13 CrMo 9 10 T1	---	---	NT	3 ≤ t ≤ 16	---	275	---	480-620	---	18	31 J at 20°C
					16 < t ≤ 40	---	265	---				
					40 < t ≤ 60	---						
					60 < t ≤ 100	---	260	---	470-620	---	17	27 J at 20°C
					100 < t ≤ 150	---	250	---	460-610	---	16	
					150 < t ≤ 300	---	240	---	450-600	---		
ASTM A 387/A 387M-03	Grade 22, Class 2	---	K21590	A or NT	---	---	310	45	515-690	75-100	18	---
JIS G 4109:1987	SCMV 4 Div 2	---	---	NT	6 ≤ t ≤ 300	---	315	---	520-690	---	18	---
ISO 9328-2:1991	13 CrMo 9 10 T2	---	---	NT	3 ≤ t ≤ 16	---	310	---	520-670	---	18	31 J at 20°C
					16 < t ≤ 40	---						
					40 < t ≤ 60	---						
					60 < t ≤ 100	---					17	27 J at 20°C
JIS G 4110:1993	SCMQ4E	---	---	NT, QT	---	---	380	---	580-760	---	18	54 J at -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

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4109:1987	SCMV 5 Div 1	---	---	---	---	0.17	0.30-0.60	0.50	0.030	0.030	2.75-3.25	---	0.90-1.10	---
ASTM A 387/A 387M-03	Grade 21, Class 1	---	K31545	---	---	0.05-0.15	0.30-0.60	0.50	0.035	0.035	2.75-3.25	---	0.90-1.10	---
	Grade 21 L, Class 1	---				0.10								
	Grade 21, Class 2	---				0.05-0.05								
JIS G 4109:1987	SCMV 5 Div 2	---	---	---	---	0.17	0.30-0.60	0.50	0.030	0.030	2.75-3.25	---	0.90-1.10	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 4109:1987	SCMV 5 Div 1	---	---	A or NT	$6 \le t \le 300$	---	205	---	410-590	---	18	---
ASTM A 387/A 387M-03	Grade 21, Class 1	---	K31545	A or NT	---	---	205	30	415-585	60-85	18	---
	Grade 21 L, Class 1	---										
	Grade 21, Class 2	---		A or NT	---	---	310	45	515-690	75-100	18	---
JIS G 4109:1987	SCMV 5 Div 2	---	---	NT	$6 \le t \le 300$	---	315	---	520-690	---	18	---

4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4109:1987	SCMV 6 Div 1	---	---	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
ASTM A 387/A 387M-03	Grade 5, Class 1	---	K41545 S50100 S50200	---	---	0.15	0.30-0.60	0.50	0.035	0.030	4.00-6.00	---	0.45-0.65	---
EN 10028-2:2003	X12CrMo5	1.7362	---	---	---	0.10-0.15	0.30-0.60	0.50	0.020	0.005	4.00-6.00	0.30	0.45-0.65	Cu 0.30; N 0.012;
ASTM A 387/A 387M-03	Grade 5, Class 2	---	K41545 S50100 S50200	---	---	0.15	0.30-0.60	0.50	0.035	0.030	4.00-6.00	---	0.45-0.65	---
JIS G 4109:1987	SCMV 6 Div 2	---	---	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 4109:1987	SCMV 6 Div 1	---	---	A or NT	$6 \le t \le 300$	---	205	---	410-590	---	18	---
ASTM A 387/A 387M-03	Grade 5, Class 1	---	K41545 S50100 S50200	A or NT	---	---	205	30	415-585	60-85	18	---
EN 10028-2:2003	X12CrMo5	1.7362	---	NT	$t \le 60$	---	320	---	510-690	---	20	see standard for impact data
				NT	$60 < t \le 150$	---	300	---	480-690	---	20	
				QT	$150 < t \le 250$	---	300	---	450-690	---	20	
ASTM A 387/A 387M-03	Grade 5, Class 2	---	K41545 S50100 S50200	A or NT	---	---	310	45	515-690	75-100	18	---
JIS G 4109:1987	SCMV 6 Div 2	---	---	NT	$6 \le t \le 300$	---	315	---	520-690	---	18	---

4.4 Cr-Mo Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 387/A 387M-03	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	N 0.030-0.070; Cb 0.06-0.10; V 0.18-0.25; B 0.0003-0.006; Al 0.04
EN 10028-2:2003	X10CrMoVNb9-1	1.4903	---	---	---	0.08-0.12	0.30-0.60	0.50	0.020	0.005	8.00-9.50	0.30	0.85-1.05	N 0.030-0.070; Cu 0.30; Nb 0.6-0.10; V 0.18-0.25
ASTM A 387/A 387M-03	Grade 911 Class 2	---	---	---	---	0.09-0.13	0.30-0.60	0.10-0.50	0.020	0.010	8.50-10.50	0.40	0.90-1.10	Cb 0.06-0.10; V 0.18-0.25; Al 0.04; N 0.04-0.09; W 0.90-1.10

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 387/A 387M-03	Grade 91 Class 2	---	K90901	NT	---	---	415	60	585	760	18	---
EN 10028-2:2003	X10CrMoVNb9-1	1.4903	---	NT	$t \leq 60$	---	445	---	580-760	---	18	see standard for impact data
				NT	$60 < t \leq 150$	---	435	---	550-730	---		
				QT	$150 < t \leq 250$	---	435	---	520-700	---		
ASTM A 387/A 387M-03	Grade 911 Class 2	---	---	NT	---	---	440	64	620	840	18	---

4.5 Ni Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10028-4:2003	11MnNi5-3	1.6212	---	---	---	0.14	0.70-1.50	0.50	0.025	0.015	---	0.30-0.80	---	V 0.05; Nb 0.05; Al 0.020
	13MnNi6-3	1.6217	---	---	---	0.16	0.85-1.70	0.50	0.025	0.015	---	0.30-0.85	---	V 0.05; Nb 0.05; Al 0.020
ISO 9328-3:1991	11 MnNi 5 3	---	---	3 ≤ t ≤ 50	---	0.14	0.70-1.50	0.50	0.030	0.025	---	0.30-0.80	---	V 0.05; Nb 0.05; Al 0.020
	13 MnNi 6 3	---	---	3 ≤ t ≤ 50	---	0.16	0.85-1.65	0.50	0.030	0.025	---	0.30-0.85	---	V 0.05; Nb 0.05; Al 0.020

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10028-4:2003	11MnNi5-3	1.6212	---	NT	≤ 30	---	285	---	420-530	---	24	see standard for impact data
					30 < t ≤ 50	---	275	---				
					50 < t ≤ 80	---	265	---				
	13MnNi6-3	1.6217	---	NT	≤ 30	---	355	---	490-610	---	22	see standard for impact data
					30 < t ≤ 50	---	345	---				
					50 < t ≤ 80	---	335	---				
ISO 9328-3:1991	11 MnNi 5 3	---	---	NT	3 < t ≤ 30	---	285	---	420-530	---	24	see standard for impact data
					30 < t ≤ 50	---	275	---				
	13 MnNi 6 3	---	---	NT	3 < t ≤ 30	---	355	---	490-610	---	22	see standard for impact data
					30 < t ≤ 50	---	345	---				

4.5 Ni Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10028-4:2003	15NiMn6	1.6228	---	---	---	0.18	0.80-1.50	0.35	0.025	0.015	---	1.30-1.70	---	V 0.05
ISO 9328-3:1991	15 NiMn 6	---	---	$3 \le t \le 50$	---	0.18	0.80-1.50	0.35	0.025	0.020	---	1.30-1.70	---	V 0.05

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10028-4:2003	15NiMn6	1.6228	---	N or NT or QT	≤ 30	---	355	---	490-640	---	22	see standard for impact data
					$30 < t \le 50$	---	345	---				
					$50 < t \le 80$	---	335	---				
ISO 9328-3:1991	15 NiMn 6	---	---	N or NT or QT	$3 < t \le 30$	---	355	---	490-640	---	22	see standard for impact data
					$30 < t \le 50$	---	345	---				

4.5 Ni Alloy Steels for Pressure Vessel Plates

4.5.3A Chemical Composition of 2¼Ni Alloy Steels for Pressure Vessel Plates

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3127:2000	SL2N255	---	---	6 ≤ t ≤ 50	---	0.17	0.70	0.30	0.025	0.025	---	2.10-2.50	---	---
ASTM A 203/A 203M-97 (2003)	A	---	K21703	≤ 50	≤ 2	0.17	0.70	0.15-0.40	0.035	0.035	---	2.10-2.50	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.20	0.80	0.15-0.40	0.035	0.035	---	2.10-2.50	---	---
				> 100	> 4	0.23	0.80	0.15-0.40	0.035	0.035	---	2.10-2.50	---	---
	B	---	K22103	≤ 50	≤ 2	0.21	0.70	0.15-0.40	0.035	0.035	---	2.10-2.50	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.24	0.80	0.15-0.40	0.035	0.035	---	2.10-2.50	---	---
				> 100	> 4	0.25	0.80	0.15-0.40	0.035	0.035	---	2.10-2.50	---	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3127:1990	SL2N255	---	---	N	6 ≤ t ≤ 16	---	255	---	450-590	---	24	see standard for impact data
					> 16	---					29	
					> 20	---					24	
ASTM A 203/A 203M-97 (2003)	A	---	K21703	N	≤ 50	≤ 2	255	37	450-585	65-85	23	---
					> 50	> 2						
	B	---	K22103	N	≤ 50	≤ 2	275	40	485-620	70-90	21	---
					> 50	> 2						

4.5 Ni Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3127:2000	SL3N255	---	---	6 ≤ t ≤ 50	---	0.15	0.70	0.30	0.025	0.025	---	3.25-3.75	---	---
ASTM A 203/A 203M-97 (2003)	D	---	K31718	≤ 50	≤ 2	0.17	0.70	0.15-0.40	0.035	0.035	---	3.25-3.75	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.20	0.80	0.15-0.40	0.035	0.035	---	3.25-3.75	---	---
ISO 9328-3:1991	12 Ni 14 G1	---	---	3 ≤ t ≤ 50	---	0.15	0.30-0.80	0.35	0.025	0.020	---	3.25-3.75	---	V 0.05
	12 Ni 14 G2	---	---	3 ≤ t ≤ 50	---	0.15	0.30-0.80	0.35	0.025	0.020	---	3.25-3.75	---	V 0.05
JIS G 3127:2000	SL3N275	---	---	6 ≤ t ≤ 50	---	0.17	0.70	0.30	0.025	0.025	---	3.25-3.75	---	---
ASTM A 203/A 203M-97 (2003)	E	---	K32018	≤ 50	≤ 2	0.20	0.70	0.15-0.40	0.035	0.035	---	3.25-3.75	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.23	0.80	0.15-0.40	0.035	0.035	---	3.25-3.75	---	---
EN 10028-4:2003	12Ni14	1.5637	---	---	---	0.15	0.30-0.80	0.35	0.020	0.010	---	3.25-3.75	---	V 0.05
JIS G 3127:2000	SL3N440	---	---	6 ≤ t ≤ 50	---	0.15	0.70	0.30	0.025	0.025	---	3.25-3.75	---	---
ASTM A 203/A 203M-97 (2003)	F	---	---	≤ 50	≤ 2	0.20	0.70	0.15-0.40	0.035	0.035	---	3.25-3.75	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.23	0.80	0.15-0.40	0.035	0.035	---	3.25-3.75	---	---

4.5 Ni Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3127:2000	SL3N255	---	---	N	6 ≤ t ≤ 16	---	255	---	450-590	---	24	see standard for impact data
					> 16	---					29	
					> 20	---					24	
ASTM A 203/A 203M-97 (2003)	D	---	K31718	N	≤ 50	≤ 2	255	37	450-585	65-85	23	---
					> 50	> 2						
ISO 9328-3:1991	12 Ni 14 G1	---	---	N or NT or QT	3 < t ≤ 30	---	285	---	450-600		23	see standard for impact data
					30 < t ≤ 50	---	275	---				
	12 Ni 14 G2	---	---	N or NT or QT	3 < t ≤ 30	---	355	---	470-620		22	see standard for impact data
					30 < t ≤ 50	---	345	---				
JIS G 3127:2000	SL3N275	---	---	N	6 ≤ t ≤ 16	---	275	---	480-620	---	22	see standard for impact data
					> 16	---					26	
					> 20	---					22	
ASTM A 203/A 203M-97 (2003)	E	---	K32018	N	≤ 50	≤ 2	275	40	485-620	70-90	21	---
					> 50	> 2						
EN 10028-4:2003	12Ni14	1.5637	---	N or NT or QT	≤ 30	---	355	---	490-640	---	22	see standard for impact data
					30 < t ≤ 50	---	345	---				
					50 < t ≤ 80	---	335	---				
JIS G 3127:2000	SL3N440	---	---	QT	6 ≤ t ≤ 16	---	440	---	540-690	---	21	see standard for impact data
					> 16	---					25	
					> 20	---					21	
ASTM A 203/A 203M-97 (2003)	F	---	---	QT	≤ 50	≤ 2	55	380	550-690	80-100	20	---
					> 50	> 2	50	345	515-655	75-95		

4.5 Ni Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10028-4:2003	X12Ni5	1.5680	---	---	---	0.15	0.30-0.80	0.35	0.020	0.010	---	4.75-5.25	---	V 0.05
JIS G 3127:2000	SL5N590	---	---	$6 \le t \le 50$	---	0.13	1.50	0.30	0.025	0.025	---	4.75-6.00	---	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10028-4:2003	X12Ni5	1.5680	---	N or NT or QT	≤ 30	---	390	---	530-710	---	20	see standard for impact data
					$30 < t \le 50$	---	380	---				
JIS G 3127:2000	SL5N590	---	---	QT	$6 \le t \le 16$	---	590	---	690-830	---	21	see standard for impact data
					> 16	---					25	
					> 20	---					21	

4.5 Ni Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 9328-3:1991	X 8 Ni 9	---	---	3 ≤ t ≤ 50	---	0.10	0.30-0.80	0.35	0.025	0.020	---	8.5-10.0	0.10	V 0.05
EN 10028-4:2003	X8Ni9	1.5662	---	---	---	0.10	0.30-0.80	0.35	0.020	0.010	---	8.50-10.00	0.10	V 0.05
	X7Ni9	1.5663	---	---	---	0.10	0.30-0.80	0.35	0.015	0.005	---	8.50-10.00	0.10	V 0.01
JIS G 3127:2000	SL9N520	---	---	6 ≤ t ≤ 50	---	0.12	0.90	0.30	0.025	0.025	---	8.50-9.50	---	---
ASTM A 353/A 353M-93 (1999)	---	---	K81340	---	---	0.13	0.90	0.15-0.40	0.035	0.035	---	8.50-9.50	---	---
ASTM A 553/A 553M-95 (2000)	Type I	---	K81340	---	---	0.13	0.90	0.15-0.40	0.035	0.035	---	8.50-9.50	---	---
	Type II	---	K71340	---	---	0.13	0.90	0.15-0.40	0.035	0.035	---	7.50-8.50	---	---
JIS G 3127:2000	SL9N590	---	---	6 ≤ t ≤ 50	---	0.12	0.90	0.30	0.025	0.025	---	8.50-9.50	---	---
ASTM A 844/A 844M-93 (1999)	---	---	K81340	---	---	0.13	0.90	0.15-0.40	0.020	0.020	---	8.50-9.50	---	---

4.5 Ni Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ISO 9328-3:1991	X 8 Ni 9	---	---	NNT or QT	3 ≤ t ≤ 30	---	490	---	640-840	---	18	see standard for impact data
					30 < t ≤ 50	---	480	---				
EN 10028-4:2003	X8Ni9	1.5662	---	NT640: N or NT	≤ 30	---	490	---	640-840	---	18	see standard for impact data
					30 < t ≤ 50	---	480	---				
				QT640: QT	≤ 30	---	585	---	680-820	---	18	see standard for impact data
					30 < t ≤ 50	---	575	---				
				QT680: QT	≤ 30	---	585	---	680-820	---		
					30 < t ≤ 50	---	575	---				
	X7Ni9	1.5663	---	QT	≤ 30	---	585	---	680-820	---	18	see standard for impact data
					30 < t ≤ 50	---	575	---				
JIS G 3127:2000	SL9N520	---	---	NNT	6 ≤ t ≤ 16	---	520	---	690-830	---	21	see standard for impact data
					> 16	---					25	
					> 20	---					21	
ASTM A 353/A 353M-93 (1999)	---	---	K81340	NNT	---	---	515	75	690-825	100-120	20.0	see standard for supplementary impact testing
ASTM A 553/A 553M-95 (2000)	Type I	---	K81340	QT	---	---	585	85	690-825	100-120	20.0	see standard for supplementary impact testing
	Type II	---	K71340									
JIS G 3127:2000	SL9N590	---	---	QT	6 ≤ t ≤ 16	---	590	---	690-830	---	21	see standard for impact data
					> 16	---					25	
					> 20	---					21	
ASTM A 844/A 844M-93 (1999)	---	---	K81340	Direct QT	≤ 50	≤ 2	585	85	690-825	100-120	20.0	see standard for supplementary impact testing

4.6 Ni-Mo Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 533/A 533M-93 (1999)	Type B Class 1	---	K12539	---	---	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	0.40-0.70	0.45-0.60	---
JIS G 3120:1987	SQV 2 A	---	---	---	---	0.25	1.15-1.50	0.15-0.30	0.035	0.040	---	0.40-0.70	0.45-0.60	---
JIS G 3119:1987	SBV 2	---	---	≤ 25	---	0.20	1.15-1.50	0.15-0.30	0.035	0.040	---	0.40-0.70	0.45-0.60	---
				25 < t ≤ 50	---	0.23								
				50 < t ≤ 150	---	0.25								
ASTM A 302/A 302M-03	C	---	K12039	≤ 25	≤ 1	0.20	1.15-1.50	0.15-0.40	0.035	0.035	---	0.40-0.70	0.45-0.60	---
				25 < t ≤ 50	1 < t ≤ 2	0.23								
				> 50	> 2	0.25								
EN 10028-2:2003	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	N 0.012; Cu 0.20; V 0.02
ASTM A 533/A 533M-93 (1999)	Type B Class 2	---	K12539	---	---	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	0.40-0.70	0.45-0.60	---
JIS G 3120:1987	SQV 2 B	---	---	---	---	0.25	1.15-1.50	0.15-0.30	0.035	0.040	---	0.40-0.70	0.45-0.60	---
ASTM A 533/A 533M-93 (1999)	Type B Class 3	---	K12539	---	---	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	0.40-0.70	0.45-0.60	---

4.6 Ni-Mo Alloy Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 533/A 533M-93 (1999)	Type B Class 1	---	K12539	QT	> 6.5	> 0.25	345	50	550-690	80-100	18	---
JIS G 3120:1987	SQV 2 A	---	---	QT	---	---	345	---	550-690	---	18	see standard for impact data
JIS G 3119:1987	SBV 2	---	---	AR	6 ≤ t ≤ 50	---	345	---	550-690	---	17	---
				N	50 < t ≤ 150	---					20	
ASTM A 302/A 302M-03	C	---	K12039	AR	6.5 ≤ t ≤ 50	¼ ≤ t ≤ 2	345	50	550-690	80-100	20	---
				N	> 50	> 2						
EN 10028-2:2003	20MnMoNi4-5	1.6311	---	QT	t ≤ 40	---	470	---	590-750	---	18	see standard for impact data
				QT	40 < t ≤ 60	---	460	---	590-730	---	18	
				QT	60 < t ≤ 100	---	450	---	570-710	---	18	
				QT	100 < t ≤ 150	---	440	---	570-710	---	18	
				QT	150 < t ≤ 250	---	400	---	560-700	---	18	
ASTM A 533/A 533M-93 (1999)	Type B Class 2	---	K12539	QT	> 6.5	> 0.25	485	70	620-795	90-115	16	---
JIS G 3120:1987	SQV 2 B	---	---	QT	---	---	480	---	620-790	---	16	see standard for impact data
ASTM A 533/A 533M-93 (1999)	Type B Class 3	---	K12539	QT	6.5 ≤ t ≤ 65	¼ ≤ t ≤ 2½	570	83	690-860	100-125	16	---

4.6 Ni-Mo Alloy Steels for Pressure Vessel Plates

4.6.2A Chemical Composition of ¾Ni-½Mo Alloy Steels for Pressure Vessel Plates

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 533/A 533M-93 (1999)	Type C, Class 1	---	K12554	---	---	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	0.70-1.00	0.45-0.60	---
JIS G 3119:1987	SBV 3	---	---	≤ 25	---	0.20	1.15-1.50	0.15-0.30	0.035	0.040	---	0.70-1.00	0.45-0.60	---
				25 < t ≤ 50	---	0.23	1.15-1.50	0.15-0.30	0.035	0.040	---	0.70-1.00	0.45-0.60	---
				50 < t ≤ 150	---	0.25	1.15-1.50	0.15-0.30	0.035	0.040	---	0.70-1.00	0.45-0.60	---
ASTM A 302/A 302M-03	D	---	K12054	≤ 25	≤ 1	0.20	1.15-1.50	0.15-0.40	0.035	0.035	---	0.70-1.00	0.45-0.60	---
				25 < t ≤ 50	1 < t ≤ 2	0.23	1.15-1.50	0.15-0.40	0.035	0.035	---	0.70-1.00	0.45-0.60	---
				> 50	> 2	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	0.70-1.00	0.45-0.60	---
JIS G 3120:1987	SQV 3 A	---	---	---	---	0.25	1.15-1.50	0.15-0.30	0.035	0.040	---	0.70-1.00	0.45-0.60	---
EN 10028-2:2003	15NiCuMoNb 5-6-4	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	N 0.020; Cu 0.50-0.80; Nb 0.015-0.045
ASTM A 533/A 533M-93 (1999)	Type C, Class 2	---	K12554	---	---	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	0.70-1.00	0.45-0.60	---
JIS G 3120:1987	SQV 3 B	---	---	---	---	0.25	1.15-1.50	0.15-0.30	0.035	0.040	---	0.70-1.00	0.45-0.60	---
ASTM A 533/A 533M-93 (1999)	Type C, Class 3	---	K12554	---	---	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	0.70-1.00	0.45-0.60	---

4.6 Ni-Mo Alloy Steels for Pressure Vessel Plates

4.6.2B Mechanical Properties of ¾Ni-½Mo Alloy Steels for Pressure Vessel Plates

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 533/A 533M-93 (1999)	Type C, Class 1	---	K12554	QT	> 6.5	> 0.25	345	50	550-690	80-100	18	---
JIS G 3119:1987	SBV 3	---	---	AR	6 ≤ t ≤ 50	---	345	---	550-690	---	17	---
				N	50 < t ≤ 150	---					20	
ASTM A 302/A 302M-03	D	---	K12054	AR	6.5 ≤ t ≤ 50	¼ ≤ t ≤ 2	345	50	550-690	80-100	20	---
				N	> 50	> 2						
JIS G 3120:1987	SQV 3 A	---	---	QT	---	---	345	---	550-690	---	18	see standard for impact data
EN 10028-2:2003	15NiCuMoNb5-6-4	1.6368	---	NT	t ≤ 40	---	460	---	610-780	---	16	see standard for impact data
				NT	40 < t ≤ 60	---	440	---	610-780	---	16	
				NT	60 < t ≤ 100	---	430	---	600-760	---	16	
				NT or QT	100 < t ≤ 150	---	420	---	590-740	---	16	
				QT	150 < t ≤ 250	---	410	---	580-740	---	16	
ASTM A 533/A 533M-93 (1999)	Type C, Class 2	---	K12554	QT	> 6.5	> 0.25	485	70	620-795	90-115	16	---
JIS G 3120:1987	SQV 3 B	---	---	QT	---	---	480	---	620-790	---	16	see standard for impact data
ASTM A 533/A 533M-93 (1999)	Type C, Class 3	---	K12554	QT	6.5 ≤ t ≤ 65	¼ ≤ t ≤ 2½	570	83	690-860	100-125	16	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 240/A 240M-03c	405	---	S40500	---	---	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.60	---	Al 0.10-0.30
EN 10028-7:2000	X2CrNi12	1.4003	---	---	---	0.030	1.50	1.00	0.040	0.015	10.50-12.50	0.30-1.00	---	N 0.030
ASTM A 240/A 240M-03c	---	---	S40975	---	---	0.030	1.00	1.00	0.040	0.030	10.5-11.7	0.50-1.00	---	N 0.030; Ti 6 x (C+N) to 0.75
EN 10028-7:2000	X6CrNiTi12	1.4516	---	---	---	0.08	1.50	0.70	0.040	0.015	10.50-12.50	0.50-1.50	---	Ti 0.05-0.35
ASTM A 240/A 240M-03c	---	---	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 10028-7:2000	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
ASTM A 240/A 240M-03c	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 N 0.030; Al 0.15
EN 10028-7:2000	X3CrTi17	1.4510	---	---	---	0.05	1.00	1.00	0.040	0.015	16.00-18.00	---	---	Ti [4 x (C+N)+0.15] to 0.80
ASTM A 240/A 240M-03c	---	---	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 N 0.030; Al 0.15
	---	---	S43940	---	---	0.030	1.00	1.00	0.040	0.015	17.5-18.5	---	---	Ti 0.10-0.60; Cb [0.30+(3 x C)] min
EN 10028-7:2000	X2CrTiNb18	1.4509	---	---	---	0.030	1.00	1.00	0.040	0.015	17.50-18.50	---	---	Ti 0.10-0.60; Nb [3 x C+0.30] to 1.00
ASTM A 240/A 240M-03c	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+4(C+N)] to 0.80; N 0.035
EN 10028-7:2000	X2CrMoTi18-2	1.4521	---	---	---	0.025	1.00	1.00	0.040	0.015	17.00-20.00	---	1.80-2.50	Ti [4 x (C+N)+0.15] to 0.80; N 0.030

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 240/A 240M-03c	405	---	S40500	---	---	---	170	25	415	60	20.0	---
EN 10028-7:2000	X2CrNi12	1.4003	---	CR St, A	≤ 6	---	280 L; 320 T	---	450-650	---	20	see standard for impact data
				HR St, A	≤ 12	---						
				HR Pl, A	≤ 25	---	250 L; 280 T	---			18	
ASTM A 240/A 240M-03c	---	---	S40975	---	---	---	275	40	415	60	20.0	---
EN 10028-7:2000	X6CrNiTi12	1.4516	---	CR St, A	≤ 6	---	280 L; 320 T	---	450-650	---	23	see standard for impact data
				HR St, A	≤ 12	---						
				HR Pl, A	≤ 25	---	250 L; 280 T	---			20	
ASTM A 240/A 240M-03c	---	---	S41500	---	---	---	620	90	795	115	15.0	---
EN 10028-7:2000	X3CrNiMo13-4	1.4313	---	HR Pl, QT	≤ 75	---	650	---	780-980	---	14	see standard for impact data
ASTM A 240/A 240M-03c	439	---	S43035	---	---	---	205	30	415	60	22.0	---
EN 10028-7:2000	X3CrTi17	1.4510	---	CR St, A	≤ 3	---	230 L; 240 T	---	420-600	---	23	see standard for impact data
ASTM A 240/A 240M-03c	---	---	S43932	---	---	---	205	30	415	60	22.0	---
	---	---	S43940	---	---	---	250	36	430	62	18	---
EN 10028-7:2000	X2CrTiNb18	1.4509	---	CR St, A	≤ 2.5	---	230 L; 250 T	---	430-630	---	18	see standard for impact data
ASTM A 240/A 240M-03c	444	---	S44400	---	---	---	275	40	415	60	20.0	---
EN 10028-7:2000	X2CrMoTi18-2	1.4521	---	CR St, A	≤ 2.5	---	300 L; 320 T	---	420-640	---	20	see standard for impact data

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 240/A 240M-03c	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 10028-7:2000	X2CrNiN18-7	1.4318	---	---	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	6.00-8.00	---	N 0.10-0.20
ASTM A 240/A 240M-03c	304	---	S30400	---	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10
EN 10028-7:2000	X5CrNi18-10	1.4301	---	---	---	0.07	2.00	1.00	0.045	0.015	17.00-19.50	8.00-10.50	---	N 0.11
ISO 9328-5:1991	X 5 CrNi 18 9	---	---	---	---	0.07	2.00	1.00	0.045	0.030	17.00-19.00	8.00-11.00	---	---
ASTM A 240/A 240M-03c	304H	---	S30409	---	---	0.04-0.10	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	---
EN 10028-7:2000	X6CrNi18-10	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 9328-5:1991	X 7 CrNi 18 9	---	---	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.00-19.00	8.00-11.00	---	---
ASTM A 240/A 240M-03c	304L	---	S30403	---	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10
EN 10028-7:2000	X2CrNiN18-9	1.4307	---	---	---	0.030	2.00	1.00	0.045	0.015	17.50-19.50	8.00-10.00	---	N 0.11
	X2CrNi19-11	1.4306	---	---	---	0.030	2.00	1.00	0.045	0.015	18.00-20.00	10.00-12.00	---	N 0.11
ISO 9328-5:1991	X 2 CrNi 18 10	---	---	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	---
ASTM A 240/A 240M-03c	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 10028-7:2000	X5CrNiN19-9	1.4315	---	---	---	0.06	2.00	1.00	0.045	0.015	18.00-20.00	8.00-11.00	---	N 0.12-0.22
ASTM A 240/A 240M-03c	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 10028-7:2000	X2CrNiN18-10	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
ISO 9328-5:1991	X 2 CrNiN 18 10	---	---	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
ASTM A 240/A 240M-03c	309H	---	S30909	---	---	0.04-0.10	2.00	0.75	0.045	0.030	22.0-24.0	12.0-15.0	---	---
EN 10028-7:2000	X6CrNi23-13	1.4950	---	---	---	0.04-0.08	2.00	0.70	0.035	0.015	22.00-24.00	12.00-15.00	---	N 0.11
ASTM A 240/A 240M-03c	310H	---	S31009	---	---	0.04-0.10	2.00	0.75	0.045	0.030	24.0-26.0	19.0-22.0	---	---
EN 10028-7:2000	X6CrNi25-20	1.4951	---	---	---	0.04-0.08	2.00	0.70	0.035	0.015	24.00-26.00	19.00-22.00	---	N 0.11
ASTM A 240/A 240M-03c	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
EN 10028-7:2000	X5CrNiMo17-12-2	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
	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
ISO 9328-5:1991	X 5 CrNiMo 17 12	---	---	---	---	0.07	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.00-2.50	---
	X 5 CrNiMo 17 13	---	---	---	---	0.07	2.00	1.00	0.045	0.030	16.50-18.50	11.00-14.00	2.50-3.00	---

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 240/A 240M-03c	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
EN 10028-7:2000	X2CrNiMo17-12-2	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
	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	N 0.11
	X2CrNiMo18-14-3	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
ISO 9328-5:1991	X 2 CrNiMo 17 12	---	---	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	11.00-14.00	2.00-2.50	---
	X 2 CrNiMo 17 13	---	---	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	11.50-14.50	2.50-3.00	---
ASTM A 240/A 240M-03c	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	---
ISO 9328-5:1991	X 7 CrNiMo 17 12	---	---	---	---	0.04-0.10	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.00-2.50	---
ASTM A 240/A 240M-03c	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 5 x (C+N) min, 0.70 max; N 0.10;
EN 10028-7:2000	X6CrNiMoTi17-12-2	1.4571	---	---	---	0.08	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.50	2.00-2.50	Ti 5 x C - 0.70
ISO 9328-5:1991	X 6 CrNiMoTi 17 12	---	---	---	---	0.08	2.00	1.00	0.045	0.030	16.50-18.50	11.00-14.00	2.00-2.50	Ti 5 X C to 0.80
ASTM A 240/A 240M-03c	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 10 x C to 1.10; N 0.10
EN 10028-7:2000	X6CrNiMoNb17-12-2	1.4580	---	---	---	0.08	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.50	2.00-2.50	Nb 10 x C to 1.00
ISO 9328-5:1991	X 6 CrNiMoNb 17 12	---	---	---	---	0.08	2.00	1.00	0.045	0.030	16.50-18.50	11.00-14.00	2.00-2.50	Nb 10 x C to 1.00
ASTM A 240/A 240M-03c	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 10028-7:2000	X2CrNiMoN17-11-2	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
	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 9328-5:1991	X 2 CrNiMoN 17 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
	X 2 CrNiMoN 17 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
ASTM A 240/A 240M-03c	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 10028-7:2000	X2CrNiMo18-15-4	1.4438	---	---	---	0.030	2.00	1.00	0.045	0.015	17.50-19.50	13.00-16.00	3.00-4.00	N 0.11
ISO 9328-5:1991	X 3 CrNiMo 18 16 4	---	---	---	---	0.030	2.00	1.00	0.045	0.030	17.50-19.50	14.00-17.00	3.00-4.00	---
ASTM A 240/A 240M-03c	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 10028-7:2000	X2CrNiMoN18-12-4	1.4434	---	---	---	0.030	2.00	1.00	0.045	0.015	16.50-19.50	10.50-14.00	3.00-4.00	N 0.10-0.20

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 240/A 240M-03c	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 10028-7:2000	X2CrNiMoN17-13-5	1.4439	---	---	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	12.50-14.50	4.00-5.00	N 0.12-0.22
ISO 9328-5:1991	X 2 CrNiMoN 17 13 5	---	---	---	---	0.030	2.00	1.00	0.045	0.025	16.50-18.50	12.50-14.50	4.00-5.00	N 0.12-0.22
ASTM A 240/A 240M-03c	321	---	S32100	---	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x (C+N) to 0.70; N 0.10
EN 10028-7:2000	X6CrNiTi18-10	1.4541	---	---	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.70
ISO 9328-5:1991	X 6 CrNiTi 18 10	---	---	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80
ASTM A 240/A 240M-03c	321H	---	S32109	---	---	0.04-0.10	2.00	0.75	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 4 x (C+N) to 0.70
EN 10028-7:2000	X6CrNiTiB18-10	1.4941	---	---	---	0.04-0.08	2.00	1.00	0.035	0.015	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80; B 0.0015-0.0050
ISO 9328-5:1991	X 7 CrNiTi 18 10	---	---	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80
ASTM A 240/A 240M-03c	347	---	S34700	---	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 10 x C to 1.00
EN 10028-7:2000	X6CrNiNb18-10	1.4550	---	---	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00
ISO 9328-5:1991	X 6 CrNiNb 18 10	---	---	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00
ASTM A 240/A 240M-03c	347H	---	S34709	---	---	0.04-0.10	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 8 x C to 1.00
EN 10028-7:2000	X8CrNiNb16-13	1.4961	---	---	---	0.04-0.10	1.50	0.30-0.60	0.035	0.015	15.00-17.00	12.00-14.00	---	Nb 10 x C to 1.20
ISO 9328-5:1991	X 7 CrNiNb 18 10	---	---	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.20
ASTM A 240/A 240M-03c	904L	---	N08904	---	---	0.020	2.00	1.00	0.045	0.035	19.0-23.0	23.0-28.0	4.0-5.0	Cu 1.0-2.0; N 0.10
EN 10028-7:2000	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 9328-5:1991	X 2 NiCrMoCu 25 20 5	---	---	---	---	0.025	2.00	1.00	0.035	0.025	19.00-22.00	24.00-27.00	4.00-5.00	Cu 1.00-2.00
ASTM A 240/A 240M-03c	---	---	N08926	---	---	0.020	2.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.0-7.0	Cu 0.5-1.5; N 0.15-0.25
EN 10028-7:2000	X1NiCrMoCuN25-20-7	1.4529	---	---	---	0.020	1.00	0.50	0.030	0.010	19.00-21.00	24.00-26.00	6.00-7.00	Cu 0.50-1.50; N 0.15-0.25
ASTM A 240/A 240M-03c	---	---	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 A 240/A 240M-03c	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;
ISO 9328-5:1991	X 7 NiCrAlTi 32 21 TQ1 X 7 NiCrAlTi 32 21 TQ2	---	---	---	---	0.10	2.00	1.00	0.030	0.020	19.00-23.00	30.00-35.00	---	Cu 0.75; Ti 0.15-0.60; Al 0.15-0.60
ASTM A 240/A 240M-03c	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
	---	---	N08811	---	---	0.06-0.10	1.50	1.00	0.040	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
EN 10028-7:2000	X8NiCrAlTi32-21	1.4959	---	---	---	0.05-0.10	1.50	0.70	0.015	0.010	19.00-22.00	30.00-34.00	---	Cu 0.50; Ti 0.25-0.65;N 0.030; Al 0.25-0.65; Co 0.50; Ni+Co 30.00-34.00
ISO 9328-5:1991	X 8 NiCrAlTi 32 21 TQ1 X 8 NiCrAlTi 32 21 TQ2	---	---	---	---	0.05-0.10	2.00	1.00	0.030	0.020	19.00-23.00	30.00-35.00	---	Cu 0.75; Ti 0.15-0.60; Al 0.15-0.60

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 240/A 240M-03c	301LN	---	S30153	---	---	---	240	35	550	80	45	---
EN 10028-7:2000	X2CrNi18-7	1.4318	---	CR St, AT	≤ 6	---	350	---	650-850	---	40	see standard for impact data
				HR St, AT	≤ 12	---	330	---				
				HR Pl, AT	≤ 75	---	330	---				
ASTM A 240/A 240M-03c	304	---	S30400	---	---	---	205	30	515	75	40	---
EN 10028-7:2000	X5CrNi18-10	1.4301	---	CR St, AT	≤ 6	---	230	---	540-750	---	45	see standard for impact data
				HR St, AT	≤ 12	---	210	---	520-720			
				HR Pl, AT	≤ 75	---	210	---				
ISO 9328-5:1991	X 5 CrNi 18 9	---	---	Q	---	---	195	---	500-700	---	40	---
ASTM A 240/A 240M-03c	304H	---	---	---	---	---	205	30	515	75	40	---
EN 10028-7:2000	X6CrNi18-10	1.4948	---	CR St, AT	≤ 6	---	230	---	530-740	---	45	see standard for impact data
				HR St, AT	≤ 12	---	210	---	510-710			
				HR Pl, AT	≤ 75	---	190	---				
ISO 9328-5:1991	X 7 CrNi 18 9	---	---	Q	---	---	195	---	490-690	---	40	---
ASTM A 240/A 240M-03c	304L	---	S30403	---	---	---	170	25	485	70	40	---
EN 10028-7:2000	X2CrNiN18-9	1.4307	---	CR St, AT	≤ 6	---	220	---	520-670	---	45	see standard for impact data
				HR St, AT	≤ 12	---	200	---				
				HR Pl, AT	≤ 75	---	200	---	500-650			
	X2CrNi19-11	1.4306	---	CR St, AT	≤ 6	---	220	---	520-670	---	45	see standard for impact data
				HR St, AT	≤ 12	---	200	---				
				HR Pl, AT	≤ 75	---	200	---	500-650			
ISO 9328-5:1991	X 2 CrNi 18 10	---	---	Q	---	---	180	---	480-680	---	40	---
ASTM A 240/A 240M-03c	304N	---	S30451	---	---	---	240	35	550	80	30	---
EN 10028-7:2000	X5CrNiN19-9	1.4315	---	CR St, AT	≤ 6	---	290	---	550-750	---	40	see standard for impact data
				HR St, AT	≤ 12	---	270	---				
				HR Pl, AT	≤ 75	---	270	---				
ASTM A 240/A 240M-03c	304LN	---	S30453	---	---	---	205	30	515	75	40	---
EN 10028-7:2000	X2CrNiN18-10	1.4311	---	CR St, AT	≤ 6	---	290	---	550-750	---	40	see standard for impact data
				HR St, AT	≤ 12	---	270	---				
				HR Pl, AT	≤ 75	---	270	---				
ISO 9328-5:1991	X 2 CrNiN 18 10	---	---	Q	---	---	270	---	550-750	---	35	---

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 240/A 240M-03c	309H	---	S30909	---	---	---	205	30	515	75	40	---
EN 10028-7:2000	X6CrNi23-13	1.4950	---	CR St, AT	≤ 6	---	220	---	530-730	---	35	see standard for impact data
				HR St, AT	≤ 12	---	200	---	510-710			
				HR Pl, AT	≤ 75	---	200	---				
ASTM A 240/A 240M-03c	310H	---	S31009	---	---	---	205	30	515	75	40	---
EN 10028-7:2000	X6CrNi25-20	1.4951	---	CR St, AT	≤ 6	---	220	---	530-730	---	35	see standard for impact data
				HR St, AT	≤ 12	---	200	---	510-710			
				HR Pl, AT	≤ 75	---	200	---				
ASTM A 240/A 240M-03c	316	---	S31600	---	---	---	205	30	515	75	40	---
EN 10028-7:2000	X5CrNiMo17-12-2	1.4401	---	CR St, AT	≤ 6	---	240	---	530-680	---	40	see standard for impact data
				HR St, AT	≤ 12	---	220	---				
				HR Pl, AT	≤ 75	---	220	---	520-670		45	
	X3CrNiMo17-13-3	1.4436	---	CR St, AT	≤ 6	---	240	---	550-700	---	40	see standard for impact data
				HR St, AT	≤ 12	---	220	---				
				HR Pl, AT	≤ 75	---	220	---	530-730			
ISO 9328-5:1991	X 5 CrNiMo 17 12	---	---	Q	---	---	205	---	510-710	---	40	---
	X 5 CrNiMo 17 13	---	---	Q	---	---	205	---	510-710	---	40	---
ASTM A 240/A 240M-03c	316L	---	S31603	---	---	---	170	25	485	70	40	---
EN 10028-7:2000	X2CrNiMo17-12-2	1.4404	---	CR St, AT	≤ 6	---	240	---	530-680	---	40	see standard for impact data
				HR St, AT	≤ 12	---	220	---				
				HR Pl, AT	≤ 75	---	220	---	520-670		45	
	X2CrNiMo17-12-3	1.4432	---	CR St, AT	≤ 6	---	240	---	550-700	---	40	see standard for impact data
				HR St, AT	≤ 12	---	220	---				
				HR Pl, AT	≤ 75	---	220	---	520-670		45	
	X2CrNiMo18-14-3	1.4435	---	CR St, AT	≤ 6	---	240	---	550-700	---	40	see standard for impact data
				HR St, AT	≤ 12	---	220	---				
				HR Pl, AT	≤ 75	---	220	---	520-670		45	
ISO 9328-5:1991	X 2 CrNiMo 17 12	---	---	Q	---	---	190	---	490-690	---	40	---
	X 2 CrNiMo 17 13	---	---	Q	---	---	190	---	490-690	---	40	---
ASTM A 240/A 240M-03c	316H	---	---	---	---	---	205	30	515	75	40	---
ISO 9328-5:1991	X 7 CrNiMo 17 12	---	---	Q	---	---	205	---	510-710	---	40	---

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 240/A 240M-03c	316Ti	---	S31635	---	---	---	205	30	515	75	40	---
EN 10028-7:2000	X6CrNiMoTi17-12-2	1.4571	---	CR St, AT	≤ 6	---	240	---	540-690	---	40	see standard for impact data
				HR St, AT	≤ 12	---	220	---				
				HR Pl, AT	≤ 75	---	220	---	520-670			
ISO 9328-5:1991	X 6 CrNiMoTi 17 12	---	---	Q	---	---	210	---	510-710	---	35	---
ASTM A 240/A 240M-03c	316Cb	---	S31640	---	---	---	205	30	515	75	30	---
EN 10028-7:2000	X6CrNiMoNb17-12-2	1.4580	---	HR Pl, AT	≤ 75	---	220	---	520-720	---	40	see standard for impact data
ISO 9328-5:1991	X 6 CrNiMoNb 17 12	---	---	Q	---	---	215	---	510-710	---	30	---
ASTM A 240/A 240M-03c	316LN	---	S31653	---	---	---	205	30	515	75	40	---
EN 10028-7:2000	X2CrNiMoN17-11-2	1.4406	---	CR St, AT	≤ 6	---	300	---	580-780	---	40	see standard for impact data
				HR St, AT	≤ 12	---	280	---				
				HR Pl, AT	≤ 75	---	280	---				
	X2CrNiMoN17-13-3	1.4429	---	CR St, AT	≤ 6	---	300	---	580-780	---	35	see standard for impact data
				HR St, AT	≤ 12	---	280	---				
				HR Pl, AT	≤ 75	---	280	---			40	
ISO 9328-5:1991	X 2 CrNiMoN 17 12	---	---	Q	---	---	280	---	580-780	---	35	---
	X 2 CrNiMoN 17 13	---	---	Q	---	---	280	---	580-780	---	35	---
ASTM A 240/A 240M-03c	317L	---	S31703	---	---	---	205	30	515	75	40	---
EN 10028-7:2000	X2CrNiMo18-15-4	1.4438	---	CR St, AT	≤ 6	---	240	---	550-700	---	35	see standard for impact data
				HR St, AT	≤ 12	---	220	---				
				HR Pl, AT	≤ 75	---	220	---	520-720		40	
ISO 9328-5:1991	X 3 CrNiMo 18 16 4	---	---	Q	---	---	195	---	490-690	---	35	---
ASTM A 240/A 240M-03c	317LN	---	S31753	---	---	---	240	35	550	80	40	---
EN 10028-7:2000	X2CrNiMoN18-12-4	1.4434	---	CR St, AT	≤ 6	---	290	---	570-770	---	35	see standard for impact data
				HR St, AT	≤ 12	---	270	---				
				HR Pl, AT	≤ 75	---	270	---	540-740		40	
ASTM A 240/A 240M-03c	317LMN	---	S31726	---	---	---	240	35	550	80	40	---
EN 10028-7:2000	X2CrNiMoN17-13-5	1.4439	---	CR St, AT	≤ 6	---	290	---	580-780	---	35	see standard for impact data
				HR St, AT	≤ 12	---	270	---				
				HR Pl, AT	≤ 75	---	270	---			40	
ISO 9328-5:1991	X 2 CrNiMoN 17 13 5	---	---	Q	---	---	285	---	580-800	---	35	---

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %,	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 240/A 240M-03c	321	---	S32100	---	---	---	205	30	515	75	40	---
EN 10028-7:2000	X6CrNiTi18-10	1.4541	---	CR St, AT	≤ 6	---	220	---	520-720	---	40	see standard for impact data
				HR St, AT	≤ 12	---	200	---				
				HR Pl, AT	≤ 75	---	200	---	500-700			
ISO 9328-5:1991	X 6 CrNiTi 18 10	---	---	Q	---	---	200	---	510-710	---	35	---
ASTM A 240/A 240M-03c	321H	---	S32109	---	---	---	205	30	515	75	40	---
EN 10028-7:2000	X6CrNiTiB18-10	1.4941	---	CR St, AT	≤ 6	---	220	---	510-710	---	40	see standard for impact data
				HR St, AT	≤ 12	---	200	---				
				HR Pl, AT	≤ 75	---	200	---	490-690			
ISO 9328-5:1991	X 7 CrNiTi 18 10	---	---	Q	---	---	175	---	490-690	---	35	---
ASTM A 240/A 240M-03c	347	---	S34700	---	---	---	205	30	515	75	40	---
EN 10028-7:2000	X6CrNiNb18-10	1.4550	---	HR Pl, AT	≤ 75	---	200	---	500-700	---	40	see standard for impact data
ISO 9328-5:1991	X 6 CrNiNb 18 10	---	---	Q	---	---	205	---	510-710	---	30	---
ASTM A 240/A 240M-03c	347H	---	S34709	---	---	---	205	30	515	75	40	---
EN 10028-7:2000	X8CrNiNb16-13	1.4961	---	HR Pl, AT	≤ 75	---	200	---	510-690	---	35	see standard for impact data
ISO 9328-5:1991	X 7 CrNiNb 18 10	---	---	Q	---	---	205	---	510-710	---	30	---
ASTM A 240/A 240M-03c	904L	---	N08904	---	---	---	220	31	490	71	35	---
EN 10028-7:2000	X1NiCrMoCu25-20-5	1.4539	---	CR St, AT	≤ 6	---	240	---	530-730	---	35	see standard for impact data
				HR St, AT	≤ 12	---	220	---				
				HR Pl, AT	≤ 75	---	220	---	520-720			
ISO 9328-5:1991	X 2 NiCrMoCu 25 20 5	---	---		---	---	220	---	520-720	---	35	---
ASTM A 240/A 240M-03c	---	---	N08926	---	---	---	295	43	650	94	35	---
EN 10028-7:2000	X1NiCrMoCuN25-20-7	1.4529	---	HR Pl, AT	≤ 75	---	300	---	650-850	---	40	see standard for impact data
ASTM A 240/A 240M-03c	---	---	S31277	---	---	---	360	40	770	112	40	---
ASTM A 240/A 240M-03c	800	---	N08800	---	---	---	205	30	520	75	30	---
ISO 9328-5:1991	X 7 NiCrAlTi 32 21 TQ1	---	---	Q1	---	---	165	---	430-680	---	25	---
	X 7 NiCrAlTi 32 21 TQ2	---	---	Q2	---	---	210	---	500-750	---	22	---

4.8 Austenitic Stainless Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %,	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 240/A 240M-03c	800H	---	N08810	---	---	---	170	25	450	65	30	---
	---	---	N08811	---	---	---	170	25	450	65	30	---
EN 10028-7:2000	X8NiCrAlTi32-21	1.4959	---	HR Pl, AT	≤ 75	---	170	---	500-750	---	30	see standard for impact data
ISO 9328-5:1991	X 8 NiCrAlTi 32 21 TQ1	---	---	Q1	---	---	165	---	430-680	---	25	---
	X 8 NiCrAlTi 32 21 TQ2	---	---	Q2	---	---	210	---	500-750	---	22	---

4.9 Duplex Stainless Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 240/A 240M-03c	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 10028-7:2000	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
ASTM A 240/A 240M-03c	2304	---	S32304	---	---	0.030	2.50	1.00	0.040	0.030	21.5-24.5	3.0-5.5	0.05-0.60	N 0.05-0.20; Cu 0.05-0.60
EN 10028-7:2000	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	N 0.05-0.20; Cu 0.10-0.60
ASTM A 240/A 240M-03c	---	---	S32520	---	---	0.030	1.50	0.80	0.035	0.020	24.0-26.0	5.5-8.0	3.0-4.0	N 0.20-0.35; Cu 0.50-2.00
EN 10028-7:2000	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	N 0.15-0.30; Cu 1.00-2.50
ASTM A 240/A 240M-03c	2507	---	S32750	---	---	0.030	1.20	0.80	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	N 0.24-0.32; Cu 0.50
EN 10028-7:2000	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
ASTM A 240/A 240M-03c	---	---	S32760	---	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	N 0.20-0.30; Cu 0.50-1.00; W 0.50-1.00
EN 10028-7:2000	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	N 0.20-0.30; Cu 0.50-1.00; W 0.50-1.00

4.9 Duplex Stainless Steels for Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 240/A 240M-03c	2205	---	S32205	---	---	---	450	65	655	95	25	---
EN 10028-7:2000	X2CrNiMoN22-5-3	1.4462	---	CR St, AT	t ≤ 6; w < 300	---	465	---	660-950	---	20	see standard for impact data
					t ≤ 6; w ≥ 300	---	480	---				
				HR St, AT	t ≤ 12; w < 300	---	445	---			25	
					t ≤ 12; w ≥ 300	---	460	---				
				HR Pl, AT	t ≤ 75; w < 300	---	445	---	640-840	---	25	
					t ≤ 75; w ≥ 300	---	460	---				
ASTM A 240/A 240M-03c	2304	---	S32304	---	---	---	400	58	600	87	25	---
EN 10028-7:2000	X2CrNiN23-4	1.4362	---	CR St, AT	t ≤ 6; w < 300	---	405	---	600-850	---	20	see standard for impact data
					t ≤ 6; w ≥ 300	---	420	---				
				HR St, AT	t ≤ 12; w < 300	---	385	---				
					t ≤ 12; w ≥ 300	---	400	---				
				HR Pl, AT	t ≤ 75; w < 300	---	385	---	630-800	---	25	
					t ≤ 75; w ≥ 300	---	400	---				
ASTM A 240/A 240M-03c	---	---	S32520	---	---	---	550	80	770	112	25	---
EN 10028-7:2000	X2CrNiMoCuN25-6-3	1.4507	---	CR St, AT	t ≤ 6; w < 300	---	495	---	690-940	---	20	see standard for impact data
					t ≤ 6; w ≥ 300	---	510	---				
				HR St, AT	t ≤ 12; w < 300	---	475	---				
					t ≤ 12; w ≥ 300	---	490	---				
				HR Pl, AT	t ≤ 75; w < 300	---	475	---	690-890	---	25	
					t ≤ 75; w ≥ 300	---	490	---				
ASTM A 240/A 240M-03c	2507	---	S32750	---	---	---	550	80	795	116	15	---
EN 10028-7:2000	X2CrNiMoN25-7-4	1.4410	---	CR St, AT	t ≤ 6; w < 300	---	535	---	750-1000	---	20	see standard for impact data
					t ≤ 6; w ≥ 300	---	550	---				
				HR St, AT	t ≤ 12; w < 300	---	515	---				
					t ≤ 12; w ≥ 300	---	530	---				
				HR Pl, AT	t ≤ 75; w < 300	---	515	---	730-930	---		
					t ≤ 75; w ≥ 300	---	530	---				
ASTM A 240/A 240M-03c	---	---	S32760	---	---	---	550	80	750	108	25	---
EN 10028-7:2000	X2CrNiMoCuWN25-7-4	1.4501	---	HR Pl, AT	t ≤ 75; w < 300	---	515	---	730-930	---	25	see standard for impact data
					t ≤ 75; w ≥ 300	---	530	---				

4.10 Non-Comparable Carbon and Alloy Steels for Pressure Vessel Plates

ASTM A 202/A 202M-03 - Pressure Vessel Plates, Alloy Steel, Chromium-Manganese-Silicon													
Grade, Class, Type	A	B	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K11742	K12542	---	---	---	---	---	---	---	---	---	---	---
ASTM A 225/A 225M-03 - Pressure Vessel Plates, Alloy Steel, Manganese-Vanadium-Nickel													
Grade, Class, Type	C	D	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K12524	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 285/A 285M-03 - Pressure Vessel Plates, Carbon Steel, Manganese-Silicon													
Grade, Class, Type	A	B	C	---	---	---	---	---	---	---	---	---	---
UNS Number	K01700	K02200	K02801	---	---	---	---	---	---	---	---	---	---
ASTM A 299/A 299M-02 - Pressure Vessel Plates, Carbon Steel, Manganese-Silicon													
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K02803	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 387/A 387M-03 - Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum													
Grade, Class, Type	Grade 9 Class 1, 2	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S50400	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 455/A 455M-03 - Pressure Vessel Plates, Carbon Steel, High-Strength Manganese													
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K03300	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 516/A 516M-03 - Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service													
Grade, Class, Type	55 [380]	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K01800	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 517/A 517M-93 (1999) - Pressure Vessel Plates, Alloy Steel, High-Strength, Quenched and Tempered													
Grade, Class, Type	A	B	C	E	F	H	J	K	M	P	Q	S	T
UNS Number	K11856	K11630	K11511	K21604	K11576	K11646	K11625	---	K11683	K21650	---	---	---
ASTM A 533/A 533M-93 (1999) - Pressure Vessel Plates, Alloy Steel, Quenched and Tempered, Manganese-Molybdenum and Manganese-Molybdenum-Nickel													
Grade, Class, Type	Type D Class 1, 2, 3	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K12529	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 542/A 542M-99 - Pressure Vessel Plates, Alloy Steel, Quenched-and-Tempered, Chromium-Molybdenum, and Chromium-Molybdenum-Vanadium													
Grade, Class, Type	Type A, Cl. 1, 2, 3, 4, 4a	Type B, Cl. 1, 2, 3, 4, 4a	Type C, Cl. 1, 2, 3, 4, 4a	Type D, Cl. 1, 2, 3, 4, 4a	Type E, Cl. 4, 4a	---	---	---	---	---	---	---	---
UNS Number	K21590	K21590	K31830	---	---	---	---	---	---	---	---	---	---
ASTM A 543/A 543M-93 (1999) - Pressure Vessel Plates, Alloy Steel, Quenched and Tempered Nickel-Chromium-Molybdenum													
Grade, Class, Type	Type B, Class 1, 2, 3	Type C, Class 1, 2, 3	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K42339	K11224	---	---	---	---	---	---	---	---	---	---	---

4.10 Non-Comparable Carbon and Alloy Steels for Pressure Vessel Plates (Continued)

ASTM A 562/A 562M-90 (2001) - Pressure Vessel Plates, Carbon Steel, Manganese-Titanium for Glass or Diffused Metallic Coatings												
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 645/A 645M-99a - Pressure Vessel Plates, Five Percent Nickel Alloy Steel, Specially Heat Treated												
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K41583	---	---	---	---	---	---	---	---	---	---	---
ASTM A 724/A 724M-99 - Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, Quenched and Tempered, for Welded Layered Pressure Vessels												
Grade, Class, Type	A	B	C	---	---	---	---	---	---	---	---	---
UNS Number	K11831	K12031	K12037	---	---	---	---	---	---	---	---	---
ASTM A 734/A 734M-87a (2003) - Pressure Vessel Plates, Alloy Steel and High-Strength Low-Alloy Steel, Quenched-and-Tempered												
Grade, Class, Type	A	B	---	---	---	---	---	---	---	---	---	---
UNS Number	K21205	K11720	---	---	---	---	---	---	---	---	---	---
ASTM A 735/A 735M-03 - Pressure Vessel Plates, Low-Carbon Manganese-Molybdenum-Columbium Alloy Steel, for Moderate and Lower Temperature Service												
Grade, Class, Type	1, 2, 3, 4	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K10623	---	---	---	---	---	---	---	---	---	---	---
ASTM A 736/A 736M-03 Pressure Vessel Plates, Low-Carbon Age-Hardening Nickel-Copper-Chromium-Molybdenum-Columbium and Nickel-Copper-Manganese-Molybdenum-Columbium Alloy Steel												
Grade, Class, Type	Grade A Class 1, 2, 3	Grade C Class 1, 3	---	---	---	---	---	---	---	---	---	---
UNS Number	K20747	---	---	---	---	---	---	---	---	---	---	---
ASTM A 738/A 738M-03a – Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service												
Grade, Class, Type	Grade D	Grade E	---	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 782/A 782M-90 (2001) - Pressure-Vessel Plates Quenched-and-Tempered, Manganese-Chromium-Molybdenum-Silicon Zirconium Alloy Steel												
Grade, Class, Type	Class 1, 2, 3	---	---	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 832/A 832M-99 - Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum-Vanadium												
Grade, Class, Type	21V	22V	23V	---	---	---	---	---	---	---	---	---
UNS Number	K31830	K31830	K31830	---	---	---	---	---	---	---	---	---
ASTM A 841/A 841M-03a - Steel Plates for Pressure Vessels, Produced by Thermo-Mechanical Control Process (TMCP)												
Grade, Class, Type	Grade D Class 3	Grade E, Class 4	Grade E, Class 5	Grade F, Class 6	Grade F, Class 7	Grade F, Class 8	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---

4.10 Non-Comparable Carbon and Alloy Steels for Pressure Vessel Plates (Continued)

JIS G 3115:2000 - Steel Plates for Pressure Vessels for Intermediate Temperature Service												
Symbol	SPV490	---	---	---	---	---	---	---	---	---	---	---
Previous Symbol	SPV 50	---	---	---	---	---	---	---	---	---	---	---
JIS G 3120:1987 - Carbon Steel and Molybdenum Alloy Steel Plates for Boilers and Other Pressure Vessels												
Steel Name	SB 42	SB 46	SB 49	SB 46 M	SB 49 M	---	---	---	---	---	---	---
Previous Symbol	---	---	---	---	---	---	---	---	---	---	---	---
JIS G 3124:1987 - High Strength Steel Plates for Pressure Vessel for Intermediate and Moderate Temperature Service												
Symbol	SEV 25	SEV 30	SEV 35	---	---	---	---	---	---	---	---	---
Previous Symbol	---	---	---	---	---	---	---	---	---	---	---	---
JIS G 4110:1993 - High Strength Chromium-Molybdenum Alloy Steel Plates for Pressure Vessels Under High-Temperature Service												
Symbol	SCMQ4V	SCMQ5V	---	---	---	---	---	---	---	---	---	---
Previous Symbol	---	---	---	---	---	---	---	---	---	---	---	---
EN 10028-2:2003 - Flat Products Made of Steels for Pressure Purposes - Part 2: Non-Alloy and Alloy Steels With Specified Elevated Temperature Properties												
Steel Name	X12CrMo9-10	13CrMoV9-10	12CrMoV12-10	---	---	---	---	---	---	---	---	---
Steel Number	1.7375	1.7703	1.7767	---	---	---	---	---	---	---	---	---
EN 10028-3:2003 - Flat Products Made of Steels for Pressure Purposes – Part 3: Weldable Fine Grain Steels, Normalized												
Steel Name	P460NH	P460NL1	P460NL2	---	---	---	---	---	---	---	---	---
Steel Number	1.8935	1.8915	1.8918	---	---	---	---	---	---	---	---	---
EN 10028-5:2003 - Flat Products Made of Steels for Pressure Purposes – Part 6: Weldable Fine Grain Steels, Thermomechanically Rolled												
Steel Name	P355M	P355M1	P355M2	P420M	P420M1	P420M2	P460M	P460M1	P460M2	---	---	---
Steel Number	1.8821	1.8832	1.8833	1.8824	1.8835	1.8828	1.8826	1.8837	1.8831	---	---	---
EN 10028-6:2003 - Flat Products Made of Steels for Pressure Purposes – Part 6: Weldable Fine Grain Steels, Quenched and Tempered												
Steel Name	P355Q	P355QH	P355QL1	P355QL2	P460Q	P460QH	P460QL1	P460QL2	P500Q	P500QH	P500QL1	P500QL2
Steel Number	1.8866	1.8867	1.8868	1.8869	1.8870	1.8871	1.8872	1.8864	1.8873	1.8874	1.8875	1.8865
Steel Name	P690Q	P690QH	P690QL1	P690QL2	---	---	---	---	---	---	---	---
Steel Number	1.8879	1.8880	1.8881	1.8888	---	---	---	---	---	---	---	---
ISO 9328-4:1991 - Steel Plates and Strips for Pressure Purposes – Part 4: Weldable Fine Grain Steels with High Proof Stress Supplied in the Normalized or Quenched and Tempered Condition												
Steel Type	P 390 TN	PH 390 TN	PL 390 TN	PLH 390 TN	P 420 TN	PH 420 TN	PL 420 TN	PLH 420 TN	P 460 TN	PH 460 TN	PL 460 TN	PLH 460 TN
Steel Type	P 460 TQ	PH 460 TQ	PL 460 TQ	PLH 460 TQ	P 500 TQ	PH 500 TQ	PL 500 TQ	PLH 500 TQ	P 550 TQ	PH 550 TQ	PL 550 TQ	PLH 550 TQ
Steel Type	P 620 TQ	PH 620 TQ	PL 620 TQ	PLH 620 TQ	P 690 TQ	PH 690 TQ	PL 690 TQ	PLH 690 TQ	---	---	---	---

4.11 Non-Comparable Stainless Steels for Pressure Vessel Plates

ASTM A 240/A 240M-03c Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications														
Grade, Class, Type	---	---	---	---	---	---	410	---	410S	---	---	---	429	
UNS Number	S32803	S40910	S40920	S40930	S40945	S40977	S41000	S41003	S41008	S41045	S41050	S42035	S42900	
Grade, Class, Type	430	434	436	---	XM-33	XM-27	---	---	---	---	---	---	---	
UNS Number	S43000	S43400	S43600	S44500	S44626	S44627	S44635	S44660	S44700	S44735	S44800	S46800	---	
Grade, Class, Type	---	---	201-1, 201-2	---	---	---	202	---	XM-19	XM-31	XM-17	XM-18	---	
UNS Number	N08020	N08367	S20100	S20103	S20153	S20161	S20200	S20400	S20910	S21400	S21600	S21603	S21800	
Grade, Class, Type	XM-29	301	301L	302	---	XM-21	305	---	---	---	---	309S	309Cb	
UNS Number	S24000	S30100	S30103	S30200	S30415	S30452	S30500	S30600	S30601	S30615	S30815	S30908	S30940	
Grade, Class, Type	309HCb	310S	310Cb	310HCb	310MoLN	---	---	316N	317	317LM	---	---	---	
UNS Number	S30941	S31008	S31040	S31041	S31050	S31254	S31266	S31651	S31700	S31725	S32050	S32615	S32654	
Grade, Class, Type	---	334	---	348	348H	---	---	---	XM-15	---	---	---	---	
UNS Number	S33228	S33400	S34565	S34800	S34809	S35045	S35135	S35315	S38100	S31200	---	---	---	
Grade, Class, Type	---	---	---	255	329	---	---	---	---	---	---	---	---	
UNS Number	S31260	S31803	S32001	S32550	S32900	S32950	---	---	---	---	---	---	---	

EN 10028-7:2000 Flat Products Made of Steels for Pressure Purposes - Part 7: Stainless Steels								
Steel Name	X1CrNiMoN25-22-2	X4CrNiMo16-5-1	X1CrNiMoCuN25-25-5	X1CrNiMoCuN20-18-7	X3CrNiMoBN17-13-3	X1NiCrMoCu31-27-4	X5NiCrAlTi31-20 (+RA)	X1CrNi25-21
Steel Number	1.4466	1.4418	1.4537	1.4547	1.4910	1.4563	1.4958 (+RA)	1.4335
Steel Name	X2CrTi17	---	---	---	---	---	---	---
Steel Number	1.4520	---	---	---	---	---	---	---

ISO 9328-5:1991 Steel Plates and Strips for Pressure Purposes - Technical Delivery Conditions - Part 5: Austenitic Steels								
Steel Type	X 7 CrNiMoB 17 12	---	---	---	---	---	---	---

Chapter 5

STEEL TUBES AND PIPES

ASTM Standards

ASTM A 53/A 53M-02	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 106-02a	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 135-01	Electric-Resistance-Welded Steel Pipe
ASTM A 139-00	Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
ASTM A 178/A 178M-02	Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes *Note: Mechanical properties data are supplementary requirements, provided for information only.*
ASTM A 179/A 179M-90a (2001)	Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes *Note: Mechanical properties data are supplementary requirements, provided for information only.*
ASTM A 192/A 192-02	Seamless Carbon Steel Boiler Tubes for High-Pressure Service *Note: Mechanical properties data are supplementary requirements, provided for information only.*
ASTM A 209/A 209-03	Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes
ASTM A 210/A 210M-02	Seamless Medium-Carbon Steel Boiler and Superheater Tubes
ASTM A 213/A 213M-03a	Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
ASTM A 214/A 214M-96 (2001)	Electric-Resistance-Welded Carbon Steel Heat-Exchanger and Condenser Tubes
ASTM A 249/A 249M-03	Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes
ASTM A 250/A 250M-95 (2001)	Electric-Resistance-Welded Ferritic Alloy-Steel Boiler and Superheater Tubes
ASTM A 268/A 268M-03	Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
ASTM A 269-02a	Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A 312/A 312M-03	Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 333/A 333M-99	Seamless and Welded Steel Pipe for Low-Temperature Service
ASTM A 334/A 334M-99	Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service
ASTM A 335/A 335M-03	Seamless Ferritic Alloy-steel Pipe for High-Temperature Service
ASTM A 358/A 358M-01	Electric-Fusion–Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service
ASTM A 376/A 376M-02a	Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service
ASTM A 409/A 409M-01	Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service
ASTM A 500-03	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501-01	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 511-96	Seamless Stainless Steel Mechanical Tubing *Note: Mechanical properties data are supplementary requirements, provided for information only.*
ASTM A 512-96 (2001)	Cold-Drawn Buttweld Carbon Steel Mechanical Tubing *Note: Mechanical properties data are supplementary requirements, provided for information only.*
ASTM A 513-00	Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing *Note: Mechanical properties data are supplementary requirements, provided for information only.*
ASTM A 519-03	Seamless Carbon and Alloy Steel Mechanical Tubing *Note: Mechanical properties data are supplementary requirements, provided for information only. Data are "typical" values.*
ASTM A 554-03	Welded Stainless Steel Mechanical Tubing *Note: Mechanical properties data are supplementary requirements, provided for information only.*
ASTM A 556/A 556M-96 (2001)	Seamless Cold-Drawn Carbon Steel Feedwater Heater Tubes
ASTM A 595-98 (2002)	Steel Tubes, Low-Carbon, Tapered for Structural Use
ASTM A 632-02a	Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service
ASTM A 688/A 688M-03	Welded Austenitic Stainless Steel Feedwater Heater Tubes
ASTM A 778-01	Welded, Unannealed Austenitic Stainless Steel Tubular Products
ASTM A 803/A 803M-03	Welded Ferritic Stainless Steel Feedwater Heater Tubes
ASTM A 984/A 984M-03	Steel Line Pipe, Black, Plain-End, Electric-Resistance-Welded
ASTM A 1005/A 1005M-00	Steel Line Pipe, Black, Plain End, Longitudinal and Helical Seam, Double Submerged-Arc Welded

SAE Standard

SAE J526 JAN00	Welded Low-Carbon Steel Tubing

API Standard

API 5L-2004	Specification for Line Pipe

CSA Standard

CSA Z245.1-2002	Steel Line Pipe

JIS Standards

JIS G 3441:1988	Alloy Steel Tubes for Machine Purposes
JIS G 3444:1994	Carbon Steel Tubes for General Structural Purposes
JIS G 3445:1988	Carbon Steel Tubes for Machine Structural Purposes
JIS G 3446:1994	Stainless Steel Pipes for Machine and Structural Purposes
JIS G 3452:1997	Carbon Steel Pipes for Ordinary Piping
JIS G 3454:1988	Carbon Steel Pipes for Pressure Service
JIS G 3455:1988	Carbon Steel Pipes for High Pressure Service
JIS G 3456:1988	Carbon Steel Pipes for High Temperature Service
JIS G 3457:1988	Arc Welded Carbon Steel Pipes
JIS G 3458:1988	Alloy Steel Pipes
JIS G 3459:1997	Stainless Steel Pipes
JIS G 3460:1988	Steel Pipes for Low Temperature Service
JIS G 3461:1988	Carbon Steel Boiler and Heat Exchanger Tubes
JIS G 3462:1988	Alloy Steel Boiler and Heat Exchanger Tubes
JIS G 3463:1994	Stainless Steel Boiler and Heat Exchanger Tubes
JIS G 3464:1988	Steel Heat Exchanger Tubes for Low Temperature Service
JIS G 3467:1988	Steel Tubes for Fired Heater
JIS G 3468:1994	Large Diameter Welded Stainless Steel Pipes
JIS G 3472:1988	Electric Resistance Welded Carbon Steel Tubes for Automobile Structural Purposes
JIS G 3473:1988	Carbon Steel Tubes for Cylinder Barrels
JIS G 3474:1995	High Tensile Strength Steel Tubes for Tower Structural Purposes

BSI Standards

BSI BS 3604-2:1991	Steel Pipes and Tubes for Pressure Purposes: Ferritic Alloy Steel with Specified Elevated Temperature Properties – Specification for Longitudinally Arc Welded Tubes
BSI BS 3605-1:1991 AMD 2:1997	Austenitic Stainless Steel Pipes and Tubes for Pressure Purposes Part 1: Specification for Seamless Tubes
BSI BS 3605-2:1992 AMD 1:1997	Austenitic Stainless Steel Pipes and Tubes for Pressure Purposes Part 2: Specification for Longitudinally Welded Tubes
BSI BS 6323-8:1982	Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes Part 8: Specific Requirements for Longitudinally Welded Stainless Steel Tubes

DIN Standards

DIN 1615:1984	Welded Circular Unalloyed Steel Tubes Not Subject to Special Requirements
DIN 1630:1984	High Performance Seamless Circular Unalloyed Steel Tubes
DIN 17455:1999	General Purpose Welded Circular Stainless Steel Tubes - Technical Delivery Conditions
DIN 17456:1999	General Purpose Seamless Circular Stainless Steel Tubes - Technical Delivery Conditions
DIN 17457:1985	Welded Circular Austenitic Stainless Steel Tubes Subject to Special Requirements - Technical Delivery Conditions
DIN 17458:1985	Seamless Circular Austenitic Stainless Steel Tubes Subject to Special Requirements - Technical Delivery Conditions
DIN 17459:1992	Seamless Circular High-Temperature Austenitic Steel Tubes - Technical Delivery Conditions
DIN 28180:1985	Seamless Steel Tubes for Tubular Heat Exchangers; Dimensions, Dimensional Deviations and Materials
DIN 28181:1985	Welded Steel Tubes for Tubular Heat Exchangers; Dimensions, Dimensional Deviations and Materials

AFNOR Standards

AFNOR NF A 49-141:1978	Welded Plain End Tubes of Commercial Quality for General Purposes at Mean Pressure Dimensions - Technical Delivery Conditions
AFNOR NF A 49-214:1978	Seamless Austenitic Steel Tubes for Use at High Temperatures. Dimensions (With Normal Tolerances) - Technical Conditions of Delivery
AFNOR NF A 49-217:1987	Seamless Tubes for Heat Exchangers - Stainless Ferritic, Austenic or Ferritic-Austenitic Steel Grades Dimensions - Technical Delivery Conditions
AFNOR NF A 49-220:1990	Grooved Seamless Steel Tubes for Use at High Temperature - Dimensions - Technical Delivery Conditions
AFNOR NF A 49-244:1993	Welded Austenitic Stainless and Austenitic Ferritic Steel Rolled Tubes for Pressure Service - Dimensions, Technical Conditions for Delivery
AFNOR NF A 49-247:1981	Tubes Welded Longitudinally for Heat Exchangers - Austenitic Stainless Steels Dimensions - Technical Delivery Conditions
AFNOR NF A 49-250:1979	Welded Plain End Tubes of Commercial Quality with or without Special Delivery Conditions Dimensions (D Superior or Equal to 168.3 mm) - Technical Delivery Conditions

AFNOR Standards (Continued)

AFNOR NF A 49-317:1980	Seamless Plain End Tubes for Engineering Use. Austenitic Stainless Steels 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

CEN Standards

EN 10208-1:1997	Steel Pipes for Pipelines for Combustible Fluids – Technical Delivery Conditions – Part 1: Pipes of Requirement Class A
EN 10208-2:1996	Steel Pipes for Pipelines for Combustible Fluids – Technical Delivery Conditions – Part 2: Pipes of Requirement Class B
EN 10216-1:2002	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 1: Non-alloy steel tubes with specified room temperature properties
EN 10216-2:2002	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties
EN 10216-3:2002	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 3: Alloy fine grain steel tubes
EN 10216-4:2002	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 4: Non-alloy and alloy steel tubes with specified low temperature properties
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 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 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 10305-1:2002	Steel tubes for precision applications – Technical delivery conditions – Part 1: Seamless cold drawn tubes
EN 10305-2:2002	Steel tubes for precision applications – Technical delivery conditions – Part 2: Welded cold drawn tubes
EN 10305-3:2002	Steel tubes for precision applications – Technical delivery conditions – Part 3: Welded cold sized tubes

ISO Standards

ISO 2604-II:1975	Steel Products for Pressure Purposes - Quality Requirements - Part 2: Wrought Seamless Tubes
ISO 2604-III:1975	Steel Products for Pressure Purposes - Quality Requirements - Part 3: Electric Resistance and Induction-Welded Tubes
ISO 2604-V:1978	Steel Products for Pressure Purposes - Quality Requirements - Part 5: Longitudinally Welded Austenitic Stainless Steel Tubes
ISO 2937:1974	Plain End Seamless Steel Tubes for Mechanical Application
ISO 3183-1:1996	Steel Pipe for Pipelines - Technical Delivery Conditions - Part 1: Pipes of Requirement Class A
ISO 3183-2:1996	Steel Pipe for Pipelines - Technical Delivery Conditions - Part 2: Pipes of Requirements Class B
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 9329-3:1997	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

Heat Treatment Terms Applicable to this Chapter

5.1 Tubes for General and Structural Applications

Standard	Heat Treatment Terms
AFNOR NF A 49-141:1978	HR: hot rolled; CF + T: cold finished and tempered
AFNOR NF A 49-250:1979	AM: as manufactured
AFNOR NF A 49-317:1980	HQ: hyperquenched
AFNOR NF A 49-647:1979	AM: as manufactured
ASTM A 268/A 268M-03	HT: heat treat
ASTM A 269-02a	HT: heat treat
ASTM A 500-03	CF: cold formed; SR: stress relieved; A: annealed; HT: heat treated
ASTM A 501-01	HF: hot formed
ASTM A 511-96	A: annealed
ASTM A 512-96 (2001)	SA: soft-annealed; SR A: stress relief annealed
ASTM A 513-03a	AW: as-welded; N: normalized; SD: sink-drawn; MD: mandrel-drawn; MD SR: mandrel-drawn stress-relieved
ASTM A 519-03	HR: hot rolled; CW: cold worked; SR: stress relieved; A: annealed; N: normalized; AM: as manufactured
ASTM A 554-03	A: annealed
ASTM A 595-98 (2002)	RCCM: roll compressed cold on a mandrel
ASTM A 632-02a	HT: heat treat
ASTM A 778-01	AM: as manufacture
DIN 1615:1984	AD: as delivered
DIN 17455:1999	A: annealed; SA+Q: solution annealed and quenched
DIN 17456:1999	A: annealed; SA+Q: solution annealed and quenched; SA+Q (HW): solution annealed and quenched, suitable for hot worked tubes
EN 10296-1:2003	CR: cold rolled; A: annealed; N: full tube normalized; NW: normalized weld zone; U: see standard; TMR: thermomechanically rolled
EN 10297-1:2003	AR: as rolled; N: normalized; QT: quenched and tempered
EN 10305-1:2002	A: annealed; C: cold drawn, hard; LC: cold drawn, soft; N: normalized; SR: cold drawn and stress relieved
EN 10305-2:2002	A: annealed; C: cold drawn, hard; LC: cold drawn, soft; N: normalized; SR: cold drawn and stress relieved
EN 10305-3:2002	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
EN 10305-4:2003	N: normalized
EN 10305-5:2003	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
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 3441:1988	AM: as manufactured; CF: cold finished; A: annealed
JIS G 3444:1994	AM: as manufactured
JIS G 3445:1988	AM: as manufactured; CF: cold formed; AHT: appropriate heat treatment
JIS G 3446:1994	ST: solution treatment; AM: as manufactured; A: annealed
JIS G 3472:1988	See standard
JIS G 3473:1988	AM: as manufactured; CF, SR: cold formed and stress relieved
JIS G 3474:1995	AM: as manufactured
SAE J526 JAN00	See standard

Heat Treatment Terms Applicable to this Chapter (Continued)

5.2 Tubes for Heat Transfer Applications

Standard	Heat Treatment Terms
AFNOR NF A 49-217:1987	HF + CR + T: hot formed + cold rolled + tempered; HF + CR + Q (HY): hot formed + cold rolled + hyperquenched
AFNOR NF A 49-247:1981	Q (HY): hyperquenched
ASTM A 178/A 178M-02	See standard
ASTM A 179/A 179M-90a (2001)	CD + 1200°F min: cold drawn + heat treated at 1200°F or higher
ASTM A 192-02	HF: hot finished; CF + 1200°F min: cold finished + heat treated at 1200°F or higher
ASTM A 209-98	See standard
ASTM A 210/A 210M-02	HF: hot finished; cf: cold finished; SA: subcritical anneal; A: full anneal; N: normalizing
ASTM A 213/A 213M-03a	A: annealed; IA: isothermal annealed; NT: normalized and tempered
ASTM A 214/A 214M-96 (2001)	See standard
ASTM A 249/A 249M-03	H + RC: heat + rapid cool; ST: solution treated; H + WQ or RC: heat + water quench or rapid cool
ASTM A 250/A 250M-95 (2001)	A: full annealed; IA: isothermal annealed; N: normalized; NT: normalized and tempered
ASTM A 556/A 556M-96 (2001)	CD + 1200°F min: cold drawn + heat treated to 1200°F or higher
ASTM A 688/A 688M-03	SA: solution-annealed
ASTM A 803/A 803M-03	SA: solution-annealed
DIN 28180:1985	N: normalized; V (QT): quenched and tempered; see standard; SA & Q: solution annealed and quenched
DIN 28181:1985	N: normalized; NG: normalized starting product, weld only normalized; AD: as delivered; see standard; SA & Q: solution annealed and quenched
ISO 2604-2:1975	HF: hot finished; SCA: subcritical annealed; A: annealed; N: normalized; T: tempered; Q: quenched
ISO 2604-3:1975	A: annealed; HR: hot-reduced; N: normalized; SCA: subcritical annealed; T: tempered; W: welded
ISO 2604-5:1978	Q: quenched
EN 10216-1:2002	HF: hot formed; HFCF: hot formed cold finished; AF: as formed; N: normalized; NF: normalizing formed;
EN 10216-2:2002	I: isothermal annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
EN 10217-1:2002	See standard
EN 10217-2:2002	See standard
JIS G 3461:1988	See standard
JIS G 3462:1988	LTA: low temperature annealing; IA: isothermal annealing; A: full annealing; N: normalizing; NT: normalizing and tempering
JIS G 3463:1994	A: annealed; ST: solution treatment
JIS G 3467:1988	HFS: hot finished seamless; CFS: cold finished seamless; AM: as manufactured; LTA: low temperature annealing; IA: isothermal annealing; A: full annealing; N: normalizing; NT: normalizing and tempering; ST: solution treatment;

5.3 Tubes for Low Temperature Service

Standard	Heat Treatment Terms
ASTM A 334/A 334M-99	N: normalized; NT: normalized and tempered; QT: quenched and tempered; NNT: double normalized and tempered
ISO 9329-3:1997	N: normalized; QT: quenched and tempered
ISO 9330-3:1997	N: normalizing; QT: quenching and tempering
ISO 9330-5:2000	N: normalizing; QT: quenching and tempering
EN 10216-4:2002	N: normalized; NT: normalized and tempered; QT: quenched and tempered
EN 10217-4:2002	See standard
JIS G 3464:1988	N: normalizing; NT: normalizing and tempering; NNT: double normalizing and tempering; QT: quenching and tempering

Heat Treatment Terms Applicable to this Chapter (Continued)

5.4 Tubes and Pipes for Pressure Service

Standard	Heat Treatment Terms
ASTM A 53/A 53M-99b	AM: as manufactured; T: tempered
ASTM A 106-99	HF: hot finished; CD + 1200°F min: cold drawn + heat treated at 1200°F or higher
ASTM A 135-97c	AM: as manufactured; T: tempered
ASTM A 139-00	See standard
ASTM A 312/A 312M-00	HF: hot finished; CF: cold finished; A: annealed
ASTM A 333/A 333M-99	See standard; QT: quenched and tempered; NNT: double normalized and tempered;
ASTM A 335/A 335M-99	FA: full annealed; IA: isothermal annealed; NT: normalized and tempered
ASTM A 358/A 358M-98	H: heat at specified temperature and water quench or rapid cool; 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 A 376/A 376M-98	See standard
ASTM A 409/A 409M-95a	H: heat at specified temperature and water quench or rapid cool; 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
BS 1387:1985	See standard
BS 3604-2:1991	See standard
BS 3605-1: 1991	ST: solution treated; HF: hot finished
BS 3605-2: 1992	AW: as welded; ST: solution treated
DIN 1615:1984	AD: as delivered
DIN 1630:1984	AD: as delivered
DIN 17457:1985	SA & Q: solution annealed and quenched
DIN 17458:1985	SA & Q: solution annealed and quenched
DIN 17459:1992	SHT: solution heat treated; A/R: annealed for recrystallization
EN 10216-1:2002	HF: hot formed; HFCF: hot formed cold finished; AF: as formed; N: normalized; NF: normalizing formed;
EN 10216-2:2002	I: isothermal annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered; NF: normalizing formed
EN 10216-3:2002	HF: hot finished; HRCF: hot rolled and cold finished; N: normalized; NF: normalizing formed; QT: quenched and tempered
EN 10216-4:2002	N: normalized; NT: normalized and tempered; QT: quenched and tempered
JIS G 3452:1997	AM: as manufactured; CF + A: cold finished and annealed
JIS G 3454:1988	AM: as manufactured; CF + A: cold finished and annealed
JIS G 3455:1988	HFS: AM: hot-finished seamless: as manufactured; CFS: LTA or N: cold-finished seamless: low temperature annealed or normalized
JIS G 3456:1988	See standard
JIS G 3457:1988	AW: As welded; ACE: as cold expanded
JIS G 3458:1988	LTA: low temperature annealing; IA: isothermal annealing; FA: full annealing; N: normalized; NT: normalized and tempered
JIS G 3459:1997	ST: solution treatment; CF: cold finished; HF: hot finished
JIS G 3460:1988	N: normalized; NT: normalized and tempered; N1N2T: double normalized and tempered; QT: quenched and tempered
JIS G 3468:1994	AM: as manufactured
NF A 49-214:1978	L: hot finished; F: cold finished; H + RC: heat + rapid cool
NF A 49-220:1990	N: normalized; T: tempered
NF A 49-244:1993	ST: no thermal treatment; TT: with thermal treatment

Heat Treatment Terms Applicable to this Chapter (Continued)

5.5 Line Pipe Steels

Standard	Heat Treatment Terms
ASTM A 1005/A 1005M-00	See standard
ASTM A 984/A 984M-00	See standard
API 5L - 2000	See standard
CSA Z245.1 - 2000	See standard
EN 10208-1:1998	See standard
EN 10208-2:1996	See standard
ISO 3183-1:1996	See standard S/NE/CE: seamless, non-expanded or cold expanded S/NE: seamless, non-expanded S/CE: seamless, cold expanded W/EW/CW: welded, electric-welded or continuous welded W/NE/CE: welded, non-expanded or cold expanded W/NE: welded, non-expanded W/CE: welded, cold expanded
ISO 3183-2:1996	See standard

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10296-1:2003	E155	1.0033	---	A	---	---	---	---	260	---	28	---
EN 10305-3:2002	E155	1.0033	---	A	---	---	---	---	260	---	28	see standard
EN 10305-2:2002	E155	1.0033	---	A	---	---	130	---	260	---	28	see standard
ASTM A 513-03a*	1008	---	G10080	N	---	---	159	23	262	38	30	65 HRB max
ISO 3304:1985	R28	---	---	GBK & GZF	---	---	---	---	270	---	30	---
ISO 3305:1985	R28	---	---	GBK & GZF	---	---	---	---	270	---	30	---
ISO 3306:1985	R28	---	---	GKM & GZF	---	---	---	---	270	---	30	---
EN 10305-2:2002	E155	1.0033	---	N	---	---	155	---	270-410	---	28	see standard
EN 10305-3:2002	E155	1.0033	---	N	---	---	155	---	270-410	---	28	see standard
EN 10296-1:2003	E155	1.0033	---	N	---	---	155	---	270	---	28	---
	E190	1.0031	---	CR	---	---	190	---	270	---	26 L; 24 T	---
EN 10305-3:2002	E190	1.0031	---	CR2	---	---	190	---	270	---	26	see standard
ASTM A 512-96 (2001)*	MT 1010	---	G10100	SA	---	---	138	20	276	40	35	40-65 HRB
ASTM A 513-03a*	1010	---	G10100	N	---	---	172	25	276	40	30	65 HRB max
EN 10305-1:2002	E215	1.0212	---	A	---	---	140	---	280	---	30	see standard
ISO 3304:1985	R28	---	---	NBK & NZF	---	---	155	---	280	---	28	---
ISO 3305:1985	R28	---	---	NBK & NZF	---	---	155	---	280	---	28	---
ISO 3306:1985	R28	---	---	NKM & NZF	---	---	155	---	280	---	28	---
JIS G 3444:1994	STK290	---	---	AM	---	---	---	---	290	---	30	---
JIS G 3445:1988	STKM 11 A	---	---	AM, CF, or AHT	---	---	---	---	290	---	35	---
JIS G 3452:1997	SGP	---	---	see standard	---	---	---	---	290	---	30 L; 25 T	---
EN 10305-3:2002	E155	1.0033	---	CR1	---	---	---	---	290	---	15	see standard
	E195	1.0034	---	A	---	---	---	---	290	---	28	see standard
EN 10305-2:2002	E195	1.0034	---	A	---	---	145	---	290	---	28	see standard
SAE J526 JAN 00	---	---	G10080 G10100	---	---	---	170	---	290	---	14	65 HR30T max
EN 10296-1:2003	E155	1.0033	---	U, NW	---	---	175	---	290	---	15	---
JIS G 3472:1988	STAM 290 GA	---	---	see standard	≤ 25	---	175	---	290	---	40	---
	STAM 290 GB	---	---	see standard	---	---	175	---	290	---	35	---
DIN 1615:1984	St 33	1.0035	---	AD	≤ 25	---	175	---	290-540	---	17 L; 15 T	---
ASTM A 513-03a*	1008	---	G10080	AW	---	---	207	30	290	42	15	50 HRB min
EN 10305-1:2002	E215	1.0212	---	N	---	---	215	---	290-430	---	30	see standard
ASTM A 512-96 (2001)*	MT 1015	---	G10150	SA	---	---	172	25	296	43	34	40 HRB min

*: 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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10305-3:2002	E195	1.0034	---	N	---	---	195	---	300-440	---	28	see standard
EN 10296-1:2003	E235	1.0308	---	N	---	---	235	---	300	---	25	---
ISO 3306:1985	R28	---	---	KM	---	---	---	---	300	---	10	---
ASTM A 512-96 (2001)*	1015	---	G10150	---	---	---	---	---	---	---	---	---
ASTM A 513-03a*	1015	---	G10150	N	---	---	207	30	310	45	30	70 HRB max
EN 10305-3:2002	E220	1.0215	---	CR2	---	---	220	---	310	---	23	see standard
ASTM A 513-03a*	1010	---	G10100	AW	---	---	221	32	310	45	15	55 HRB min
ASTM A 512-96 (2001)*	1012	---	---	---	---	---	---	---	---	---	---	---
ASTM A 500-03	A	---	K03000	CF, SR, A	---	---	228	33	310	45	25	---
EN 10296-1:2003	E220	1.0215	---	CR	---	---	220	---	310	---	23 L; 21 T	---
	E235	1.0308	---	A	---	---	---	---	315	---	25	---
EN 10305-3:2002	E235	1.0308	---	A	---	---	---	---	315	---	25	see standard
EN 10305-1:2002	E235	1.0308	---	A	---	---	158	---	315	---	25	see standard
ISO 3304:1985	R33	---	---	GBK & GZF	---	---	---	---	320	---	27	---
ISO 3305:1985	R33	---	---	GBK & GZF	---	---	---	---	320	---	27	---
ISO 3306:1985	R33	---	---	GKM & GZF	---	---	---	---	320	---	27	---
ISO 3304:1985	R33	---	---	NBK & NZF	---	---	195	---	320	---	25	---
ISO 3305:1985	R33	---	---	NBK & NZF	---	---	195	---	320	---	25	---
ISO 3306:1985	R33	---	---	NKM & NZF	---	---	195	---	320	---	25	---
EN 10296-1:2003	E195	1.0034	---	A	---	---	---	---	300	---	28	---
				N	---	---	195	---	300	---	28	---
EN 10305-2:2002	E195	1.0034	---	N	---	---	195	---	300-440	---	28	see standard
	E235	1.0308	---	A	---	---	158	---	315	---	25	see standard
ISO 2937:1974	TS 1	---	---	HF	---	---	195	---	320-440	---	25	---
ISO 3306:1985	R33	---	---	KM	---	---	---	---	330	---	8	---
EN 10305-3:2002	E195	1.0034	---	CR1	---	---	---	---	330	---	8	see standard
EN 10296-1:2003	E195	1.0034	---	U, NW	---	---	250	---	330	---	8	---
ASTM A 519-03	1020	---	G10200	A	---	---	193	28	331	48	30	50 HRB
ASTM A 513-03a*	1015	---	G10150	AW	---	---	241	35	331	48	15	58 HRB min
	1008	---	G10080	SD	---	---	262	38	331	48	8	65 HRB min
ISO 3304:1985	R37	---	---	GBK & GZF	---	---	---	---	340	---	26	---
ISO 3305:1985	R37	---	---	GBK & GZF	---	---	---	---	340	---	26	---
ISO 3306:1985	R37	---	---	GKM & GZF	---	---	---	---	340	---	26	---
JIS G 3445:1988	STKM 12 A	---	---	AM, CF, or AHT	---	---	175	---	340	---	35	---
JIS G 3472:1988	STAM 340 G	---	---	see standard	---	---	195	---	340	---	35	---
EN 10305-1:2002	E235	1.0308	---	N	---	---	235	---	340-480	---	25	see standard
EN 10305-2:2002	E235	1.0308	---	N	---	---	235	---	340-480	---	25	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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10305-3:2002	E235	1.0308	---	N	---	---	235	---	340-550	---	25	see standard
EN 10296-1:2003	E260	1.0220	---	CR	---	---	260	---	340	---	21 L; 19 T	---
EN 10305-3:2002	E260	1.0220	---	CR2	---	---	260	---	340	---	21	see standard
ASTM A 519-03	1020	---	G10200	HR	---	---	221	32	345	50	25	55 HRB
ASTM A 513-03a*	1020	---	G10200	N	---	---	241	35	345	50	25	75 HRB max
	1021	---	G10210	N	---	---	241	35	345	50	25	78 HRB max
	1010	---	G10100	SD	---	---	276	40	345	50	8	65 HRB min
ASTM A 512-96 (2001)*	MT 1020	---	G10200	SA	---	---	207	30	345	50	32	50 HRB min
ISO 3304:1985	R28	---	---	BKW	---	---	---	---	350	---	10	---
ISO 3305:1985	R28	---	---	BKW	---	---	---	---	350	---	10	---
EN 10305-2:2002	E155	1.0033	---	LC	---	---	245	---	350	---	10	see standard
				SR	---	---	245	---	350	---	18	
ASTM A 513-03a*	1020	---	G10200	AW	---	---	262	38	359	52	12	62 HRB min
ISO 2937:1974	TS 4	---	---	HF	---	---	215	---	360-480	---	24	---
ISO 3304:1985	R37	---	---	NBK & NZF	---	---	215	---	360	---	24	---
ISO 3305:1985	R37	---	---	NBK & NZF	---	---	215	---	360	---	24	---
ISO 3306:1985	R37	---	---	NKM & NZF	---	---	215	---	360	---	24	---
AFNOR NF A 49-141:1978	TS 37-a	---	---	HR or CF+T	---	---	235	---	360	---	25	---
AFNOR NF A 49-250:1979	TS E 24-a	---	---	AM	---	---	235	---	360	---	23	---
EN 10297-1:2003	E235	1.0308	---	AR+N	≤ 16	---	235	---	360	---	25 L; 23 T	---
					16 < t ≤ 40	---	225	---	360			
					40 < t ≤ 65	---	215	---	360			
					65 < t ≤ 80	---	205	---	340			
					80 < t ≤ 100	---	195	---				
ASTM A 519-03	1025	---	G10250	A	---	---	207	30	365	53	25	57 HRB
ISO 3304:1985	R33	---	---	BKW	---	---	---	---	370	---	10	---
ISO 3305:1985	R33	---	---	BKW	---	---	---	---	370	---	10	---
JIS G 3473:1988	STC 370	---	---	AM	---	---	215	---	370	---	30	---
JIS G 3445:1988	STKM 13 A	---	---	AM, CF, or AHT	---	---	215	---	370	---	30	---
EN 10305-2:2002	E195	1.0034	---	LC	---	---	259	---	370	---	10	see standard
				SR	---	---	260	---	370	---	18	
EN 10296-1:2003	E275K2	1.0456	---	---	≤ 16	---	275	---	370	---	24 L; 22 T	40 J at -20°C
					>16	---	265	---				
ASTM A 513-03a*	1021	---	G10210	AW	---	---	276	40	372	54	12	62 HRB min
ASTM A 519-03	1020	---	G10200	N	---	---	234	34	379	55	22	60 HRB
ASTM A 512-96 (2001)*	MT 1025	---	G10250	SA	---	---	241	35	379	55	32	55 HRB 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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 519-03	1025	---	G10250	HR	---	---	241	35	379	55	25	60 HRB
				N	---	---	248	36	379	55	22	60 HRB
ASTM A 513-03a*	1025	---	G10250	N	---	---	255	37	379	55	25	80 HRB max
	1008	---	G10080	MD SR	---	---	310	45	379	55	12	68 HRB min
	1010	---	G10100	MD SR	---	---	310	45	379	55	12	68 HRB min
	1015	---	G10150	SD	---	---	310	45	379	55	8	67 HRB min
EN 10305-1:2002	E215	1.0212	---	LC	---	---	266	---	380	---	12	see standard
				SR			280	---	380	---	16	
ASTM A 513-03a*	1025	---	G10250	AW	---	---	276	40	386	56	12	65 HRB min
EN 10296-1:2003	E275	1.0225	---	A	---	---	---	---	390	---	21	---
EN 10305-1:2002	E255	1.0408	---	C	---	---	---	---	390	---	21	see standard
EN 10305-3:2002	E275	1.0225	---	A	---	---	---	---	390	---	21	
	E235	1.0308	---	CR1	---	---	---	---	390	---	7	see standard
EN 10305-2:2002	E275	1.0225	---	A	---	---	195	---	390	---	21	see standard
EN 10296-1:2003	E235	1.0308	---	U, NW	---	---	300	---	390	---	7	---
JIS G 3472:1988	STAM 390 G	---	---	see standard	---	---	235	---	390	---	30	---
JIS G 3445:1988	STKM 12 B	---	---	AM, CF, or AHT	---	---	275	---	390	---	25	---
ISO 3304:1985	R28	---	---	BK	---	---	---	---	400	---	8	---
	R37	---	---	BKW	---	---	---	---	400	---	9	---
	R44	---	---	GBK & GZF	---	---	---	---	400	---	24	---
ISO 3305:1985	R28	---	---	BK	---	---	---	---	400	---	8	---
	R37	---	---	BKW	---	---	---	---	400	---	9	---
	R44	---	---	GBK & GZF	---	---	---	---	400	---	24	---
ISO 3306:1985	R37	---	---	KM	---	---	---	---	400	---	7	---
	R44	---	---	GKM & GZF	---	---	---	---	400	---	24	---
EN 10305-2:2002	E155	1.0033	---	C	---	---	320	---	400	---	6	see standard
JIS G 3444:1994	STK400	---	---	AM	---	---	235	---	400	---	23	---
ASTM A 500-03	D	---	---	HT	---	---	250	36	400	58	23	---
ASTM A 501-01	---	---	K03000	HF	---	---	250	36	400	58	23	---
ASTM A 500-03	B	---	K03000	CF, SR, A	---	---	290	42	400	58	23	---
EN 10296-1:2003	E275	1.0225	---	N	---	---	275	---	410	---	21	---
EN 10297-1:2003	E275	1.0225	---	AR+N	≤ 16	---	275	---	410	---	22 L; 20 T	---
					16 < t ≤ 40	---	265	---	410			
					40 < t ≤ 65	---	255	---	410			
					65 < t ≤ 80	---	245	---	380			
					80 < t ≤ 100	---	235	---				

*: 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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10305-2:2002	E275	1.0225	---	N	---	---	275	---	410-550	---	21	see standard
AFNOR NF A 49-250:1979	TS E 26-b	---	---	AM	---	---	255	---	410-490	---	23	---
EN 10305-3:2002	E275	1.0225	---	N	---	---	275	---	410-550	---	21	see standard
EN 10296-1:2003	E320	1.0237	---	CR	---	---	320	---	410	---	19 L; 17 T	---
EN 10305-3:2002	E320	1.0237	---	CR2	---	---	320	---	410	---	19	see standard
EN 10297-1:2003	E275K2	1.0456	---	N	≤ 16	---	275	---	410	---	22 L; 20 T	L: 40 J at -20°C T: 27 J at -20°C
					16 < t ≤ 40	---	265	---	410			
					40 < t ≤ 65	---	255	---	410			
					65 < t ≤ 80	---	245	---	380			
					80 < t ≤ 100	---	235	---				
ISO 2937:1974	TS 9	---	---	HF	---	---	235	---	410-530	---	22	---
JIS G 3445:1988	STKM 14 A	---	---	AM, CF, or AHT	---	---	245	---	410	---	25	---
ASTM A 519-03	1035	---	G10350	A	---	---	228	33	414	60	25	67 HRB
ASTM A 513-03a*	1026	---	G10260	N	---	---	276	40	414	60	25	85 HRB max
	1030	---	G10300	N	---	---	276	40	414	60	25	85 HRB max
	1008	---	G10080	MD	---	---	345	50	414	60	5	73 HRB min
	1010	---	G10100	MD	---	---	345	50	414	60	5	73 HRB min
	1015	---	G10150	MD SR	---	---	345	50	414	60	12	72 HRB min
	1020	---	G10200	SD	---	---	345	50	414	60	8	70 HRB min
ISO 3304:1985	R33	---	---	BK	---	---	---	---	420	---	6	---
ISO 3305:1985	R33	---	---	BK	---	---	---	---	420	---	6	---
EN 10305-1:2002	E235	1.0308	---	LC	---	---	294	---	420	---	10	see standard
EN 10305-2:2002	E195	1.0034	---	C	---	---	336	---	420	---	6	see standard
EN 10305-1:2002	E235	1.0308	---	SR	---	---	350	---	420	---	16	
ASTM A 513-03a*	1026	---	G10260	AW	---	---	310	45	427	62	12	68 HRB min
	1030	---	G10300	AW	---	---	310	45	427	62	10	70 HRB min
ASTM A 500-03	C	---	K02705	CF, SR, A	---	---	317	46	427	62	21	---
ASTM A 513-03a*	1021	---	G10210	SD	---	---	359	52	428	62	7	70 HRB min
EN 10297-1:2003	C22E	1.1151	---	N	≤ 16	---	240	---	430	---	24 L; 22 T	see standard
					16 < t ≤ 40	---	210	---	410	---	25 L; 23 T	
					40 < t ≤ 80	---	210	---	410	---	25 L; 23 T	---
ISO 3306:1985	R44	---	---	KM	---	---	---	---	430	---	6	---
ISO 3304:1985	R44	---	---	NBK & NZF	---	---	255	---	430	---	22	---
ISO 3305:1985	R44	---	---	NBK & NZF	---	---	255	---	430	---	22	---
ISO 3306:1985	R44	---	---	NKM & NZF	---	---	255	---	430	---	22	---
EN 10305-1:2002	E215	1.0212	---	C	---	---	344	---	430	---	8	see standard
ASTM A 512-96 (2001)*	MT 1010	---	G10100	SR A	---	---	400	58	434-689	63-100	15	70-90 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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10305-1:2002	C35E	1.1181	---	A	---	---	---	---	440	---	22	see standard
EN 10305-3:2002	E275	1.0225	---	CR1	---	---	---	---	440	---	6	see standard
EN 10305-1:2002	E255	1.0408	---	C	---	---	255	---	440-570	---	21	see standard
EN 10305-2:2002	E235	1.0308	---	LC	---	---	308	---	440	---	10	see standard
				SR	---	---	325	---	440	---	14	
EN 10296-1:2003	E275	1.0225	---	U, NW	---	---	340	---	440	---	6	---
JIS G 3445:1988	STKM 18 A	---	---	AM, CF, or AHT	---	---	275	---	440	---	25	---
JIS G 3445:1988	STKM 13 B	---	---	AM, CF, or AHT	---	---	305	---	440	---	20	---
JIS G 3472:1988	STAM 440 G	---	---	see standard	---	---	305	---	440	---	25	---
JIS G 3473:1988	STC 440	---	---	CF, SR	---	---	305	---	440	---	10	---
JIS G 3472:1988	STAM 440 H	---	---	see standard	---	---	355	---	440	---	20	---
ASTM A 519-03	1045	---	G10450	A	---	---	241	35	448	65	20	72 HRB
	1035	---	G10350	HR	---	---	276	40	448	65	20	72 HRB
	1035	---	G10350	N	---	---	276	40	448	65	20	72 HRB
ASTM A 513-03a*	1035	---	G10350	N	---	---	310	45	448	65	20	88 HRB max
	1040	---	G10400	N	---	---	310	45	448	65	20	90 HRB max
ASTM A 519-03	1020	---	G10200	SR	---	---	345	50	448	65	10	72 HRB
ASTM A 513-03a*	1015	---	G10150	MD	---	---	379	55	448	65	5	77 HRB min
	1020	---	G10200	MD SR	---	---	379	55	448	65	10	75 HRB min
	1025	---	G10250	SD	---	---	379	55	448	65	7	72 HRB min
ASTM A 512-96 (2001)*	MT 1030	---	G10300	SA	---	---	276	40	448	65	30	60 HRB min
	1011	---	G10110	SR A	---	---	407	59	448-689	65-100	13	70-100 HRB
ASTM A 512-96 (2001)*	1110	---	G11100	SR A	---	---	407	59	448-689	65-100	13	70-100 HRB
ISO 3304:1985	R37	---	---	BK	---	---	---	---	450	---	6	---
	R44	---	---	BKW	---	---	---	---	450	---	8	---
ISO 3305:1985	R37	---	---	BK	---	---	---	---	450	---	6	---
	R44	---	---	BKW	---	---	---	---	450	---	8	---
EN 10305-3:2002	E355	1.0580	---	A	---	---	---	---	450	---	22	see standard
EN 10305-1:2002	E355	1.0580	---	A	---	---	225	---	450	---	22	see standard
EN 10305-2:2002	E355	1.0580	---	A	---	---	225	---	450	---	22	see standard
EN 10297-1:2003	E315	1.0236	---	AR+N	≤ 16	---	315	---	450	---	21L; 19 T	---
					16 < t ≤ 40	---	305	---	450			
					40 < t ≤ 65	---	295	---	450			
					65 < t ≤ 80	---	280	---	420			
					80 < t ≤ 100	---	270	---				

*: 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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10305-3:2002	E370	1.0261	---	CR2	---	---	370	---	450	---	15	see standard
EN 10296-1:2003	E370	1.0261	---	CR	---	---	370	---	450	---	15 L; 13 T	---
ASTM A 595-98 (2002)	A	---	K02004	RCCM	---	---	380	55	450	65	23.0	---
ASTM A 513-03a*	1035	---	G10350	AW	---	---	345	50	455	66	10	75 HRB min
	1524	---	G15240	AW	---	---	345	50	455	66	10	75 HRB min
	1040	---	G10400	AW	---	---	345	50	455	66	10	75 HRB min
ASTM A 512-96 (2001)*	MT 1015	---	G10150	SR A	---	---	414	60	455-689	66-100	14	70-100 HRB
EN 10305-1:2002	C35E	1.1181	---	N	---	---	280	---	460	---	21	see standard
ASTM A 512-96 (2001)*	1016	---	G10160	SR A	---	---	421	61	462-689	67-100	13	70-100 HRB
	MT 1017	---	G10170	SR A	---	---	427	62	462-689	67-100	13	72-100 HRB
ASTM A 519-03	1050	---	G10500	A	---	---	262	38	469	68	18	74 HRB
ASTM A 513-03a*	1021	---	G10210	MD SR	---	---	400	58	469	68	10	75 HRB min
ASTM A 512-96 (2001)*	1018	---	G10180	SR A	---	---	427	62	469-689	68-100	13	73-100 HRB
AFNOR NF A 49-341:1975	TS 42-a	---	---	BKW	---	---	---	---	470	---	8	---
JIS G 3445:1988	STKM 15 A	---	---	AM, CF, or AHT	---	---	275	---	470	---	22	---
JIS G 3472:1988	STAM 470 G	---	---	see standard	---	---	325	---	470	---	22	---
JIS G 3445:1988	STKM 12 C	---	---	AM, CF, or AHT	---	---	355	---	470	---	20	---
JIS G 3472:1988	STAM 470 H	---	---	see standard	---	---	410	---	470	---	18	---
ISO 3304:1985	R50	---	---	GBK & GZF	---	---	---	---	480	---	23	---
ISO 3305:1985	R50	---	---	GBK & GZF	---	---	---	---	480	---	23	---
ISO 3306:1985	R50	---	---	GKM & GZF	---	---	---	---	480	---	23	---
EN 10305-1:2002	E235	1.0308	---	C	---	---	384	---	480	---	6	see standard
ASTM A 595-98 (2002)	B	---	K02005	RCCM	---	---	410	60	480	70	21.0	---
ASTM A 519-03*	1025	---	G10250	SR	---	---	379	55	483	70	8	75 HRB
ASTM A 513-03a*	1026	---	G10260	SD	---	---	379	55	483	70	7	77 HRB
	1020	---	G10200	MD	---	---	414	60	483	70	5	80 HRB min
ASTM A 519-03*	1020	---	G10200	CW	---	---	414	60	483	70	5	75 HRB
ASTM A 513-03a*	1025	---	G10250	MD SR	---	---	414	60	483	70	10	77 HRB min
	1030	---	G10300	SD	---	---	427	62	483	70	7	78 HRB min
EN 10297-1:2003	E355	1.0580	---	AR+N	≤ 16	---	355	---	490	---	20 L; 18 T	---
					16 < t ≤ 40	---	345	---	490			
					40 < t ≤ 65	---	335	---	490			
					65 < t ≤ 80	---	315	---	470			
					80 < t ≤ 100	---	295	---				
EN 10296-1:2003	E355	1.0580	---	A	---	---	---	---	490	---	22	---
ISO 3304:1985	R50	---	---	NBK & NZF	---	---	285	---	490	---	21	---

*: 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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ISO 3305:1985	R50	---	---	NBK & NZF	---	---	285	---	490	---	21	---
ISO 3306:1985	R50	---	---	NKM & NZF	---	---	285	---	490	---	21	---
JIS G 3444:1994	STK490	---	---	AM	---	---	315	---	490	---	23	---
JIS G 3445:1988	STKM 18 B	---	---	AM, CF, or AHT	---	---	315	---	490	---	23	---
	STKM 19 A	---	---	AM, CF, or AHT	---	---	315	---	490	---	23	---
ISO 2937:1974	TS 18	---	---	HF	---	---	285	---	490-610	---	21	---
EN 10296-1:2003	E355	1.0580	---	N	---	---	355	---	490	---	22	---
EN 10305-1:2002	E355	1.0580	---	N	---	---	355	---	490-630	---	22	see standard
EN 10305-2:2002	E355	1.0580	---	N	---	---	355	---	490-630	---	22	see standard
EN 10305-3:2002	E355	1.0580	---	N	---	---	355	---	490-630	---	22	see standard
EN 10305-2:2002	E235	1.0308	---	C	---	---	392	---	490	---	6	see standard
EN 10305-3:2002	E420	1.0575	---	CR2	---	---	420	---	490	---	12	see standard
ASTM A 512-96 (2001)*	MT 1020	---	G10200	SR A	---	---	448	65	490-896	71-130	11	75 HRB-20 HRC
ASTM A 513-03a*	1021	---	G10210	MD	---	---	427	62	496	72	5	80 HRB min
ASTM A 512-96 (2001)*	1025	---	G10250	SR A	---	---	462	67	496-896	72-130	11	78 HRB-20 HRC
EN 10297-1:2003	C22E	1.1151	---	QT	≤ 8	---	340	---	500	---	20 L; 18 T	---
					8 < t ≤ 20	---	290	---	470	---	22 L; 20 T	
					20 < t ≤ 50	---	270	---	440	---	22 L; 20 T	
					50 < t ≤ 80	---	260	---	420	---	2 L; 20	
JIS G 3444:1994	STK500	---	---	AM	---	---	355	---	500	---	15	---
JIS G 3472:1988	STAM 500 G	---	---	see standard	---	---	355	---	500	---	18	---
JIS G 3445:1988	STKM 14 B	---	---	AM, CF, or AHT	---	---	355	---	500	---	15	---
JIS G 3472:1988	STAM 500 H	---	---	see standard	---	---	430	---	500	---	16	---
EN 10305-1:2002	C45E	1.1191	---	A	---	---	---	---	510	---	20	see standard
JIS G 3445:1988	STKM 16 A	---	---	AM, CF, or AHT	---	---	325	---	510	---	20	---
EN 10305-2:2002	E275	1.0225	---	LC	---	---	357	---	510	---	8	see standard
				SR	---	---	375	---	510	---	12	
JIS G 3445:1988	STKM 13 C	---	---	AM, CF, or AHT	---	---	380	---	510	---	15	---
	STKM 18 C	---	---	AM, CF, or AHT	---	---	380	---	510	---	15	---
JIS G 3473:1988	STC 510A	---	---	CF or SR	---	---	380	---	510	---	10	---
	STC 510B	---	---	SR	---	---	380	---	510	---	15	---
ASTM A 519-03	1045	---	G10450	HR	---	---	310	45	517	75	15	80 HRB
				N	---	---	331	48	517	75	15	80 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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 513-03a*	1025	---	G10250	MD	---	---	448	65	517	75	5	82 HRB min
	1026	---	G10260	MD SR	---	---	448	65	517	75	10	80 HRB min
ASTM A 519-03	1025	---	G10250	CW	---	---	448	65	517	75	5	80 HRB
	1035	---	G10350	SR	---	---	448	65	517	75	8	80 HRB
EN 10305-1:2002	E255	1.0408	---	C	---	---	---	---	520	---	8	see standard
	E410	1.0509	---	A	---	---	---	---	520	---	22	
ISO 3304:1985	R44	---	---	BK	---	---	---	---	520	---	5	---
ISO 3305:1985	R44	---	---	BK	---	---	---	---	520	---	5	---
ISO 3306:1985	R50	---	---	KM	---	---	---	---	520	---	5	---
EN 10305-1:2002	E255	1.0408	---	SR	---	---	375	---	520	---	12	see standard
ASTM A 519-03	1050	---	G10500	N	---	---	345	50	538	78	12	82 HRB
EN 10305-1:2002	C35E	1.1181	---	LC	---	---	---	---	540	---	7	see standard
EN 10305-3:2002	E355	1.0580	---	CR1	---	---	---	---	540	---	5	see standard
ISO 2937:1974	C 35	---	---	HF	---	---	275	---	540-660	---	20	---
EN 10305-1:2002	C45E	1.1191	---	N	---	---	340	---	540	---	18	see standard
JIS G 3444:1994	STK540	---	---	AM	---	---	390	---	540	---	20	---
JIS G 3445:1988	STKM 20 A	---	---	AM, CF, or AHT	---	---	390	---	540	---	23	---
JIS G 3473:1988	STC 540	---	---	AM	---	---	390	---	540	---	20	---
JIS G 3474:1995	STKT 540	---	---	AM	---	---	390	---	540	---	20	---
EN 10296-1:2003	E355	1.0580	---	U, NW	---	---	400	---	540	---	5	---
JIS G 3472:1988	STAM 540 H	---	---	see standard	---	---	480	---	540	---	13	---
ISO 3304:1985	R50	---	---	BKW	---	---	---	---	550	---	7	---
ISO 3305:1985	R50	---	---	BKW	---	---	---	---	550	---	7	---
EN 10297-1:2003	C35E	1.1181	---	N	≤ 16	---	300	---	550	---	18 L; 16 T	see standard
					16 < t ≤ 40	---	270	---	520	---	19 L; 17 T	
					40 < t ≤ 80	---	270	---	520	---	19 L; 17 T	
JIS G 3445:1988	STKM 17 A	---	---	AM, CF, or AHT	---	---	345	---	550	---	20	---
EN 10305-1:2002	E410	1.0509	---	N	---	---	410	---	550-700	---	22	see standard
JIS G 3445:1988	STKM 14 C	---	---	AM, CF, or AHT	---	---	410	---	550	---	15	---
	STKM 19 C	---	---	AM, CF, or AHT	---	---	410	---	550	---	15	---
ASTM A 519-03	1050	---	G10500	HR	---	---	345	50	552	80	10	85 HRB
ASTM A 512-96 (2001)*	1030	---	G10300	SR A	---	---	483	70	552-896	80-130	10	80 HRB-20 HRC
ASTM A 513-03a*	1026	---	G10260	MD	---	---	483	70	552	80	5	85 HRB min
	1030	---	G10300	MD SR	---	---	483	70	552	80	10	81 HRB min
	1035	---	G10350	SD	---	---	483	70	552	80	7	82 HRB 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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 519-03	1045	---	G10450	SR	---	---	483	70	552	80	8	85 HRB
EN 10305-2:2002	E275	1.0225	---	C	---	---	448	---	560	---	5	see standard
ASTM A 519-03	1050	---	G10500	SR	---	---	483	70	565	82	6	86 HRB
EN 10305-1:2002	E255	1.0408	---	C	---	---	---	---	580	---	5	see standard
	E355	1.0580	---	LC	---	---	406	---	580	---	7	
				SR	---	---	450	---	580	---	10	
JIS G 3445:1988	STKM 15 C	---	---	AM, CF, or AHT	---	---	430	---	580	---	12	---
ASTM A 513-03a*	1030	---	G10300	MD	---	---	517	75	586	85	5	87 HRB min
	1035	---	G10350	MD SR	---	---	517	75	586	85	10	85 HRB min
	1040	---	G10400	MD SR	---	---	517	75	586	85	10	85 HRB min
	1524	---	G15240	MD SR	---	---	517	75	586	85	10	85 HRB min
ASTM A 519-03	1035	---	G10350	CW	---	---	517	75	586	85	5	88 HRB
EN 10305-1:2002	C35E	1.1181	---	C	---	---	---	---	590	---	5	see standard
EN 10305-2:2002	E355	1.0580	---	SR	---	---	435	---	590	---	10	see standard
JIS G 3474:1995	STKT 590	---	---	AM	---	---	440	---	590-740	---	20	---
JIS G 3473:1988	STC 590A	---	---	CF or SR	---	---	490	---	590	---	10	---
	STC 590B	---	---	SR	---	---	490	---	590	---	15	---
EN 10305-2:2002	E355	1.0580	---	LC	---	---	513	---	590	---	6	see standard
EN 10297-1:2003	E420J2	1.0599	---	N	≤ 16	---	420	---	600	---	19 L; 17 T	L: 27J at -20°C T: 20 J at -20°C
					16 < t ≤ 40	---	400	---	560			
					40 < t ≤ 65	---	390	---	530			
					65 < t ≤ 80	---	370	---	500			
					80 < t ≤ 100	---	360	---				
ISO 3304:1985	R50	---	---	BK	---	---	---	---	600	---	4	---
ISO 3305:1985	R50	---	---	BK	---	---	---	---	600	---	4	---
EN 10305-1:2002	E410	1.0509	---	LC	---	---	---	---	620	---	8	see standard
EN 10297-1:2003	C45E	1.1181	---	N	≤ 16	---	340	---	620	---	14 L; 12 T	see standard
					16 < t ≤ 40	---	305	---	580	---	16 L; 14 T	
					40 < t ≤ 80	---	305	---	580	---	16 L; 14 T	
JIS G 3445:1988	STKM 16 C	---	---	AM, CF, or AHT	---	---	460	---	620	---	12	---
ASTM A 513-03a*	1035	---	G10350	MD	---	---	552	80	621	90	5	90 HRB min
	1040	---	G10400	MD	---	---	552	80	621	90	5	90 HRB min
	1524	---	G15240	MD	---	---	552	80	621	90	5	90 HRB min
ASTM A 519-03	1045	---	G10450	CW	---	---	552	80	621	90	5	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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10297-1:2003	C35E	1.1181	---	N	≤ 8	---	430	---	630	---	17 L; 15 T	---
					8 < t ≤ 20	---	380	---	600	---	19 L; 17 T	
					20 < t ≤ 50	---	320	---	550	---	20 L; 18 T	
					50 < t ≤ 80	---	290	---	500	---	20 L; 18 T	
EN 10305-1:2002	E355	1.0580	---	C	---	---	512	---	640	---	4	see standard
EN 10305-2:2002	E355	1.0580	---	C	---	---	512	---	640	---	4	see standard
EN 10305-1:2002	26Mn5	1.1161	---	LC	---	---	---	---	650	---	7	see standard
EN 10297-1:2003	E470	1.0536	---	AR	≤ 16	---	470	---	650	---	17 L; 15 T	---
					16 < t ≤ 40	---	430	---	600			
					40 < t ≤ 65	---	---	---	---			
					65 < t ≤ 80	---	---	---				
					80 < t ≤ 100	---	---	---				
JIS G 3445:1988	STKM 17 C	---	---	AM, CF, or AHT	---	---	480	---	650	---	10	---
EN 10305-1:2002	C45E	1.1191	---	LC	---	---	---	---	670	---	6	see standard
EN 10297-1:2003	38Mn6	1.1127	---	N	≤ 16	---	400	---	670	---	14 L; 12 T	---
					16 < t ≤ 40	---	380	---	620	---	15 L; 13 T	
					40 < t ≤ 80	---	360	---	570	---	16 L; 14 T	
EN 10305-1:2002	E410	1.0509	---	SR	---	---	590	---	690	---	12	see standard
EN 10305-1:2002	26Mn5	1.1161	---	C	---	---	---	---	700	---	4	see standard
EN 10297-1:2003	C45E	1.1181	---	QT	≤ 8	---	490	---	700	---	14 L; 12 T	---
					8 < t ≤ 45	---	430	---	650	---	16 L; 14 T	
					20 < t ≤ 50	---	370	---	630	---	17 L; 15 T	
					50 < t ≤ 80	---	340	---	600	---	17 L; 15 T	
	E590K2	1.0644	---	QT	≤ 16	---	590	---	700	---	16 L; 14 T	L: 40 J at -20°C T: 27 J at -20°C
					16 < t ≤ 40	---	540	---	650			
					40 < t ≤ 65	---	480	---	570			
					65 < t ≤ 80	---	455	---	520			
					80 < t ≤ 100	---	420	---				
EN 10305-1:2002	C45E	1.1191	---	C	---	---	---	---	720	---	4	see standard
	E410	1.0509	---	C	---	---	---	---	750	---	4	

5.1 Carbon Steel Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	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 10305-3:2002	E155	1.0033	---	0.11	0.70	0.35	0.025	0.025	---	---	---	---
EN 10305-2:2002	E155	1.0033	---	0.11	0.70	0.05	0.025	0.025	---	---	---	---
ASTM A 512-96 (2001)*	1008	---	---	0.10	0.50	---	0.040	0.045	---	---	---	---
ASTM A 513-03a*	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 10305-3:2002	E190	1.0031	---	0.10	0.70	0.35	0.025	0.025	---	---	---	---
ASTM A 512-96 (2001)*	1010	---	---	0.08-0.13	0.30-0.60	---	0.040	0.045	---	---	---	---
	MT 1010	---	G10100	0.05-0.15	0.30-0.60	---	0.04	0.045	---	---	---	--
ASTM A 513-03a*	1010	---	G10100	0.08-0.13	0.30-0.60	---	0.035	0.035	---	---	---	---
EN 10305-1:2002	E215	1.0212	---	0.10	0.70	0.05	0.025	0.025	---	---	---	Al 0.025 min
ASTM A 512-96 (2001)*	1012	---	G10120	0.10-0.15	0.30-0.60	---	0.040	0.045	---	---	---	---
JIS G 3444:1994	STK290	---	---	---	---	---	0.050	0.050	---	---	---	---
JIS G 3445:1988	STKM 11 A	---	---	0.12	0.60	0.35	0.040	0.040	---	---	---	---
JIS G 3452:1997	SGP	---	---	---	---	---	0.040	0.040	---	---	---	---
EN 10305-3:2002	E195	1.0034	---	0.15	0.70	0.35	0.025	0.025	---	---	---	---
EN 10305-2:2002	E195	1.0034	---	0.15	0.70	0.35	0.025	0.025	---	---	---	---
EN 10296-1:2003	E155	1.0033	---	0.11	0.70	0.35	0.045	0.045	---	---	---	---
SAE J526 JAN 00	---	---	G10080	0.10	0.20-0.50	---	0.040	0.050	---	---	---	---
	---	---	G10100	0.08-0.13	0.30-0.60	---	0.040	0.050	---	---	---	---
JIS G 3472:1988	STAM 290 GA	---	---	0.12	0.60	0.35	0.035	0.035	---	---	---	---
	STAM 290 GB	---	---	0.12	0.60	0.35	0.035	0.035	---	---	---	---
DIN 1615:1984	St 33	1.0035	---	---	---	---	---	---	---	---	---	---
ASTM A 512-96 (2001)*	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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10296-1:2003	E235	1.0308	---	0.17	1.20	0.35	0.045	0.045	---	---	---	---
ISO 3306:1985	R28	---	---	0.13	0.60	---	0.050	0.050	---	---	---	---
ASTM A 512-96 (2001)*	1015	---	G10150	0.12-0.18	0.30-0.60	---	0.040	0.045	---	---	---	---
ASTM A 513-03a*	1015	---	G10150	0.12-0.18	0.30-0.60	---	0.035	0.035	---	---	---	---
EN 10305-3:2002	E220	1.0215	---	0.14	0.70	0.35	0.025	0.025	---	---	---	---
ASTM A 513-03a*	1010	---	G10100	0.08-0.13	0.30-0.60	---	0.035	0.035	---	---	---	---
ASTM A 512-96 (2001)*	1012	---	---	0.10-0.15	0.30-0.60	---	0.040	0.045	---	---	---	---
ASTM A 500-03	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 10305-3:2002	E235	1.0308	---	0.17	1.20	0.35	0.025	0.025	---	---	---	---
EN 10305-1:2002	E235	1.0308	---	0.17	1.20	0.35	0.025	0.025	---	---	---	---
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	---	---	---	---
EN 10305-2:2002	E235	1.0308	---	0.17	1.20	0.35	0.025	0.025	---	---	---	---
ISO 2937:1974	TS 1	---	---	0.16	0.30-0.70	---	0.050	0.050	---	---	---	---
ASTM A 519-03	1020	---	G10200	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 513-03a*	1015	---	G10150	0.12-0.18	0.30-0.60	---	0.035	0.035	---	---	---	---
	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 3445:1988	STKM 12 A	---	---	0.20	0.60	0.35	0.040	0.040	---	---	---	---
JIS G 3472:1988	STAM 340 G	---	---	0.20	0.60	0.35	0.035	0.035	---	---	---	---
EN 10296-1:2003	E260	1.0220	---	0.16	1.20	0.35	0.045	0.045	---	---	---	---
EN 10305-3:2002	E260	1.0220	---	0.16	1.20	0.35	0.025	0.025	---	---	---	---
ASTM A 513-03a*	1020	---	G10200	0.17-0.23	0.30-0.60	---	0.035	0.035	---	---	---	---
	1021	---	G10210	0.17-0.23	0.30-0.90	---	0.035	0.035	---	---	---	---
ASTM A 512-96 (2001)*	MT 1020	---	G10200	0.15-0.25	0.30-0.60	---	0.04	0.045	---	--	---	---
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 10305-2:2002	E155	1.0033	---	0.11	0.70	0.05	0.025	0.025	---	---	---	---
ASTM A 513-03a*	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	---	---	---	---

*: 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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
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	---	---	---	---
AFNOR NF A 49-250:1979	TS E 24-a	---	---	0.18	1.20	---	0.045	0.045	---	---	---	---
EN 10297-1:2003	E235	1.0308	---	0.17	1.20	0.35	0.030	0.035	---	---	---	---
ASTM A 519-03	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 3473:1988	STC 370	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
JIS G 3445:1988	STKM 13 A	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
EN 10305-2:2002	E195	1.0034	---	0.15	0.70	0.35	0.025	0.025	---	---	---	---
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 0.05; Ti 0.03; V 0.05
ASTM A 513-03a*	1021	---	G10210	0.17-0.23	0.30-0.90	---	0.035	0.035	---	---	---	---
ASTM A 519-03	1020	---	G10200	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 512-96 (2001)*	MT 1025	---	G10250	---	---	---	---	---	---	---	---	---
ASTM A 519-03	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 513-03a*	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.035	0.035	---	---	---	---
	1008	---	G10080	0.10	0.50	---	0.035	0.035	---	---	---	---
	1010	---	G10100	0.08-0.13	0.30-0.60	---	0.035	0.035	---	---	---	---
	1015	---	G10150	0.12-0.18	0.30-0.60	---	0.035	0.035	---	---	---	---
ASTM A 512-96 (2001)*	1015	---	G10150	0.12-0.18	0.30-0.60	---	0.040	0.045	---	---	---	---
AFNOR NF A 49-141:1978	TS 37-a (NE)	---	---	0.20	1.30	---	0.05	0.05	---	---	---	N 0.008
EN 10305-1:2002	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 10305-1:2002	E255	1.0408	---	0.21	0.40-1.10	0.35	0.025	0.025	---	---	---	V 0.08-0.15; Al 0.010-0.060; Nb 0.07; Ti 0.05; Nb+V 0.02
EN 10305-3:2002	E275	1.0225	---	0.21	1.40	0.35	0.025	0.025	---	---	---	---
	E235	1.0308	---	0.17	1.20	0.35	0.025	0.025	---	---	---	---
EN 10305-2:2002	E275	1.0225	---	0.21	1.40	0.35	0.025	0.025	---	---	---	---
EN 10296-1:2003	E235	1.0308	---	0.17	1.20	0.35	0.045	0.045	---	---	---	---
JIS G 3472:1988	STAM 390 G	---	---	0.25	0.30-0.90	0.35	0.035	0.035	---	---	---	---
JIS G 3445:1988	STKM 12 B	---	---	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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	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 10305-2:2002	E155	1.0033	---	0.11	0.70	0.05	0.025	0.025	---	---	---	---
JIS G 3444:1994	STK400	---	---	0.25	---	---	0.040	0.040	---	---	---	---
ASTM A 500-03	D	---	---	0.26	1.35	---	0.035	0.035	---	---	---	Cu ≥ 0.20
ASTM A 501-01	---	---	K03000	0.26	---	---	0.035	0.035	---	---	---	Cu ≥ 0.20
ASTM A 500-03	B	---	K03000	0.26	1.35	---	0.035	0.035	---	---	---	Cu ≥ 0.20
EN 10296-1:2003	E275	1.0225	---	0.21	1.40	0.35	0.030	0.035	---	---	---	---
EN 10297-1:2003	E275	1.0225	---	0.21	1.40	0.35	0.030	0.035	---	---	---	---
EN 10305-2:2002	E275	1.0225	---	0.21	1.40	0.35	0.025	0.025	---	---	---	---
AFNOR NF A 49-250:1979	TS E 26-b	---	---	0.20	1.30	0.40	0.045	0.045	---	---	---	---
EN 10305-3:2002	E275	1.0225	---	0.21	1.40	0.35	0.025	0.025	---	---	---	---
EN 10296-1:2003	E320	1.0237	---	0.20	1.40	0.35	0.045	0.045	---	---	---	---
EN 10305-3:2002	E320	1.0237	---	0.20	1.40	0.35	0.025	0.025	---	---	---	---
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 3445:1988	STKM 14 A	---	---	0.30	0.30-1.00	0.35	0.040	0.040	---	---	---	---
ASTM A 519-03	1035	---	G10350	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 513-03a*	1026	---	G10260	0.22-0.28	0.60-0.90	---	0.035	0.035	---	---	---	---
	1030	---	G10300	0.27-0.34	0.60-0.90	---	0.035	0.035	---	---	---	---
	1008	---	G10080	0.10	0.50	---	0.035	0.035	---	---	---	---
	1010	---	G10100	0.08-0.13	0.30-0.60	---	0.035	0.035	---	---	---	---
	1015	---	G10150	0.12-0.18	0.30-0.60	---	0.035	0.035	---	---	---	---
	1020	---	G10200	0.17-0.23	0.30-0.60	---	0.035	0.035	---	---	---	---
AFNOR NF A 49-141:1978	TS 37-a (NE)	---	---	0.20	1.30	---	≤ 0.05	≤ 0.05	---	---	---	N 0.008
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 10305-1:2002	E235	1.0308	---	0.17	1.20	0.35	0.025	0.025	---	---	---	---

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10305-2:2002	E195	1.0034	---	0.15	0.70	0.35	0.025	0.025	---	---	---	---
ASTM A 500-03	C	---	K02705	0.23	1.35	---	0.035	0.035	---	---	---	Cu ≥ 0.20
ASTM A 513-03a*	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 10305-1:2002	E215	1.0212	---	0.10	0.70	0.05	0.025	0.025	---	---	---	Al 0.025 min
ASTM A 512-96 (2001)*	MT 1010	---	G10100	0.05-0.15	0.30-.60	---	0.04	0.045	---	---	---	---
	1110	---	G11100	0.08-0.15	0.30-0.60	---	0.040	0.130	---	---	---	---
EN 10305-1:2002	C35E	1.1181	---	0.32-0.39	0.50-0.80	0.40	0.035	0.035	0.40	---	0.10	Cr+Mo+Ni 0.63
EN 10305-1:2002	E255	1.0408	---	0.21	0.40-1.10	0.35	0.025	0.025	---	---	---	V 0.08-0.15; Al 0.010-0.060; Nb 0.07; Ti 0.05; Nb+V 0.02
EN 10305-2:2002	E235	1.0308	---	0.17	1.20	0.35	0.025	0.025	---	---	---	---
JIS G 3445:1988	STKM 18 A	---	---	0.18	1.50	0.55	0.040	0.040	---	---	---	---
JIS G 3445:1988	STKM 13 B	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
JIS G 3472:1988	STAM 440 G	---	---	0.25	0.30-0.90	0.35	0.035	0.035	---	---	---	---
JIS G 3473:1988	STC 440	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
JIS G 3472:1988	STAM 440 H	---	---	0.25	0.30-0.90	0.35	0.035	0.035	---	---	---	---
ASTM A 519-03	1045	---	G10450	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
	1035	---	G10350	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 513-03a*	1035	---	G10350	0.31-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
	1040	---	G10400	0.36-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 519-03	1020	---	G10200	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 513-03a*	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.035	0.035	---	---	---	---
ASTM A 512-96 (2001)*	MT 1030	---	G10300	---	---	---	---	---	---	---	---	---
	1011	---	G10110	---	---	---	---	---	---	---	---	---
ASTM A 512-96 (2001)*	1110	---	G11100	0.08-0.15	0.30-0.60	---	0.040	0.130	---	---	---	---
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 10305-3:2002	E355	1.0580	---	0.22	1.60	0.55	0.025	0.025	---	---	---	---
EN 10305-1:2002	E355	1.0580	---	0.22	1.60	0.55	0.045	0.045	---	---	---	---
EN 10305-2:2002	E355	1.0580	---	0.22	1.60	0.55	0.025	0.025	---	---	---	---
EN 10297-1:2003	E315	1.0236	---	0.21	1.50	0.30	0.030	0.035	---	---	---	---
EN 10305-3:2002	E370	1.0261	---	0.21	1.60	0.55	0.025	0.025	---	---	---	---

*: 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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	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 A 595-98 (2002)	A	---	K02004	0.15-0.25	0.30-0.90	---	0.035	0.035	---	---	---	---
ASTM A 513-03a*	1035	---	G10350	0.31-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
	1524	---	G15240	0.18-0.25	1.35-1.65	---	0.040	0.050	---	---	---	---
	1040	---	G10400	0.36-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 512-96 (2001)*	MT 1015	---	G10150	0.10-0.20	0.30-0.60	---	0.04	0.045	---	---	---	---
EN 10305-1:2002	C35E	1.1181	---	0.32-0.39	0.50-0.80	0.40	0.035	0.035	0.40	---	0.10	Cr+Mo+Ni 0.63
ASTM A 512-96 (2001)*	1016	---	G10160	0.12-0.18	0.60-0.90	0.040	0.045	---	---	---	---	---
	MT 1017	---	G10170	---	---	---	---	---	---	---	---	---
ASTM A 519-03	1050	---	G10500	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 513-03a*	1021	---	G10210	0.17-0.23	0.30-0.90	---	0.035	0.035	---	---	---	---
ASTM A 512-96 (2001)*	1018	---	G10180	0.14-0.20	0.60-0.90	---	0.040	0.045	---	---	---	---
JIS G 3445:1988	STKM 15 A	---	---	0.25-0.35	0.30-1.00	0.35	0.040	0.040	---	---	---	---
JIS G 3472:1988	STAM 470 G	---	---	0.25	0.30-0.90	0.35	0.035	0.035	---	---	---	---
JIS G 3445:1988	STKM 12 C	---	---	0.20	0.60	0.35	0.040	0.040	---	---	---	---
JIS G 3472:1988	STAM 470 H	---	---	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 10305-1:2002	E235	1.0308	---	0.17	1.20	0.35	0.025	0.025	---	---	---	---
ASTM A 595-98 (2002)	B	---	K02005	0.15-0.25	0.40-1.35	---	0.035	0.035	---	---	---	---
ASTM A 519-03	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 513-03a*	1026	---	G10260	0.22-0.28	0.60-0.90	---	0.035	0.035	---	---	---	---
	1020	---	G10200	0.17-0.23	0.30-0.60	---	0.035	0.035	---	---	---	---
ASTM A 519-03	1020	---	G10200	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 513-03a*	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.035	0.035	---	---	---	---
	1030	---	G10300	0.27-0.34	0.60-0.90	---	0.035	0.035	---	---	---	---
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 3444:1994	STK 490	---	---	0.18	1.50	0.55	0.040	0.040	---	---	---	---
JIS G 3445:1988	STKM 18 B	---	---	0.18	1.50	0.55	0.040	0.040	---	---	---	---
	STKM 19 A	---	---	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	---	---	---	---

*: 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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10305-2:2002	E235	1.0308	---	0.17	1.20	0.35	0.025	0.025	---	---	---	---
EN 10305-3:2002	E420	1.0575	---	0.16	1.70	0.50	0.025	0.025	---	---	---	---
ASTM A 512-96 (2001)*	MT 1020	---	G10200	0.15-0.25	0.30-0.60	---	0.04	0.045	---	---	---	---
ASTM A 513-03a*	1021	---	G10210	0.17-0.23	0.30-0.90	---	0.035	0.035	---	---	---	---
ASTM A 519-03	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
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 3444:1994	STK500	---	---	0.24	0.30-1.30	0.35	0.040	0.040	---	---	---	---
JIS G 3472:1988	STAM 500 G	---	---	0.30	0.30-1.00	0.35	0.035	0.035	---	---	---	---
JIS G 3445:1988	STKM 14 B	---	---	0.30	0.30-1.00	0.35	0.040	0.040	---	---	---	---
JIS G 3472:1988	STAM 500 H	---	---	0.30	0.30-1.00	0.35	0.035	0.035	---	---	---	---
EN 10305-1:2002	C45E	1.1191	---	0.42-0.55	0.50-0.80	0.40	0.035	0.035	0.40	---	0.10	Cr+Mo+Ni 0.63
JIS G 3445:1988	STKM 16 A	---	---	0.35-0.45	0.40-1.00	0.40	0.040	0.040	---	---	---	---
EN 10305-2:2002	E275	1.0225	---	0.21	1.40	0.35	0.025	0.025	---	---	---	---
JIS G 3445:1988	STKM 13 C	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
	STKM 18 C	---	---	0.18	1.50	0.55	0.040	0.040	---	---	---	---
JIS G 3473:1988	STC 510A	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
	STC 510B	---	---	0.18	1.50	0.55	0.040	0.040	---	---	---	---
ASTM A 519-03	1045	---	G10450	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 513-03a*	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.035	0.035	---	---	---	---
ASTM A 519-03	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 513-03a*	1026	---	G10260	0.22-0.28	0.60-0.90	---	0.035	0.035	---	---	---	---
ASTM A 519-03	1035	---	G10350	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
EN 10305-1:2002	E255	1.0408	---	0.21	0.40-1.10	0.35	0.025	0.025	---	---	---	V 0.08-0.15; Al 0.010-0.060; Nb 0.07; Ti 0.05; Nb+V 0.02
	E410	1.0509	---	0.16-0.22	1.30-1.70	0.10-0.50	0.030	0.035	---	---	---	---
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	---	---	---	---
ISO 3306:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
ASTM A 519-03	1050	---	G10500	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
EN 10305-1:2002	C35E	1.1181	---	0.32-0.39	0.50-0.80	0.40	0.035	0.035	0.40	---	0.10	Cr+Mo+Ni 0.63
EN 10305-3:2002	E355	1.0580	---	0.22	1.60	0.55	0.025	0.025	---	---	---	---
ISO 2937:1974	C 35	---	---	0.32-0.39	0.50-0.80	0.15-0.40	0.035	0.035	---	---	---	---
JIS G 3444:1994	STK540	---	---	0.23	1.50	0.55	0.040	0.040	---	---	---	---
JIS G 3445:1988	STKM 20 A	---	---	0.25	1.60	0.55	0.040	0.040	---	---	---	Nb or V 0.15
JIS G 3473:1988	STC 540	---	---	0.25	1.60	0.55	0.040	0.040	---	---	---	Nb or V 0.15

*: 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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3474:1995	STKT 540	---	---	0.23	1.50	0.55	0.040	0.040	---	---	---	---
EN 10296-1:2003	E355	1.0580	---	0.22	1.60	0.55	0.045	0.045	---	---	---	---
JIS G 3472:1988	STAM 540 H	---	---	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 3445:1988	STKM 17 A	---	---	0.45-0.55	0.40-1.00	0.40	0.040	0.040	---	---	---	---
EN 10305-1:2002	E410	1.0509	---	0.16-0.22	1.30-1.70	0.10-0.50	0.030	0.035	---	---	---	---
JIS G 3445:1988	STKM 14 C	---	---	0.30	0.30-1.00	0.35	0.040	0.040	---	---	---	---
	STKM 19 C	---	---	0.25	1.50	0.55	0.040	0.040	---	---	---	---
ASTM A 519-03	1050	---	G10500	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 513-03a*	1026	---	G10260	0.22-0.28	0.60-0.90	---	0.035	0.035	---	---	---	---
ASTM A 512-96 (2001)*	1030	---	G10300	0.27-0.34	0.60-0.90	---	0.040	0.045	---	---	---	---
ASTM A 513-03a*	1030	---	G10300	0.27-0.34	0.60-0.90	---	0.035	0.035	---	---	---	---
	1035	---	G10350	0.31-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
ASTM A 519-03	1045	---	G10450	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
EN 10305-2:2002	E275	1.0225	---	0.21	1.40	0.35	0.025	0.025	---	---	---	---
ASTM A 519-03	1050	---	G10500	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
EN 10305-1:2002	E255	1.0408	---	0.21	0.40-1.10	0.35	0.025	0.025	---	---	---	V 0.08-0.15; Al 0.010-0.060; Nb 0.07; Ti 0.05; Nb+V 0.02
	E355	1.0580	---	0.22	1.60	0.55	0.025	0.025	---	---	---	---
JIS G 3445:1988	STKM 15 C	---	---	0.25-0.35	0.30-1.00	0.35	0.040	0.040	---	---	---	---
ASTM A 513-03a*	1030	---	G10300	0.27-0.34	0.60-0.90	---	0.035	0.035	---	---	---	---
	1035	---	G10350	0.31-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
ASTM A 519-03	1035	---	G10350	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 513-03a*	1040	---	G10400	0.36-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
	1524	---	G15240	0.18-0.25	1.35-1.65	---	0.040	0.050	---	---	---	---
EN 10305-1:2002	C35E	1.1181	---	0.32-0.39	0.50-0.80	0.40	0.035	0.035	0.40	---	0.10	Cr+Mo+Ni 0.63
EN 10305-2:2002	E355	1.0580	---	0.22	1.60	0.55	0.025	0.025	---	---	---	---
JIS G 3474:1995	STKT 590	---	---	0.12	2.00	0.40	0.030	0.030	---	---	---	Nb+V ≤ 0.15
JIS G 3473:1988	STC 590A	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
	STC 590B	---	---	0.25	1.50	0.55	0.040	0.040	---	---	---	---

*: 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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
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 10305-1:2002	E410	1.0509	---	0.16-0.22	1.30-1.70	0.10-0.50	0.030	0.035	---	---	---	---
EN 10297-1:2003	C45E	---	---	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 3445:1988	STKM 16 C	---	---	0.35-0.45	0.40-1.00	0.40	0.040	0.040	---	---	---	---
ASTM A 513-03a*	1035	---	G10350	0.31-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
	1040	---	G10400	0.36-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
	1524	---	G15240	0.18-0.25	1.35-1.65	---	0.040	0.050	---	---	---	---
ASTM A 519-03	1045	---	G10450	0.43-0.50	0.60-0.90	---	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 10305-1:2002	E355	1.0580	---	0.22	1.60	0.55	0.025	0.025	---	---	---	---
EN 10305-2:2002	E355	1.0580	---	0.22	1.60	0.55	0.025	0.025	---	---	---	---
EN 10305-1:2002	26Mn5	1.1161	---	0.20-0.30	1.20-1.50	0.40	0.035	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 0.15
JIS G 3445:1988	STKM 17 C	---	---	0.45-0.55	0.40-1.00	0.40	0.040	0.040	---	---	---	---
EN 10305-1:2002	C45E	1.1191	---	0.42-0.55	0.50-0.80	0.40	0.035	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 10305-1:2002	E410	1.0509	---	0.16-0.22	1.30-1.70	0.10-0.50	0.030	0.035	---	---	---	---
EN 10305-1:2002	26Mn5	1.1161	---	0.20-0.30	1.20-1.50	0.40	0.035	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 0.02; Nb 0.07; Ti 0.05; V 0.08-0.15; Nb+V 0.20

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

5.2 Alloy Steel Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 519-03	4028	---	G40280	0.25-0.30	0.70-0.90	0.15-0.35	0.040	0.035-0.050	---	---	0.20-0.30	---
EN 10305-1:2002	26Mo2	1.5417	---	0.22-0.29	1.50	0.40	0.035	0.035	---	0.40	0.15-0.25	---
JIS G 3441:1988	SCM 418 TK	---	---	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
	SCM 420 TK	---	---	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
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	---
EN 10305-1:2002	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	---
ASTM A 513-03a*	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 A 519-03	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	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	---
JIS G 3441:1988	SCM 430 TK	---	---	0.28-0.33	0.60-0.85	0.25-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.30	Cu 0.30
ASTM A 519-03	4135	---	G41350	0.33-0.38	0.70-0.90	0.15-0.35	0.040	0.040	0.80-1.10	---	0.15-0.25	---
JIS G 3441:1988	SCM 435 TK	---	---	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
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	---
ASTM A 519-03	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	---
ASTM A 513-03a*	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 A 519-03	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	---
JIS G 3441:1988	SCM 440 TK	---	---	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
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 10305-1:2002	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	---
ASTM A 519-03	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	---

*: 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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 519-03	4028	---	G40280	---	---	---	---	---	---	---	---	---
EN 10305-1:2002	26Mo2	1.5417	---	C	---	---	---	---	720	---	4	---
				LC			---	---	670	---	6	
				SR			---	---	---	---	---	
				A			---	---	---	---	---	
				N			---	---	---	---	---	
JIS G 3441:1988	SCM 418 TK	---	---	AM, CF or A	---	---	---	---	---	---	---	---
	SCM 420 TK	---	---	AM, CF or A	---	---	---	---	---	---	---	---
EN 10297-1:2003	25CrMo4	1.7218	---	A	---	---	---	---	---	---	---	212 HB
				QT	≤ 8	---	700	---	900	---	12 L; 10 T	see standard for impact data
					8 < t ≤ 20	---	600	---	800	---	14 L; 12 T	
					20 < t ≤ 50	---	450	---	700	---	15 L; 13 T	
					50 < t ≤ 80	---	400	---	650	---	16 L; 14 T	
EN 10305-1:2002	25CrMo4	1.7218	---	C	---	---	---	---	720	---	4	---
				LC			---	---	670	---	6	
				SR			---	---	---	---	---	
				A			---	---	---	---	---	
				N			---	---	---	---	---	
ASTM A 513-03a*	4130	---	G41300	AW	---	---	379	55	496	72	10	80 HRB min
				N	---	---	345	50	483	70	20	100 HRB max
				MD	---	---	586	85	655	95	5	90 HRB min
				MD SR	---	---	552	80	621	90	10	87 HRB min
ASTM A 519-03	4130	---	G41300	HR	---	---	483	70	621	90	20	89 HRB
				SR	---	---	586	85	724	105	10	95 HRB
				A	---	---	379	55	517	75	30	81 HRB
				N	---	---	414	60	621	90	20	89 HRB
EN 10297-1:2003	30CrMo4	1.7216	---	QT	≤ 8	---	1050	---	1250	---	9 L; 7 T	see standard for impact data
					8 < t ≤ 20	---	1050	---	1250	---	9 L; 7 T	
					20 < t ≤ 50	---	900	---	1100	---	10 L; 8 T	
					50 < t ≤ 80	---	800	---	1000	---	11 L; 9 T	
				A	---	---	---	---	---	---	---	223 HB
JIS G 3441:1988	SCM 430 TK	---	---	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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 519-03	4135	---	G41350	AM	---	---	---	---	---	---	---	---
JIS G 3441:1988	SCM 435 TK	---	---	AM, CF or A	---	---	---	---	---	---	---	---
EN 10297-1:2003	34CrMo4	1.7220	---	QT	≤ 8	---	800	---	1000	---	11 L; 9 T	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
ASTM A 519-03	4137	---	G41370	---	---	---	---	---	---	---	---	---
ASTM A 513-03a*	4140	---	G41400	AW	---	---	485	70	621	90	10	85 HRB min
				N	---	---	448	65	621	90	20	105 HRB max
				MD	---	---	690	100	758	110	5	90 HRB min
				MD SR	---	---	655	95	724	105	10	90 HRB min
ASTM A 519-03	4140	---	G41400	HR	---	---	621	90	855	120	15	100 HRB
				SR	---	---	689	100	855	120	10	100 HRB
				A	---	---	414	60	552	80	25	85 HRB
				N	---	---	621	90	855	120	20	100 HRB
JIS G 3441:1988	SCM 440 TK	---	---	AM, CF or A	---	---	---	---	---	---	---	---
EN 10297-1:2003	42CrMo4	1.7225	---	QT	≤ 8	---	900	---	1100	---	10 L; 8 T	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 10305-1:2002	42CrMo4	1.7225	---	C	---	---	---	---	720	---	4	---
				LC			---	---	670	---	6	
				SR			---	---	---	---	---	
				A			---	---	---	---	---	
				N			---	---	---	---	---	
ASTM A 519-03	4142	---	G41420	---	---	---	---	---	---	---	---	---

*: 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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 268/A 268M-03	TP405	---	S40500	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.50	---	Al 0.10-0.30
ASTM A 511-96	MT 405	---	---	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.50	---	Al 0.10-0.30
DIN 17456:1999	X6CrAl13	1.4002	---	0.08	1.00	1.00	0.040	0.015	12.00-14.00	---	---	Al 0.10-0.30
ASTM A 268/A 268M-03	TP410	---	S41000	0.15	1.00	1.00	0.040	0.030	11.5-13.5	---	---	---
ASTM A 511-96	MT 410	---	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.50	---	---
JIS G 3446:1994	SUS410TKA	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	---	---	---
	SUS410TKC	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	---	---	---
DIN 17456:1999	X12Cr13	1.4006	---	0.08-0.15	1.50	1.00	0.040	0.015	11.50-13.50	0.75	---	---
ASTM A 268/A 268M-03	TP409	---	S40900	0.08	1.00	1.00	0.045	0.030	10.5-11.7	0.50	---	Ti 6 x C to 0.75
BS 6323-8:1982 AMD 2:1989	LW 12	---	---	0.06	0.60	0.90	0.040	0.020	11.0-13.0	0.50	---	N 0.025; Ti 5 x C to 0.70
	LW 19	---	---	0.08	1.00	1.00	0.040	0.030	10.5-12.5	1.00	---	Ti 6 x C to 1.00
DIN 17455:1999	X2CrTi12	1.4512	---	0.030	1.00	1.00	0.040	0.015	10.50-12.50	---	---	Ti 6 x (C+N) to 0.65
DIN 17456:1999	X2CrTi12	1.4512	---	0.030	1.00	1.00	0.040	0.015	10.50-12.50	---	---	Ti 6 x (C+N) to 0.65
ASTM A 268/A 268M-03	TP430	---	S43000	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	---	---
ASTM A 554-03	MT-430	---	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	0.50	---	---
ASTM A 511-96	MT 430	---	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	0.50	---	---
JIS G 3446:1994	SUS430TKA	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	---	---	---
	SUS430TKC	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	---	---	---
DIN 17455:1999	X6Cr17	1.4016	---	0.08	1.00	1.00	0.040	0.015	16.00-18.00	---	---	Al 0.10-0.30
DIN 17456:1999	X6Cr17	1.4016	---	0.08	1.00	1.00	0.040	0.015	16.00-18.00	---	---	---
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	---	---
ASTM A 268/A 268M-03	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 + 4 (C + N) to 1.10
DIN 17455:1999	X3CrTi17	1.4510	---	0.05	1.00	1.00	0.040	0.015	16.00-18.00	---	---	Ti 4 x (C+N)+0.15 to 0.80
DIN 17456:1999	X3CrTi17	1.4510	---	0.05	1.00	1.00	0.040	0.015	16.00-18.00	---	---	Ti 4 x (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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa min	ksi min	N/mm^2 or MPa min	ksi min		
ASTM A 268/A 268M-03	TP405	---	S40500	HT	---	---	205	30	415	60	20	207 HB; 95 HRB max
ASTM A 511-96	MT 405	---	S40500	A	---	---	207	30	414	60	20	207 HB; 95 HRB max
DIN 17456:1999	X6CrAl13	1.4002	---	A	---	---	250	---	400-600	---	20 L; 15 T	185 HB max
ASTM A 268/A 268M-03	TP410	---	S41000	HT	---	---	215	30	415	60	20	207 HB; 95 HRB max
ASTM A 511-96	MT 410	---	S41000	A	---	---	207	30	414	60	20	207 HB; 95 HRB max
JIS G 3446:1994	SUS410TKA	---	---	A	---	---	205	---	410	---	20	---
	SUS410TKC	---	---	AM	---	---	205	---	410	---	20	---
DIN 17456:1999	X12Cr13	1.4006	---	A	---	---	250	---	450-650	---	20 L; 15 T	200 HB max
ASTM A 268/A 268M-03	TP409	---	S40900	HT	---	---	470	25	380	55	20	207 HB; 95 HRB max
BS 6323-8:1982 AMD 2:1989	LW 12	---	---	KM	---	---	300	---	400	---	10	---
	LW 19	---	---	KM	---	---	300	---	400	---	10	---
DIN 17455:1999	X2CrTi12	1.4512	---	A	---	---	190	---	390-560	---	20 L; 18 T	175 HB max
DIN 17456:1999	X2CrTi12	1.4512	---	A	---	---	190	---	390-560	---	30 L; 25 T	175 HB max
ASTM A 268/A 268M-03	TP430	---	S43000	HT	---	---	240	35	415	60	20	190 HB; 90 HRB max
ASTM A 554-03	MT 430	---	S43000	A	---	---	241	35	414	60	20	190 HB; 90 HRB max
ASTM A 511-96	MT 430	---	S43000	A	---	---	241	35	414	60	20	190 HB; 90 HRB max
JIS G 3446:1994	SUS430TKA	---	---	A	---	---	245	---	410	---	20	---
	SUS430TKC	---	---	AM	---	---	245	---	410	---	20	---
DIN 17455:1999	X6Cr17	1.4016	---	A	---	---	270	---	450-600	---	20 L; 18 T	185 HB max
DIN 17456:1999	X6Cr17	1.4016	---	A	---	---	270	---	450-600	---	20 L; 15 T	185 HB max
AFNOR NF A 49-647:1979	TS Z 8 C 17	---	---	AM	---	---	300	---	450	---	16	---
ASTM A 268/A 268M-03	TP439	---	S43035	HT	---	---	205	30	415	60	20	190 HB; 90 HRB max
DIN 17455:1999	X3CrTi17	1.4510	---	A	---	---	270	---	430-600	---	20 L; 18 T	185 HB max
DIN 17456:1999	X3CrTi17	1.4510	---	A	---	---	270	---	450-600	---	20 L; 15 T	185 HB max

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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 269-02a	TP304	---	S30400	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A 511-96	MT 304	---	---	0.08	2.00	1.00	0.040	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A 554-03	MT-304	---	---	0.08	2.00	1.00	0.040	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A 632-02a	TP 304	---	S30400	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-11.0	---	---
JIS G 3446:1994	SUS304TKA	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	8.00-11.00	---	---
	SUS304TKC	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	8.00-11.00	---	---
BS 6323-8:1982 AMD 2:1989	LW 21	---	---	0.06	2.00	1.00	0.045	0.030	17.5-19.0	8.0-11.0	---	---
	LWCF 21	---	---	0.06	2.00	1.00	0.045	0.030	17.5-19.0	8.0-11.0	---	---
DIN 17455:1999	X5CrNi18-10	1.4301	---	0.07	2.00	1.00	0.045	0.015	17.00-19.50	8.00-10.50	---	N 0.11
DIN 17456:1999	X5CrNi18-10	1.4301	---	0.07	2.0	1.00	0.045	0.015	17.00-19.50	8.00-10.50	---	N 0.11
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	---	---
ASTM A 269-02a	TP304L	---	S30403	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
ASTM A 511-96	MT 304L	---	---	0.035	2.00	1.00	0.040	0.030	18.0-20.0	8.0-13.0	---	---
ASTM A 554-03	MT-304L	---	---	0.035	2.00	1.00	0.040	0.030	18.0-20.0	8.0-13.0	---	---
ASTM A 632-02a	TP 304L	---	S30403	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-13.0	---	---
ASTM A 778-01	TP 304L	---	S30403	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-13.0	---	N 0.10
BS 6323-8:1982 AMD 2:1989	LW 20	---	---	0.03	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	---
	LWCF 20	---	---	0.03	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	---
DIN 17455:1999	X2CrNi19-11	1.4306	---	0.030	2.00	1.00	0.045	0.015	18.00-20.00	10.00-12.00	---	N 0.11
DIN 17456:1999	X2CrNi19-11	1.4306	---	0.030	2.0	1.00	0.045	0.015	18.00-20.00	10.00-12.00	---	N 0.11
AFNOR NF A 49-317:1980	TU Z 2 CN 18-10	---	---	0.030	2.00	1.00	0.040	0.030	17-20.0	9-12.00	---	---
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 A 269-02a	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
DIN 17455:1999	X2CrNiN18-10	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
DIN 17456:1999	X2CrNiN18-10	1.4311	---	0.030	2.0	1.00	0.045	0.015	17.00-19.50	8.50-11.50	---	N 0.12-0.22

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 269-02a	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 A 511-96	MT 316	---	---	0.08	2.00	1.00	0.040	0.030	16.0-18.0	11.0-14.0	2.0-3.0	---
ASTM A 554-03	MT-316	---	---	0.08	2.00	1.00	0.040	0.030	16.0-18.0	10.0-14.0	2.0-3.0	---
ASTM A 632-02a	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 3446:1994	SUS316TKA	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
	SUS316TKC	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
BS 6323-8:1982 AMD 2:1989	LW 23	---	---	0.07	2.00	1.00	0.045	0.030	16.5-18.5	11.0-14.0	2.5-3.0	---
	LWCF 23	---	---	0.07	2.00	1.00	0.045	0.030	16.5-18.5	11.0-14.0	2.5-3.0	---
DIN 17455:1999	X5CrNiMo17-12-2	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
	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
DIN 17456:1999	X5CrNiMo17-12-2	1.4401	---	0.07	2.0	1.00	0.045	0.015	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X3CrNiMo17-13-3	1.4436	---	0.05	2.0	1.00	0.045	0.015	16.50-18.50	10.50-13.00	2.50-3.00	N 0.11
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 A 269-02a	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 A 511-96	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 A 554-03	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 A 632-02a	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 A 778-01	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
BS 6323-8:1982 AMD 2:1989	LW 22	---	---	0.03	2.00	1.00	0.045	0.030	16.5-18.5	11.5-14.5	2.5-3.0	---
	LWCF 22	---	---	0.03	2.00	1.00	0.045	0.030	16.5-18.5	11.5-14.5	2.5-3.0	---
DIN 17455:1999	X2CrNiMo17-12-2	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
	X2CrNiMo18-14-3	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
DIN 17456:1999	X2CrNiMo17-12-2	1.4404	---	0.030	2.0	1.00	0.045	0.015	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X2CrNiMo18-14-3	1.4435	---	0.030	2.0	1.00	0.045	0.015	17.00-19.00	12.50-15.00	2.50-3.00	N 0.11
AFNOR NF A 49-317:1980	TU Z 2 CND 17-12	---	---	0.030	2.00	1.00	0.040	0.030	16-18.0	10.5-13.00	2.00-2.40	---
ASTM A 269-02a	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
DIN 17455:1999	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
DIN 17456:1999	X2CrNiMoN17-13-3	1.4429	---	0.030	2.0	1.00	0.045	0.015	16.50-18.50	11.00-14.00	2.50-3.00	N 0.12-0.22

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 269-02a	TP321	---	S32100	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x (C+N) to 0.70
ASTM A 511-96	MT 321	---	---	0.08	2.00	1.00	0.040	0.030	17.0-20.0	9.0-13.0	---	Ti 5 x C to 0.60
ASTM A 554-03	MT-321	---	---	0.08	2.00	1.00	0.040	0.030	17.0-20.0	9.0-13.0	---	Ti 5 x C to 0.60
ASTM A 632-02a	TP 321	---	S32100	0.08	2.00	0.75	0.045	0.030	17.0-20.0	9.0-13.0	---	Ti 5 x C to 0.60
ASTM A 778-01	TP 321	---	S32100	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.70
JIS G 3446:1994	SUS321TKA	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C min
BS 6323-8:1982 AMD 2:1989	LW 24	---	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.80
	LWCF 24	---	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.80
DIN 17455:1999	X6CrNiTi18-10	1.4541	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.70
DIN 17456:1999	X6CrNiTi18-10	1.4541	---	0.08	2.0	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.70
ASTM A 269-02a	TP347	---	S34700	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 10 x C min to 1.10
ASTM A 511-96	MT 347	---	---	0.08	2.00	1.00	0.040	0.030	17.0-20.0	9.0-13.0	---	Cb+Ta 10 x C to 1.00
ASTM A 554-03	MT-347	---	---	0.08	2.00	1.00	0.040	0.030	17.0-20.0	9.0-13.0	---	Cb+Ta 10 x C to 1.00
ASTM A 632-02a	TP 347	---	S34700	0.08	2.00	0.75	0.045	0.030	17.0-20.0	9.0-13.0	---	Cb+Ta 10 x C to 1.0
ASTM A 778-01	TP 347	---	S34700	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb+Ta 10 x C to 1.10
JIS G 3446:1994	SUS347TKA	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C min
DIN 17455:1999	X6CrNiNb18-10	1.4550	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00
DIN 17456:1999	X6CrNiNb18-10	1.4550	---	0.08	2.0	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00
ASTM A 269-02a	---	---	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
DIN 17455:1999	X2CrNiMoN17-13-5	1.4439	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	12.40-14.50	4.00-5.00	N 0.12-0.22
DIN 17456:1999	X2CrNiMoN17-13-5	1.4439	---	0.030	2.0	1.00	0.045	0.015	16.50-18.50	12.50-14.50	4.00-5.00	N 0.12-0.22

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa min	ksi min	N/mm^2 or MPa min	ksi min		
ASTM A 269-02a	TP304	---	S30400	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
ASTM A 511-96	MT 304	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 554-03	MT-304	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 632-02a	TP 304	---	S30400	HT	---	---	205	30	515	75	35	---
JIS G 3446:1994	SUS304TKA	---	---	ST	---	---	205	---	520	---	35	---
	SUS304TKC	---	---	AM	---	---	205	---	520	---	35	---
BS 6323-8:1982 AMD 2:1989	LW 21	---	---	KM	---	---	450	---	560	---	25	---
	LWCF 21	---	---	KM	---	---	450	---	560	---	25	---
DIN 17455:1999	X5CrNi18-10	1.4301	---	SA & Q	---	---	195	---	500-720	---	40 L; 35 T	---
DIN 17456:1999	X5CrNi18-10	1.4301	---	SA & Q	---	---	195	---	500-700	---	40 L; 35 T	---
AFNOR NF A 49-647:1979	TS Z 6 CN 18-09	---	---	AM	---	---	400	---	600	---	35	---
ASTM A 269-02a	TP304L	---	S30403	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
ASTM A 511-96	MT 304L	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 554-03	MT-304L	---	---	A	---	---	172	25	483	70	35	192 HB; 90 HRB max
ASTM A 632-02a	TP 304L	---	S30403	HT	---	---	170	25	485	70	35	---
ASTM A 778-01	TP 304L	---	S30403	AM	---	---	170	25	485	70	40	---
BS 6323-8:1982 AMD 2:1989	LW 20	---	---	KM	---	---	420	---	520	---	25	---
	LWCF 20	---	---	KM	---	---	420	---	520	---	25	---
DIN 17455:1999	X2CrNi19-11	1.4306	---	SA & Q	---	---	180	---	460-680	---	40 L; 35 T	---
DIN 17456:1999	X2CrNi19-11	1.4306	---	SA & Q	---	---	180	---	460-680	---	40 L; 35 T	---
AFNOR NF A 49-317:1980	TU Z 2 CN 18-10	---	---	HQ	---	---	175	---	470	---	45	---
AFNOR NF A 49-647:1979	TS Z 2 CN 18-10	---	---	AM	---	---	400	---	600	---	35	---
ASTM A 269-02a	TP304LN	---	S30453	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
DIN 17455:1999	X2CrNiN18-10	1.4311	---	SA & Q	---	---	270	---	550-760	---	35 L; 30 T	---
DIN 17456:1999	X2CrNiN18-10	1.4311	---	SA & Q	---	---	270	---	550-760	---	35 L; 30 T	---

*: 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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa min	ksi min	N/mm^2 or MPa min	ksi min		
ASTM A 269-02a	TP316	---	S31600	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
ASTM A 511-96	MT 316	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 554-03	MT-316	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 632-02a	TP 316	---	S31600	HT	---	---	205	30	515	75	35	---
JIS G 3446:1994	SUS316TKA	---	---	ST	---	---	205	---	520	---	35	---
	SUS316TKC	---	---	AM	---	---	205	---	520	---	35	---
BS 6323-8:1982 AMD 2:1989	LW 23	---	---	KM	---	---	450	---	560	---	25	---
	LWCF 23	---	---	KM	---	---	450	---	560	---	25	---
DIN 17455:1999	X5CrNiMo17-12-2	1.4401	---	SA & Q	---	---	205	---	510-710	---	40 L; 35 T	---
	X3CrNiMo17-13-3	1.4436	---	SA & Q	---	---	205	---	510-710	---	40 L; 35 T	---
DIN 17456:1999	X5CrNiMo17-12-2	1.4401	---	SA & Q	---	---	205	---	510-710	---	40 L; 30 T	---
	X3CrNiMo17-13-3	1.4436	---	SA & Q	---	---	205	---	510-710	---	40 L; 30 T	---
AFNOR NF A 49-647:1979	TS Z 6 CND 17-11	---	---	AM	---	---	400	---	600	---	35	---
ASTM A 269-02a	TP316L	---	S31603	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
ASTM A 511-96	MT 316L	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 554-03	MT-316L	---	---	A	---	---	172	25	483	70	35	192 HB; 90 HRB max
ASTM A 632-02a	TP 316L	---	S31603	HT	---	---	170	25	485	70	35	---
ASTM A 778-01	TP 316L	---	S31603	AM	---	---	---	---	485	70	---	---
BS 6323-8:1982 AMD 2:1989	LW 22	---	---	KM	---	---	420	---	520	---	25	---
BS 6323-8:1982 AMD 2:1989	LWCF 22	---	---	KM	---	---	420	---	520	---	25	---
DIN 17455:1999	X2CrNiMo17-12-2	1.4404	---	SA & Q	---	---	190	---	490-690	---	40 L; 35 T	---
	X2CrNiMo18-14-3	1.4435	---	SA & Q	---	---	190	---	490-690	---	40 L; 35 T	---
DIN 17456:1999	X2CrNiMo17-12-2	1.4404	---	SA & Q	---	---	190	---	490-690	---	40 L; 30 T	---
	X2CrNiMo18-14-3	1.4435	---	SA & Q	---	---	190	---	490-690	---	40 L; 30 T	---
AFNOR NF A 49-317:1980	TU Z 2 CND 17-12	---	---	HQ	---	---	175	---	470	---	45	---
ASTM A 269-02a	TP316LN	---	S31653	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
DIN 17455:1999	X2CrNiMoN17-13-3	1.4429	---	SA & Q	---	---	295	---	580-800	---	35 L; 30 T	---
DIN 17456:1999	X2CrNiMoN17-13-3	1.4429	---	SA & Q	---	---	295	---	580-800	---	35 L; 30 T	---

*: 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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa min	ksi min	N/mm² or MPa min	ksi min		
ASTM A 269-02a	TP321	---	S32100	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
ASTM A 511-96	MT 321	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 554-03	MT-321	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 632-02a	TP 321	---	S32100	HT	---	---	205	30	515	75	35	---
ASTM A 778-01	TP 321	---	S32100	AM	---	---	---	---	515	75	---	---
JIS G 3446:1994	SUS321TKA	---	---	ST	---	---	205	---	520	---	35	---
BS 6323-8:1982 AMD 2:1989	LW 24	---	---	KM	---	---	450	---	560	---	25	---
	LWCF 24	---	---	KM	---	---	450	---	560	---	25	---
DIN 17455:1999	X6CrNiTi18-10	1.4541	---	SA & Q	---	---	200	---	500-730	---	35 L; 30 T	---
DIN 17456:1999	X6CrNiTi18-10	1.4541	---	SA & Q	---	---	200	---	500-730	---	35 L; 30 T	---
DIN 17456:1999	X6CrNiTi18-10	1.4541	---	SA & Q (HW) see standard	---	---	180	---	460-680	---	35 L; 30 T	---
ASTM A 269-02a	TP347	---	S34700	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
ASTM A 511-96	MT 347	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 554-03	MT-347	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 632-02a	TP 347	---	S34700	HT	---	---	205	30	515	75	35	---
ASTM A 778-01	TP 347	---	S34700	AM	---	---	---	---	515	75	---	---
JIS G 3446:1994	SUS347TKA	---	---	ST	---	---	205	---	520	---	35	---
DIN 17455:1999	X6CrNiNb18-10	1.4550	---	SA & Q	---	---	205	---	510-740	---	35 L; 30 T	---
DIN 17456:1999	X6CrNiNb18-10	1.4550	---	SA & Q	---	---	205	---	510-740	---	35 L; 30 T	---
ASTM A 269-02a	---	---	S31725	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
DIN 17455:1999	X2CrNiMoN17-13-5	1.4439	---	SA & Q	---	---	285	---	580-800	---	35 L; 30 T	---
DIN 17456:1999	X2CrNiMoN17-13-5	1.4439	---	SA & Q	---	---	285	---	580-800	---	35 L; 30 T	---

*: 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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10216-4:2002	P215NL	1.0451	---	N	≤ 10	---	215	---	360-480	---	25 L; 23 T	see standard for impact data
EN 10217-4:2002	P215NL	1.0451	---	see standard	≤ 10	---	215	---	360-480	---	25 L; 23 T	see standard for impact data
EN 10217-6:2002	P215NL	1.0451	---	see standard	≤ 10	---	215	---	360-480	---	25 L; 23 T	see standard for impact data
ISO 9329-3:1997	PL 21	---	---	N	≤ 13	---	215	---	360-480	---	24	t ≤ 10 mm L: 40 J at -40°C
					13 < t ≤ 25	---	215	---				
ISO 9330-3:1997	PL 21	---	---	N	---	---	215	---	360-480	---	24	L: 40 J at -40°C
ISO 9330-5:2000	PL 21	---	---	N	≤ 13	---	215	---	360-480	---	24	≤ 10 mm L: 40 J at -40°C
					13 < t ≤ 25	---	215	---				
EN 10216-4:2002	P255QL	1.0452	---	QT	≤ 40	---	255	---	360-490	---	23 L; 21 T	see standard for impact data
ISO 9329-3:1997	PL 25	---	---	QT	≤ 13	---	255	---	360-490	---	21	L: 40 J at -50°C
					13 < t ≤ 25	---	255	---				
					25 < t ≤ 40	---	235	---				L: 40 J at -40°C
ISO 9330-3:1997	PL 25	---	---	QT	---	---	255	---	360-490	---	21	L: 40 J at -50°C
ISO 9330-5:2000	PL 25	---	---	N	≤ 13	---	255	---	360-490	---	21	L: 40 J at -50°C
					13 < t ≤ 25	---	255	---				
					25 < t ≤ 40	---	235	---				L: 40 J at -40°C
ASTM A 333/A 333M-99	1	---	K03008	see standard	---	---	205	30	380	55	≥ 8mm (5⁄16 in) 35 L; 25 T	18 J at -45°C
ASTM A 334/A 334M-99	1	---	K03008	N, NT	---	---	205	30	380	55	t ≥ 5⁄16 in. (8 mm): 35	85 HRB max 163 HB max 18 J at -45°C
JIS G 3460:1988	STPL 380	---	---	N or NT	---	---	205	---	380	---	35	21 J at -45°C
JIS G 3464:1988	STBL 380	---	---	N or NT	O.D. < 10	---	205	---	380	---	27	21 J at -45°C
					10 ≤ O.D. < 20	---					30	
					O.D. ≥ 20	---					35	
EN 10216-3:2002	P275NL2	1.1104	---	HF+N or HRCF+N	≤ 12	---	275	---	390-530	---	24 L; 22 T	see standard for impact data
					12 < t ≤ 20	---	275	---				
					20 < t ≤ 40	---	275	---	390-510			
					40 < t ≤ 50	---	265	---				
					50 < t ≤ 65	---	255	---				
					65 < t ≤ 80	---	245	---	360-480			
					80 < t ≤ 100	---	235	---				

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ISO 9330-3:1997	PL 23	---	---	N	---	---	235	---	410-530	---	22	L: 27 J at -50°C
ISO 9330-5:2000	PL 23	---	---	N	≤ 13	---	235	---	410-530	---	22	L: 27 J at -50°C
					13 < t ≤ 25	---	235	---				
ISO 9329-3:1997	PL 23	---	---	N	≤ 13	---	235	---	410-530	---	22	L: 27 J at -50°C
					13 < t ≤ 25	---	235	---				
EN 10216-4:2002	P265NL	1.0453	---	N	≤ 25	---	265	---	410-570	---	24 L; 22 T	see standard for impact data
EN 10217-4:2002	P265NL	1.0453	---	see standard	≤ 16	---	265	---	410-570	---	24 L; 22 T	see standard for impact data
EN 10217-6:2002	P265NL	1.0453	---	see standard	≤ 25	---	265	---	410-570	---	24 L; 22 T	see standard for impact data
ASTM A 333/A 333M-99	6	---	K03006	see standard	---	---	240	35	415	60	≥ 8mm (5⁄16 in) 30 L; 16.5 T	18 J at -45°C
ASTM A 334/A 334M-99	6	---	K03006	N, NT	---	---	240	35	415	60	t ≥ 5⁄16 in. (8 mm): 30	90 HRB max 190 HB max 18 J at -45°C
ASTM A 333/A 333M-99	3	---	K31918	see standard	---	---	240	35	450	65	≥ 8mm (5⁄16 in) 30 L; 20 T	18 J at -100°C
JIS G 3460:1988	STPL 450	---	---	N or NT	---	---	245	---	450	---	30	21 J at -100°C
ASTM A 333/A 333M-99	8	---	K81340	QT or NNT	---	---	515	75	690	100	≥ 8mm (5⁄16 in) 22 L	see standard
JIS G 3460:1988	STPL 690	---	---	N1N2T or QT	---	---	520	---	690	---	21	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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10216-4:2002	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 0.01; Ti 0.040; V 0.02
EN 10217-4:2002	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	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 10216-4:2002	P255QL	1.0452	---	0.17	0.40-1.20	0.35	0.025	0.020	0.30	0.30	0.08	Al 0.020 min; Cu 0.30; Nb 0.01; 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
ASTM A 333/A 333M-99	1	---	K03008	0.30	0.40-1.06	---	0.025	0.025	---	---	---	---
ASTM A 334/A 334M-99	1	---	K03008	0.30	0.40-1.06	---	0.025	0.025	---	---	---	---
JIS G 3460:1988	STBL 380	---	---	0.25	1.35	0.35	0.035	0.035	---	---	---	---
JIS G 3464:1988	STBL 380	---	---	0.25	1.35	0.35	0.035	0.035	---	---	---	---
EN 10216-3:2002	P275NL2	1.1104	---	0.16	0.50-1.50	0.40	0.025	0.015	---	---	---	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
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 10216-4:2002	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 0.040; V 0.02
EN 10217-4:2002	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	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 0.030; V 0.02
ASTM A 333/A 333M-99	6	---	K03006	0.30	0.29-1.06	0.10 min	0.025	0.025	---	---	---	---
ASTM A 334/A 334M-99	6	---	K03006	0.30	0.29-1.06	0.10 min	0.025	0.025	---	---	---	---
ASTM A 333/A 333M-99	3	---	K31918	0.19	0.31-0.64	0.18-0.37	0.025	0.025	---	3.18-3.82	---	---
JIS G 3460:1988	STPL 450	---	---	0.18	0.30-0.60	0.10-0.35	0.030	0.030	---	3.20-3.80	---	---
ASTM A 333/A 333M-99	8	---	K81340	0.13	0.90	0.13-0.32	0.025	0.025	---	8.40-9.60	---	---
JIS G 3460:1988	STPL 690	---	---	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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10216-4:2002	11MnNi5-3	1.6212	---	0.14	0.70-1.50	0.50	0.025	0.015	---	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 10216-4:2002	13MnNi6-3	1.6217	---	0.16	0.85-1.70	0.50	0.025	0.015	---	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
ASTM A 333/A 333M-99	3	---	K31918	0.19	0.31-0.64	0.18-0.37	0.025	0.025	---	3.18-3.82	---	---
ASTM A 334/A 334M-99	3	---	K31918	0.19	0.31-0.64	0.18-0.37	0.025	0.025	---	3.18-3.82	---	---
JIS G 3460:1988	STPL 450	---	---	0.18	0.30-0.60	0.10-0.35	0.030	0.030	---	3.20-3.80	---	---
JIS G 3464:1988	STBL 450	---	---	0.18	0.30-0.60	0.10-0.35	0.030	0.030	---	3.20-3.80	---	---
EN 10216-4:2002	12Ni14	1.5637	---	0.15	0.30-0.80	0.15-0.35	0.025	0.010	---	3.25-3.75	---	Cu 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
EN 10216-4:2002	X12Ni5	1.5680	---	0.15	0.30-0.80	0.35	0.020	0.010	---	4.50-5.30	---	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
ASTM A 333/A 333M-99	8	---	K81340	0.13	0.90	0.13-0.32	0.025	0.025	---	8.40-9.60	---	---
ASTM A 334/A 334M-99	8	---	K81340	0.13	0.90	0.13-0.32	0.025	0.025	---	8.40-9.60	---	---
JIS G 3460:1988	STPL 690	---	---	0.13	0.90	0.10-0.35	0.030	0.030	---	8.50-9.50	---	---
JIS G 3464:1988	STBL 690	---	---	0.13	0.90	0.10-0.35	0.030	0.030	---	8.50-9.50	---	---
EN 10216-4:2002	X10Ni9	1.5682	---	0.13	0.30-0.80	0.15-0.35	0.020	0.010	---	8.50-9.50	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
EN 10216-4:2002	26CrMo4-2	1.7219	---	0.22-0.29	0.50-0.80	0.35	0.025	0.020	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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10216-4:2002	11MnNi5-3	1.6212	---	N	≤ 40	---	285	---	410-530	---	24 L; 22 T	see standard for impact data
ISO 9329-3:1997	11 MnNi 5-3	---	---	N	≤ 13	---	285	---	410-530	---	22	L: 40 J at -60°C
					13 < t ≤ 25	---	275	---				
					25 < t ≤ 40	---	265	---				
ISO 9330-3:1997	11 MnNi 5-3	---	---	N	≤ 13	---	285	---	410-530	---	22	L: 40 J at -60°C
ISO 9330-5:2000	11 MnNi 5-3	---	---	N	≤ 13	---	285	---	410-530	---	22	L: 40 J at -60°C
					13 < t ≤ 25	---	275	---				
					25 < t ≤ 40	---	265	---				
EN 10216-4:2002	13MnNi6-3	1.6217	---	N	≤ 40	---	355	---	490-610	---	22 L; 20 T	see standard for impact data
ISO 9329-3:1997	13 MnNi 6-3	---	---	N	≤ 13	---	355	---	490-610	---	20	L: 40 J at -60°C
					13 < t ≤ 25	---	345	---				
					25 < t ≤ 40	---	335	---				
ISO 9330-3:1997	13 MnNi 6-3	---	---	N	≤ 13	---	355	---	490-610	---	20	L: 40 J at -60°C
ISO 9330-5:2000	13 MnNi 6-3	---	---	N	≤ 13	---	355	---	490-610	---	20	L: 40 J at -60°C
					13 < t ≤ 25	---	345	---				
					25 < t ≤ 40	---	335	---				
ASTM A 333/A 333M-99	3	---	K31918	N, NT	---	---	240	35	450	65	30	---
ASTM A 334/A 334M-99	3	---	K31918	N, NT	---	---	240	35	450	65	t ≥ 5⁄16 in. (8 mm): 30	90 HRB max 190 HB max 18 J at -100°C
JIS G 3460:1988	STPL 450	---	---	N, NT	---	---	245	---	450	---	see standard	see standard for impact data
JIS G 3464:1988	STBL 450	---	---	N or NT	O.D. < 10	---	245	---	450	---	22	21 J at -100°C
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
EN 10216-4:2002	12Ni14	1.5637	---	NT, QT	≤ 40	---	345	---	440-620	---	22 L; 20 T	see standard for impact data
ISO 9329-3:1997	12 Ni 14	---	---	QT	≤ 13	---	245	---	440-590	---	16	L: 40 J at -100°C
					13 < t ≤ 25	---	245	---				
					25 < t ≤ 40	---	245	---				L: 40 J at -90°C
ISO 9330-3:1997	12 Ni 14	---	---	QT	≤ 13	---	245	---	440-590	---	16	L: 40 J at -100°C
ISO 9330-5:2000	12 Ni 14	---	---	QT	≤ 13	---	245	---	440-590	---	16	L: 40 J at -100°C
					13 < t ≤ 25	---	245	---				
					25 < t ≤ 40	---	245	---				L: 40 J at -90°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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10216-4:2002	X12Ni5	1.5680	---	NT, QT	≤ 40	---	390	---	510-710	---	21 L; 19 T	see standard for impact data
ISO 9329-3:1997	X 12 Ni 5	---	---	QT	≤ 13	---	390	---	510-710	---	17	L: 40 J at -120°C
					13 < t ≤ 25	---	390	---				
					25 < t ≤ 40	---	380	---				L: 40 J at -110°C
ISO 9330-3:1997	X 12 Ni 5	---	---	QT	≤ 13	---	390	---	510-710	---	17	L: 40 J at -120°C
ISO 9330-5:2000	X 12 Ni 5	---	---	QT	≤ 13	---	390	---	510-710	---	17	L: 40 J at -120°C
					13 < t ≤ 25	---	390	---				
					25 < t ≤ 40	---	380	---				L: 40 J at -110°C
ASTM A 333/A 333M-99	8	---	K81340	QT	---	----	515	75	690	100	22	see standard for impact data
ASTM A 334/A 334M-99	8	---	K81340	QT or NNT	---	---	520	75	690	100	t ≥ 5/16 in. (8 mm): 22	18 J at -195°C
JIS G 3460:1988	STPL 690	---	---	NNT or QT	---	---	520	---	690	---	see standard	see standard for impact data
JIS G 3464:1988	STBL 690	---	---	NNT or QT	O.D. < 10	---	520	---	690	---	13	21 J at -196°C
					10 ≤ O.D. < 20	---					16	
					O.D. ≥ 20	---					21	
AFNOR NF A 49-215:1981	TU Z 6 N 9	---	---	NT or WQT	---	---	520	---	650	---	16	60 J at -196°C
EN 10216-4:2002	X10Ni9	1.5682	---	QT, N, NT	≤ 40	---	510	---	690-840	---	20 L; 18 T	see standard for impact data
ISO 9329-3:1997	X 10 Ni 9	---	---	QT	≤ 13	---	510	---	690-840	---	15	L: 40 J at -196°C
					13 < t ≤ 25	---	510	---				
					25 < t ≤ 40	---	510	---				
ISO 9330-5:2000	X 10 Ni 9	---	---	QT	≤ 13	---	510	---	690-840	---	15	L: 40 J at -196°C
					13 < t ≤ 25	---	510	---				
					25 < t ≤ 40	---	510	---				
EN 10216-4:2002	26CrMo4-2	1.7219	---	QT	≤ 40	---	440	---	560-740	---	18 L; 16 T	see standard for impact data
ISO 9329-3:1997	26 CrMo 4	---	---	QT	≤ 13	---	440	---	560-740	---	16	L: 40 J at -60°C
					13 < t ≤ 25	---	440	---				
					25 < t ≤ 40	---	420	---				

5.6 Carbon Steel Tubes and Pipes for Pressure Purposes

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10216-1:2002	P195TR1	1.0107	---	HF: AF, N or NF; HFCF: N	≤ 16	---	195	---	320-440	---	27 L; 25 T	---
					16 < t ≤ 40	---	185	---				
					40 < t ≤ 60	---	175	---				
	P195TR2	1.0108	---	HF: N or NF; HFCF: N	≤ 16	---	195	---	320-440	---	27 L; 25 T	see standard
					16 < t ≤ 40	---	185	---				
					40 < t ≤ 60	---	175	---				
EN 10217-1:2002	P195TR1	1.0107	---	see standard	≤ 16	---	195	---	320-440	---	27 L; 25 T	---
					16 < t ≤ 40	---	185	---				
	P195TR2	1.0108	---	see standard	≤ 16	---	195	---	320-440	---	27 L; 25 T	see standard
					16 < t ≤ 40	---	185	---				
ASTM A 53/A 53M-02	Type E Grade A	---	K02504	AM	---	---	205	30	330	48	see standard	---
	Type F Grade A	---	---	AM	---	---	205	30	330	48	see standard	---
	Type S Grade A	---	K02504	AM	---	---	205	30	330	48	see standard	---
ASTM A 139-00	A	---	---	---	---	---	205	30	330	48	≥ 7.9 mm (5⁄16 in) 35	---
ASTM A 135-01	A	---	---	AM	---	---	207	30	331	48	≥ 7.9 mm (5⁄16 in) 35	---
EN 10216-1:2002	P235TR1	1.0254	---	HF: AF, N or NF; HFCF: N	≤ 16	---	235	---	360-500	---	25L; 23 T	---
					16 < t ≤ 40	---	225	---				
					40 < t ≤ 60	---	215	---				
	P235TR2	1.0255	---	HF: N or NF; HFCF: N	≤ 16	---	235	---	360-500	---	25 L; 23 T	see standard
					16 < t ≤ 40	---	225	---				
					40 < t ≤ 60	---	215	---				
EN 10217-1:2002	P235TR1	1.0254	---	see standard	≤ 16	---	235	---	360-500	---	25 L; 23 T	---
					16 < t ≤ 40	---	225	---				
	P235TR2	1.0255	---	see standard	≤ 16	---	235	---	360-500	---	25 L; 23 T	see standard
					16 < t ≤ 40	---	225	---				
JIS G 3454:1988	STPG 370	---	---	AM or CF+A	---	---	215	---	370	---	30	---

5.6 Carbon Steel Tubes and Pipes for Pressure Purposes

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3457:1988	STPY 400	---	---	AW or ACE	---	---	225	---	400	---	18	---
EN 10216-1:2002	P265TR1	1.0258	---	HF: AF, N or NF; HFCF: N	≤ 16	---	265	---	410-570	---	21 L; 19 T	---
					16 < t ≤ 40	---	255	---				
					40 < t ≤ 60	---	245	---				
	P265TR2	1.0259	---	HF: N or NF; HFCF: N	≤ 16	---	265	---	410-570	---	21 L; 19 T	see standard
					16 < t ≤ 40	---	255	---				
					40 < t ≤ 60	---	245	---				
EN 10217-1:2002	P265TR1	1.0258	---	see standard	≤ 16	---	265	---	410-570	---	21 L; 19 T	---
					16 < t ≤ 40	---	255	---				
	P265TR2	1.0259	---	see standard	≤ 16	---	265	---	410-570	---	21 L; 19 T	see standard
					16 < t ≤ 40	---	255	---				
JIS G 3454:1988	STPG 410	---	---	AM or CF+A	---	---	245	---	410	---	25	---
ASTM A 135-01	B	---	---	Tempered	---	---	241	35	414	60	≥ 7.9mm (5⁄16 in) 30	---
ASTM A 53/A 53M-02	Type E Grade B	---	K03005	Tempered	---	---	240	35	415	60	see standard	---
	Type S Grade B	---	K03005	AM	---	---	240	35	415	60	see standard	---
ASTM A 139-00	B	---	K03003	---	---	---	240	35	415	60	≥ 7.9mm (5⁄16 in) 30	---
	C	---	K03004	---	---	---	290	42	415	60	≥ 7.9mm (5⁄16 in) 25	---
	D	---	K03010	---	---	---	315	46	415	60	≥ 7.9mm (5⁄16 in) 23	---
	E	---	K03012	---	---	---	360	52	455	66	≥ 7.9mm (5⁄16 in) 22	---

5.6 Carbon Steel Tubes and Pipes for Pressure Purposes

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10216-1:2002	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
EN 10217-1:2002	P195TR1	1.0107	---	0.13	0.70	0.35	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.01; Ti 0.040; 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 0.020 min; Cu 0.30; Nb 0.01; Ti 0.040; V 0.02; Cr+Cu+Mo+Ni 0.70
ASTM A 53/A 53M-02	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 A 139-00	A	---	---	0.25	1.00	---	0.035	0.035	---	---	---	---
ASTM A 135-01	A	---	---	0.25	0.95	---	0.035	0.035	---	---	---	---
EN 10216-1:2002	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
EN 10217-1:2002	P235TR1	1.0254	---	0.16	1.20	0.35	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.01; Ti 0.040; 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 0.020 min; Cu 0.30; Nb 0.01; Ti 0.040; V 0.02; Cr+Cu+Mo+Ni 0.70
JIS G 3454:1988	STPG 370	---	---	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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3457:1988	STPY 400	---	---	0.25	---	---	0.040	0.040	---	---	---	---
EN 10216-1:2002	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
EN 10217-1:2002	P265TR1	1.0258	---	0.20	1.40	0.40	0.025	0.020	0.30	0.30	0.08	Cu 0.30; Nb 0.01; Ti 0.040; 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 0.020 min; Cu 0.30; Nb 0.01; Ti 0.040; V 0.02; Cr+Cu+Mo+Ni 0.70
JIS G 3454:1988	STPG 410	---	---	0.30	0.30-1.00	0.35	0.040	0.040	---	---	---	---
ASTM A 135-01	B	---	---	0.30	1.20	---	0.035	0.035	---	---	---	---
ASTM A 53/A 53M-02	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 A 139-00	B	---	K03003	0.26	1.00	---	0.035	0.035	---	---	---	---
	C	---	K03004	0.28	1.20	---	0.035	0.035	---	---	---	---
	D	---	K03010	0.30	1.30	---	0.035	0.035	---	---	---	---
	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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 214/A 214M-96 (2001)	---	---	K01807	see standard	---	---	---	---	---	---	---	72 HRB max
ASTM A 556/A 556M-96 (2001)	A2	---	K01807	---	---	---	180	26	320	47	35	72 HRB max
EN 10216-2:2002	P195GH	1.0348	---	N, NF	≤ 16	---	195	---	320-440	---	27 L; 25 T	L: 40 J at 0°C L: 28 J at -10°C T: 27 J at 0°C
					16 < t ≤ 40	---	---	---				
					40 < t ≤ 60	---	---	---				
EN 10217-2:2002	P195GH	1.0348	---	see standard	≤ 16	---	195	---	320-440	---	27 L; 25 T	see standard
ISO 2604-II:1975	TS 1	---	---	HF,SCA, A, N	---	---	195	---	320-440	---	25	---
	TS 2	---	---	HF, N	---	---	195	---	320-440	---	25	---
ISO 2604-III:1975	TW 1	---	---	W, HR, SCA, A, N	---	---	195	---	320-440	---	25	---
	TW 2	---	---	N	---	---	195	---	320-440	---	25	---
ASTM A 178/A 178M-02*	A	---	K01200	see standard	---	---	180	26	325	47	35	---
ASTM A 179/A 179M-90a (2001)*	---	---	K01200	CD+1200°F min	---	---	180	26	325	47	35	72 HRB max
ASTM A 192/A 192M-02*	---	---	K01201	HF or CF + 1200°F min	---	---	180	26	325	47	35	5.1 mm (0.200 in) 137 HB max 77 HRB max
ASTM A 106-02a	A	---	K02501	HF or CD + 1200°F min	---	---	205	30	330	48	35 L; 25 T	---
JIS G 3461:1988	STB 340	---	---	see standard	---	---	175	---	340	---	35	---
DIN 28180:1985	TTSt 35 N	1.0356	---	N	≤ 10	---	225	---	340-460	---	25 L; 23 T	L:40 J at -40°C
DIN 28181:1985	TTSt 35 N	1.0356	---	N or NG	≤ 10	---	225	---	340-460	---	25 L; 23 T	40 J at -40°C

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

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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
DIN 1630:1984	St 37.4	1.0255	---	AD	≤ 16	---	235	---	350-480	---	25 L; 23 T	L:43 J at 20°C T:27 J at 20°C
					16 < t ≤ 40	---	225	---				
					> 40	---	215	---				
DIN 28180:1985	St 37.0	1.0254	---	see standard	≤ 16	---	235	---	350-480	---	25 L; 23 T	---
					16 < t ≤ 40	---	225	---	350-480	---	25 L; 23 T	---
					40 < t ≤ 65	---	215	---	350-480	---	25 L; 23 T	---
DIN 28181:1985	St 37.0	1.0254	---	see standard	≤ 16	---	235	---	350-480	---	25 L; 23 T	---
					16 < t ≤ 40	---	225	---	350-480	---	25 L; 23 T	---
ISO 2604-II:1975	TS 4	---	---	HF,SCA, A, N	---	---	215	---	360-480	---	24	---
	TS 5	---	---	HF, N	---	---	215	---	360-480	---	24	---
	TS 6	---	---	HF, A, N	---	---	215	---	360-480	---	24	---
ISO 2604-III:1975	TW 4	---	---	W, HR, SCA, A, N	---	---	215	---	360-480	---	24	---
	TW 5	---	---	N	---	---	215	---	360-480	---	24	---
	TW 6	---	---	A, N	---	---	215	---	360-480	---	24	---
AFNOR NF A 49-220:1990	TU 37 C	---	---	N	---	---	220	---	360-460	---	---	32 J at 0°C
DIN 28180:1985	St 35.8	1.0305	---	N	≤ 16	---	235	---	360-480	---	25 L; 23 T	T: 34 J at RT
					16 < t ≤ 40	---	225	---	360-480	---	25 L; 23 T	T: 34 J at RT
					40 < t ≤ 60	---	215	---	360-480	---	25 L; 23 T	T: 34 J at RT
DIN 28181:1985	St 37.8	1.0315	---	AD	≤ 16	---	235	---	360-480	---	25 L; 23 T	---
DIN 28180:1985	TTSt 35 N	1.0356	---	V (QT)	≤ 25	---	255	---	360-490	---	23 L; 21 T	L:45 J at -40°C T:30 J at -40°C
					25 < t ≤ 40	---	235	---	360-490	---	23 L; 21 T	L:40 J at -40°C T:27 J at -40°C
EN 10216-2:2002	P235GH	1.0345	---	N, NF	≤ 16	---	235	---	360-500	---	25 L; 23 T	L: 40 J at 0°C L: 28 J at -10°C T: 27 J at 0°C
					16 < t ≤ 40	---	225	---				
					40 < t ≤ 60	---	215	---				
EN 10217-2:2002	P235GH	1.0345	---	see standard	≤ 16	---	235	---	360-500	---	25 L; 23 T	see standard
EN 10217-5:2002	P235GH	1.0345	---	see standard	≤ 16	---	235	---	360-500	---	25 L; 23 T	see standard
					16 < t ≤ 40	---	225	---				
JIS G 3455:1988	STS 370	---	---	HFS: AM CFS: LTA or N	---	---	215	---	370	---	30	---
JIS G 3456:1988	STPT 370	---	---	see standard	---	---	215	---	370	---	30	---

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
AFNOR NF A 49-220:1990	TU 42 C	---	---	N	---	---	235	---	410-510	---	---	32 J at 0°C
ISO 2604-II:1975	TS 9	---	---	HF, N	---	---	235	---	410-530	---	22	---
	TS 9H	---	---	HF, N	---	---	235	---	410-530	---	22	---
	TS 10	---	---	HF, A, N	---	---	235	---	410-530	---	22	---
ISO 2604-III:1975	TW 9	---	---	W, HR, SCA, A, N	---	---	235	---	410-530	---	22	---
	TW 9H	---	---	N	---	---	235	---	410-530	---	22	---
	TW 10	---	---	A, N	---	---	235	---	410-530	---	22	---
JIS G 3455:1988	STS 410	---	---	HFS: AM CFS: LTA or N	---	---	245	---	410	---	25	---
JIS G 3456:1988	STPT 410	---	---	see standard	---	---	245	---	410	---	25	---
JIS G 3467:1988	STF 410	---	---	HFS: AM CFS: LTA, N	---	---	245	---	410	---	25	---
JIS G 3461:1988	STB 410	---	---	see standard	---	---	255	---	410	---	25	---
ASTM A 556/A 556M-96 (2001)	B2	---	K02707	CD+1200°F min	---	---	260	37	410	60	30	79 HRB max
EN 10216-2:2002	P265GH	1.0425	---	N, NF	≤ 16	---	265	---	410-570	---	23 L; 21 T	L: 40 J at 0°C L: 28 J at -10°C T: 27 J at 0°C
					16 < t ≤ 40	---	255	---				
					40 < t ≤ 60	---	245	---				
EN 10217-2:2002	P265GH	1.0425	---	see standard	≤ 16	---	265	---	410-570	---	23 L; 21 T	see standard
EN 10217-5:2002	P265GH	1.0425	---	see standard	≤ 16	---	265	---	410-570	---	23 L; 21 T	see standard
					16 < t ≤ 40	---	255	---				
ASTM A 106-02a	B	---	K03006	HF or CD + 1200°F min	---	---	240	35	415	60	30 L; 16.5 T	---
ASTM A 178/A 178M-02*	C	---	K03503	see standard	---	---	255	37	415	60	30	---
ASTM A 210/A 210M-02	A-1	---	K02707	HF or CF + SA, A, N	---	---	255	37	415	60	30	79 HRB max 143 HB max
DIN 1630:1984	St 44.4	1.0257	---	AD	≤ 16	---	275	---	420-550	---	21 L; 19 T	L:43 J at 20°C T:27 J at 20°C
					16 < t ≤ 40	---	265	---				
					40 < t ≤ 65	---	255	---				

*: 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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
AFNOR NF A 49-220:1990	TU 48 C	---	---	N	---	---	275	---	470-570	---	---	40 J at 0°C
JIS G 3455:1988	STS 480	---	---	LTA or N	---	---	275	---	480	---	25	---
JIS G 3456:1988	STPT 480	---	---	see standard	---	---	275	---	480	---	25	---
ISO 2604-II:1975	TS 13	---	---	HF,SCA, A, N	---	---	265	---	460-580	---	21	---
	TS 14	---	---	HF, N	---	---	265	---	460-580	---	21	---
	TS 15	---	---	HF, A, N	---	---	265	---	460-580	---	21	---
ISO 2604-III:1975	TW 13	---	---	W, HR, SCA, A, N	---	---	265	---	460-580	---	21	---
	TW 14	---	---	N	---	---	265	---	460-580	---	21	---
	TW 15	---	---	A, N	---	---	265	---	460-580	---	21	---
ASTM A 556/A 556M-26 (2001)	C2	---	K03006	CD+1200°F min	---	---	280	40	480	70	30	89 HRB max
ASTM A 178/A 178M-02*	D	---	---	see standard	---	---	275	40	485	70	30	---
ASTM A 210/A 210M-02	C	---	K03501	HF or CF + SA, A, N	---	---	275	40	485	70	30	89 HRB max 179 HB max
ISO 2604-II:1975	TS 18	---	---	HF, N	---	---	285	---	490-610	---	21	---
ASTM A 106-02a	C	---	K03501	HF or CD + 1200°F min	---	---	275	40	485	70	30 L; 16.5 T	---
DIN 1630:1984	St 52.4	1.0581	---	AD	≤ 16	---	355	---	500-650	---	21 L; 19 T	L:43 J at 20°C T:27 J at 20°C
					16 < t ≤ 40	---	345	--				
					40 < t ≤ 65	---	335	---				
JIS G 3461:1988	STB 510	---	---	N	---	---	295	---	510	---	25	---
AFNOR NF A 49-220:1990	TU 52 C	---	---	N	---	---	350	---	510-630	---	---	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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 214/A 214M-96 (2001)	---	---	K01807	0.18	0.27-0.63	---	0.035	0.035	---	---	---	---
ASTM A 556/A 556M-96 (2001)	A2	---	K01807	0.18	0.27-0.63	---	0.035	0.035	---	---	---	---
EN 10216-2:2002	P195GH	1.0348	---	0.13	0.70	0.35	0.025	0.020	0.30	0.30	0.08	Al 0.020; Cu 0.30; Nb 0.010; Ti 0.040; V 0.02;Cr+Cu+Mo+Ni 0.70
EN 10217-2:2002	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
ISO 2604-II:1975	TS 1	---	---	0.16	0.30-0.70	---	0.050	0.050	---	---	---	---
	TS 2	---	---	0.16	0.40-0.70	---	0.050	0.050	---	---	---	---
ISO 2604-III:1975	TW 1	---	---	0.16	0.30-0.70	---	0.050	0.050	---	---	---	---
	TW 2	---	---	0.16	0.30-0.70	---	0.050	0.050	---	---	---	---
ASTM A 178/A 178M-02*	A	---	K01200	0.06-0.18	0.27-0.63	---	0.035	0.035	---	---	---	---
ASTM A 179/A 179M-90a (2001)*	---	---	K01200	0.06-0.18	0.27-0.63	---	0.035	0.035	---	---	---	---
ASTM A 192/A 192M-02*	---	---	K01201	0.06-0.18	0.27-0.63	0.25	0.035	0.035	---	---	---	---
ASTM A 106-02a	A	---	K02501	0.25	0.27-0.93	≥ 0.10	0.035	0.035	0.40	0.40	0.15	Cu 0.40; V 0.08; Cu+Ni+Cr+Mo+V 1.0
JIS G 3461:1988	STB 340	---	---	0.18	0.30-0.60	0.35	0.035	0.035	---	---	---	---
DIN 28180:1985	TTSt 35 N	1.0356	---	0.17	0.40	0.35	0.030	0.025	---	---	---	---
DIN 28181:1985	TT St 35 N	1.0356	---	0.17	0.40	0.35	0.030	0.025	---	---	---	Al 0.020 min
DIN 1630:1984	St 37.4	1.0255	---	0.17	≥ 0.35	0.35	0.040	0.040	---	---	---	N fixing elements
DIN 28180:1985	St 37.0	1.0254	---	0.17	---	---	0.040	0.040	---	---	---	N 0.009
DIN 28181:1985	St 37.0	1.0254	---	0.17	---	---	0.040	0.040	---	---	---	N 0.009
ISO 2604-II:1975	TS 4	---	---	0.17	0.40-0.80	0.35	0.045	0.045	---	---	---	---
	TS 5	---	---	0.17	0.40-0.80	0.35	0.045	0.045	---	---	---	---
	TS 6	---	---	0.17	0.40-1.00	0.35	0.045	0.045	---	---	---	Al 0.015
ISO 2604-III:1975	TW 4	---	---	0.17	0.40-0.80	0.35	0.045	0.045	---	---	---	---
	TW 5	---	---	0.17	0.40-0.80	0.35	0.045	0.045	---	---	---	---
	TW 6	---	---	0.17	0.40-1.00	0.35	0.045	0.045	---	---	---	Al 0.015
AFNOR NF A 49-220:1990	TU 37 C	---	---	0.16	0.35-0.75	0.06-0.30	0.025	0.025	---	---	---	---
DIN 28180:1985	St 35.8	1.0305	---	0.17	0.40-0.80	0.10-0.35	0.040	0.040	---	---	---	---
DIN 28181:1985	St 37.8	1.0315	---	0.17	0.40-0.80	0.10-0.35	0.040	0.040	---	---	---	---
DIN 28180:1985	TTSt 35 N	1.0356	---	0.17	0.40	0.35	0.030	0.025	---	---	---	Al 0.020 min
EN 10216-2:2002	P235GH	1.0345	---	0.16	1.20	0.35	0.025	0.020	0.30	0.30	0.08	Al 0.020; Cu 0.30; Nb 0.010; Ti 0.040; V 0.02;Cr+Cu+Mo+Ni 0.70
EN 10217-2:2002	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	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 3455:1988	STS 370	---	---	0.25	0.30-1.10	0.10-0.35	0.035	0.035	---	---	---	---
JIS G 3456:1988	STPT 370	---	---	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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	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	---	---	---	---
ISO 2604-II:1975	TS 9	---	---	0.21	0.40-1.20	0.35	0.045	0.045	---	---	---	---
	TS 9H	---	---	0.21	0.40-1.20	0.35	0.045	0.045	---	---	---	---
	TS 10	---	---	0.19	0.60-1.20	0.35	0.045	0.045	---	---	---	Al 0.015
ISO 2604-III:1975	TW 9	---	---	0.21	0.40-1.20	0.35	0.045	0.045	---	---	---	---
	TW 9H	---	---	0.21	0.40-1.20	0.35	0.045	0.045	---	---	---	---
	TW 10	---	---	0.19	0.60-1.20	0.35	0.045	0.045	---	---	---	Al 0.015
JIS G 3455:1988	STS 410	---	---	0.30	0.30-1.40	0.10-0.35	0.035	0.035	---	---	---	---
JIS G 3456:1988	STPT 410	---	---	0.30	0.30-1.00	0.10-0.35	0.035	0.035	---	---	---	---
JIS G 3467:1988	STF 410	---	---	0.30	0.30-1.00	0.10-0.35	0.035	0.035	---	---	---	---
JIS G 3461:1988	STB 410	---	---	0.32	0.30-0.80	0.35	0.035	0.035	---	---	---	---
ASTM A 556/A 556M-96 (2001)	B2	---	K02707	0.27	0.29-0.93	0.10	0.035	0.035	---	---	---	---
EN 10216-2:2002	P265GH	1.0425	---	0.20	1.40	0.40	0.025	0.020	0.30	0.30	0.08	Al 0.020; Cu 0.30; Nb 0.010; Ti 0.040; V 0.02;Cr+Cu+Mo+Ni 0.70
EN 10217-2:2002	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	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
ASTM A 106-02a	B	---	K03006	0.30	0.29-1.06	≥ 0.10	0.035	0.035	0.40	0.40	0.15	Cu 0.40; V 0.08; Cu+Ni+Cr+Mo+V 1.0
ASTM A 178/A 178M-02*	C	---	K03503	0.35	0.80	---	0.035	0.035	---	---	---	---
ASTM A 210/A 210M-02	A-1	---	K02707	0.27	0.93	0.10	0.035	0.035	---	---	---	---
DIN 1630:1984	St 44.4	1.0257	---	0.20	≥ 0.40	0.35	0.040	0.040	---	---	---	N fixing elements

*: 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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	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 3455:1988	STS 480	---	---	0.33	0.30-1.50	0.10-0.35	0.035	0.035	---	---	---	---
JIS G 3456:1988	STPT 480	---	---	0.33	0.30-1.00	0.10-0.35	0.035	0.035	---	---	---	---
ISO 2604-II:1975	TS 13	---	---	0.22	0.60-1.40	0.35	0.045	0.045	---	---	---	---
	TS 14	---	---	0.22	0.80-1.40	0.35	0.045	0.045	---	---	---	---
	TS 15	---	---	0.20	0.80-1.40	0.35	0.045	0.045	---	---	---	Al 0.015
ISO 2604-III:1975	TW 13	---	---	0.22	0.60-1.40	0.35	0.045	0.045	---	---	---	---
	TW 14	---	---	0.22	0.80-1.40	0.35	0.045	0.045	---	---	---	---
	TW 15	---	---	0.20	0.80-1.40	0.35	0.045	0.045	---	---	---	Al 0.015
ASTM A 556/A 556M-96 (2001)	C2	---	K03006	0.30	0.29-1.06	0.10	0.035	0.035	---	---	---	---
ASTM A 178/A 178M-02*	D	---	---	0.27	1.00-1.50	0.10 min	0.030	0.015	---	---	---	---
ASTM A 210/A 210M-02	C	---	K03501	0.35	0.29-1.06	0.10	0.035	0.035	---	---	---	---
ISO 2604-II:1975	TS 18	---	---	0.23	0.80-1.50	0.35	0.045	0.045	---	---	---	---
ASTM A 106-02a	C	---	K03501	0.35	0.29-1.06	≥ 0.10	0.035	0.035	0.40	0.40	0.15	Cu 0.40; V 0.08; Cu+Ni+Cr+Mo+V 1.0
DIN 1630:1984	St 52.4	1.0581	---	0.22	1.60	0.55	0.040	0.035	---	---	---	N fixing elements
JIS G 3461:1988	STB 510	---	---	0.25	1.00-1.50	0.35	0.035	0.035	---	---	---	---
AFNOR NF A 49-220:1990	TU 52 C	---	---	0.20	1.00-1.50	0.15-0.50	0.025	0.025	---	---	---	---

*: 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 ¼Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	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	---
DIN 28180:1985	15 Mo 3	1.5415	---	0.12-0.20	0.40-0.80	0.10-0.35	0.035	0.035	---	---	0.25-0.35	---
EN 10216-2:2002	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	Al 0.040; Cu 0.30
EN 10217-2:2002	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	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
ISO 2604-II:1975	TS 26	---	---	0.12-0.20	0.40-0.80	0.10-0.35	0.040	0.040	---	---	0.25-0.35	Al 0.012
ISO 2604-III:1975	TW 26	---	---	0.12-0.20	0.40-0.80	0.10-0.35	0.040	0.040	---	---	0.25-0.35	Al 0.012

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
AFNOR NF A 49-220:1990	TU 15 D 3	---	---	heat + air cool	---	---	265	---	430-550	---	22	---
DIN 28180:1985	15 Mo 3	1.5415	---	see standard	≤ 16	---	270	---	450-600	---	22 L; 20 T	T: 34 J at RT
					16 < t ≤ 40	---	270	---	450-600	---	22 L; 20 T	
					40 < t ≤ 60	---	260	---	450-600	---	22 L; 20 T	
EN 10216-2:2002	16Mo3	1.5415	---	N, NF	≤ 16	---	280	---	450-600	---	22 L; 20 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	270	---				
					40 < t ≤ 60	---	260	---				
EN 10217-2:2002	16Mo3	1.5415	---	see standard	≤ 16	---	280	---	450-600	---	22 L; 20 T	see standard for impact data
EN 10217-5:2002	16Mo3	1.5415	---	see standard	≤ 16	---	280	---	450-600	---	22 L; 20 T	see standard for impact data
					16 < t ≤ 40	---	270	---				
ISO 2604-II:1975	TS 26	---	---	N, NT	---	---	250	---	450-600	---	22	---
ISO 2604-III:1975	TW 26	---	---	N, NT	---	---	250	---	450-600	---	22	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 209/A 209M-03	T1	---	K11522	0.10-0.20	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	T1a	---	K12023	0.15-0.25	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	T1b	---	K11422	0.14	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
ASTM A 250/A 250M-95 (2001)	T1	---	K11522	0.10-0.20	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	T1a	---	K12023	0.15-0.25	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	T1b	---	K11422	0.14	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
ASTM A 335/A 335M-03	P1	---	K11522	0.10-0.20	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
JIS G 3458:1988	STPA 12	---	---	0.10-0.20	0.30-0.80	0.10-0.50	0.035	0.035	---	---	0.45-0.65	---
JIS G 3462:1988	STBA 12	---	---	0.10-0.20	0.30-0.80	0.10-0.50	0.035	0.035	---	---	0.45-0.65	---
JIS G 3467:1988	STFA 12	---	---	0.10-0.20	0.30-0.80	0.10-0.50	0.035	0.035	---	---	0.45-0.65	---
JIS G 3462:1988	STBA 13	---	---	0.15-0.25	0.30-0.80	0.10-0.50	0.035	0.035	---	---	0.45-0.65	---
EN 10216-2:2002	8MoB5-4	1.5450	---	0.06-0.10	0.60-0.80	0.10-0.35	0.025	0.020	0.20	---	0.40-0.50	Al 0.060; Cu 0.30; Ti 0.060; B 0.002-0.006

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 209/A 209M-03	T1	---	K11522	see standard	< 5.1	< 0.200	205	30	380	55	30	80 HRB max
					≥ 5.1	≥ 0.200						146 HB max
	T1a	---	K12023	see standard	< 5.1	< 0.200	220	32	415	60	30	81 HRB max
					≥ 5.1	≥ 0.200						153 HB max
	T1b	---	K11422	see standard	< 5.1	< 0.200	195	28	365	53	30	77 HRB max
					≥ 5.1	≥ 0.200						137 HB max
ASTM A 250/A 250M-95 (2001)	T1	---	K11522	A, IA, N or NT	---	---	205	30	380	55	30	146 HB max 80 HRB max
	T1a	---	K12023	A, IA, N or NT	---	---	220	32	415	60	30	153 HB max 81 HRB max
	T1b	---	K11422	A, IA, N or NT	---	---	195	28	365	53	30	137 HB max 77 HRB max
ASTM A 335/A 335M-03	P1	---	K11522	FA, IA or NT	---	---	205	30	380	55	≥ 8mm (5⁄16 in) 30 L; 20 T	---
JIS G 3458:1988	STPA 12	---	---	LTA, IA, FA, N, or NT	---	---	205	---	380 min	---	30	---
JIS G 3462:1988	STBA 12	---	---	LTA, IA, A, N or NT	O.D. < 10	---	205	---	380	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
JIS G 3467:1988	STFA 12	---	---	LTA, IA, A, N or NT	---	---	205	---	380	---	30	---
JIS G 3462:1988	STBA 13	---	---	LTA, IA, A, N or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
EN 10216-2:2002	8MoB5-4	1.5450	---	N, NF	≤ 16	---	400	---	540-690	---	19 L; 17 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	---	---				
					40 < t ≤ 60	---	---	---				

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	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 A 250/A 250M-95 (2001)	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 A 335/A 335M-03	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	---
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	---
JIS G 3458:1988	STPA 20	---	---	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 3462:1988	STBA 20	---	---	0.10-0.20	0.30-0.60	0.10-0.50	0.035	0.035	0.50-0.80	---	0.40-0.65	---
ISO 2604-II:1975	TS 33	---	---	0.10-0.18	0.40-0.70	0.10-0.35	0.040	0.040	0.30-0.60	---	0.50-0.70	Al 0.02; V 0.22-0.32
EN 10216-2:2002	14MoV6-3	1.7715	---	0.10-0.15	0.40-0.70	0.15-0.35	0.025	0.020	0.30-0.60	0.30	0.50-0.70	Al 0.040; Cu 0.30; V 0.22-0.28

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 213/A 213M-03a	T2	---	K11547	A, IA, NT, SA	---	---	205	30	415	60	30	163 HB max 85 HRB max
ASTM A 250/A 250M-95 (2001)	T2	---	K11547	A, IA, N or NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
ASTM A 335/A 335M-03	P2	---	K11547	FA, IA or NT	---	---	205	30	380	55	≥ 8mm (5⁄16 in) 30 L; 20 T	---
AFNOR NF A 49-220:1990	TU 15 CD 2-05	---	---	heat + air cool + T	---	---	275	---	440-570	---	22	32 J at 0°C
JIS G 3458:1988	STPA 20	---	---	LTA, IA, FA, or NT	---	---	205	---	410 min	---	30	---
JIS G 3462:1988	STBA 20	---	---	LTA, IA, A, or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
ISO 2604-II:1975	TS 33	---	---	NT	---	---	275	---	460-610	---	15	---
EN 10216-2:2002	14MoV6-3	1.7715	---	NT, NF, QT	≤ 16	---	320	---	460-610	---	20 L; 18 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	320	---				
					40 < t ≤ 60	---	310	---				

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

5.8.4A Chemical Composition of 1Cr-½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	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 A 250/A 250M-95 (2001)	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 A 335/A 335M-03	P12	---	K11562	0.05-0.15	0.30-0.61	0.50	0.025	0.025	0.80-1.25	---	0.44-0.65	---
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	---
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
JIS G 3458:1988	STPA 22	---	---	0.15	0.30-0.60	0.50	0.035	0.035	0.80-1.25	---	0.45-0.65	---
JIS G 3462:1988	STBA 22	---	---	0.15	0.30-0.60	0.50	0.035	0.035	0.80-1.25	---	0.45-0.65	---
JIS G 3467:1988	STFA 22	---	---	0.15	0.30-0.60	0.50	0.035	0.035	0.80-1.25	---	0.45-0.65	---
DIN 28180:1985	13 CrMo 4 4	1.7335	---	0.10-0.18	0.40-0.70	0.10-0.35	0.035	0.035	0.70-1.10	---	0.45-0.65	---
EN 10216-2:2002	13CrMo4-5	1.7335	---	0.10-0.17	0.40-0.70	0.35	0.025	0.020	0.70-1.15	0.30	0.40-0.60	Al 0.040; Cu 0.30
ISO 2604-II:1975	TS 32	---	---	0.10-0.18	0.40-0.70	0.10-0.35	0.040	0.040	0.70-1.10	---	0.45-0.65	Al 0.02
ISO 2604-III:1975	TW 32	---	---	0.10-0.18	0.40-0.70	0.10-0.35	0.040	0.040	0.70-1.10	---	0.45-0.65	Al 0.020

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

5.8.4B Mechanical Properties of 1Cr-½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 213/A 213M-03a	T12	---	K11562	A, IA, NT, SA	---	---	220	32	415	60	30	163 HB max 85 HRB max
ASTM A 250/A 250M-95 (2001)	T12	---	K11562	A, IA, N or NT	---	---	220	32	415	60	30	163 HB max 85 HRB max
ASTM A 335/A 335M-03	P12	---	K11562	FA, IA or NT	---	---	220	32	415	60	≥ 8mm (5⁄16 in) 30 L; 20 T	---
AFNOR NF A 49-220:1990	TU 13 CD 4-04	---	---	heat + air cool + T	---	---	290	---	440-590	---	22	32 J at 0°C
BS 3604-2:1991	620	---	---	see standard	---	---	340	---	480-600	---	18	---
JIS G 3458:1988	STPA 22	---	---	LTA, IA, FA, or NT	---	---	205	---	410	---	30	---
JIS G 3462:1988	STBA 22	---	---	LTA, IA, A, or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
JIS G 3467:1988	STFA 22	---	---	LTA, IA, A or NT	---	---	205	---	410	---	30	---
DIN 28180:1985	13 CrMo 4 4	1.7335	---	see standard	≤ 16	---	290	---	440-590	---	22 L; 20 T	T: 34 J at RT
					16 < t ≤ 40	---	290	---	440-590	---	22 L; 20 T	
					40 < t ≤ 60	---	280	---	440-590	---	22 L; 20 T	
EN 10216-2:2002	13CrMo4-5	1.7335	---	NT, NF, QT	≤ 16	---	290	---	440-590	---	22 L; 20 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	290	---				
					40 < t ≤ 60	---	280	---				
ISO 2604-II:1975	TS 32	---	---	NT	---	---	275	---	440-590	---	22	---
ISO 2604-III:1975	TW 32	---	---	NT	---	---	275	---	440-590	---	22	---

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

5.8.5A Chemical Composition of 1¼Cr-½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	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 A 250/A 250M-95 (2001)	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 A 335/A 335M-03	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	---
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	---
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 10216-2:2002	10CrMo5-5	1.7338	---	0.15	0.30-0.60	0.50-1.00	0.025	0.020	1.00-1.50	0.30	0.45-0.65	Al 0.040; Cu 0.30
JIS G 3462:1988	STBA 23	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	---
JIS G 3467:1988	STFA 23	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	---
JIS G 3458:1988	STPA 23	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	---

5.8.5B Mechanical Properties of 1¼Cr-½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 213/A 213M-03a	T11	---	K11597	A, IA, NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
ASTM A 250/A 250M-95 (2001)	T11	---	K11597	A, IA, N or NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
ASTM A 335/A 335M-03	P11	---	K11597	FA, IA or NT	---	---	205	30	415	60	≥ 8mm (5⁄16 in) 30 L; 20 T	---
AFNOR NF A 49-220:1990	TU 10 CD 5-05	---	---	see standard	---	---	225	---	440-590	---	22	---
				heat + air cool + T	---	---	325	---	440-640	---	20	32 J at 0°C
BS 3604-2:1991	621	---	---	see standard	---	---	340	---	515-690	---	18	---
EN 10216-2:2002	10CrMo5-5	1.7338	---	NT, NF, QT	≤ 16	---	275	---	410-560	---	22 L; 20 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	275	---				
					40 < t ≤ 60	---	265	---				
JIS G 3462:1988	STBA 23	---	---	IA, A or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
JIS G 3467:1988	STFA 23	---	---	IA, A, or NT	---	---	205	---	410	---	30	---
JIS G 3458:1988	STPA 23	---	---	IA, FA or NT	---	---	205	---	410	---	30	---

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

5.8.6A Chemical Composition of 2¼-1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	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 A 250/A 250M-95 (2001)	T22	---	K21590	0.15	0.30-0.60	0.50	0.025	0.020	1.90-2.60	---	0.87-1.13	---
ASTM A 335/A 335M-03	P22	---	K21590	0.05-0.15	0.30-0.60	0.50	0.025	0.025	1.90-2.60	---	0.87-1.13	---
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	---
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 10216-2:2002	10CrMo9-10	1.7380	---	0.08-0.14	0.30-0.70	0.50	0.025	0.020	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	0.020	2.00-2.50	0.30	0.90-1.10	Al 0.040; Cu 0.30
JIS G 3458:1988	STPA 24	---	---	0.15	0.30-0.60	0.50	0.030	0.030	1.90-2.60	---	0.87-1.13	---
JIS G 3462:1988	STBA 24	---	---	0.15	0.30-0.60	0.50	0.030	0.030	1.90-2.60	---	0.87-1.13	---
JIS G 3467:1988	STFA 24	---	---	0.15	0.30-0.60	0.50	0.030	0.030	1.90-2.60	---	0.87-1.13	---
ISO 2604-II:1975	TS 34	---	---	0.08-0.15	0.40-0.70	0.50	0.040	0.040	2.00-2.50	---	0.90-1.20	Al 0.02

5.8.6B Mechanical Properties of 2¼-1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 213/A 213M-03a	T22	---	K21590	A, IA, NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
ASTM A 250/A 250M-95 (2001)	T22	---	K21590	A, IA, N or NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
ASTM A 335/A 335M-03	P22	---	K21590	FA, IA or NT	---	---	205	30	415	60	≥ 8mm (5⁄16 in) 30 L; 20 T	---
AFNOR NF A 49-220:1990	TU 10 CD 9-10	---	---	see standard	---	---	225	---	410-560	---	22	---
				heat + air cool + T	---	---	325	---	490-640	---	20	32 J at 0°C
BS 3604-2:1991	622	---	---	see standard	---	---	310	---	515-690	---	16	---
EN 10216-2:2002	10CrMo9-10	1.7380	---	NT, NF, QT	≤ 16	---	280	---	480-630	---	22 L; 20 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	280	---				
					40 < t ≤ 60	---	270	---				
	11CrMo9-10	1.7383	---	QT	≤ 16	---	355	---	540-680	---	20 L; 18 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	355	---				
					40 < t ≤ 60	---	355	---				
JIS G 3458:1988	STPA 24	---	---	IA, FA or NT	---	---	205	---	410	---	30	---
JIS G 3462:1988	STBA 24	---	---	IA, A or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
JIS G 3467:1988	STFA 24	---	---	IA, A, or NT	---	---	205	---	410	---	30	---
ISO 2604-II:1975	TS 34	---	---	A	---	---	135	---	410-560	---	20	---

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

5.8.7A Chemical Composition of 5Cr-½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	T5	---	K41545	0.15	0.30-0.60	0.50	0.025	0.025	4.00-6.00	---	0.45-0.65	---
	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 A 335/A 335M-03	P5	---	K41545	0.15	0.30-0.60	0.50	0.025	0.025	4.00-6.00	---	0.45-0.65	---
EN 10216-2:2002	X11CrMo5+I	1.7362+I	---	0.08-0.15	0.30-0.60	0.15-0.50	0.025	0.020	4.00-6.00	---	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	0.020	4.00-6.00	---	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	0.020	4.00-6.00	---	0.45-0.65	Al 0.040; Cu 0.30
JIS G 3458:1988	STPA 25	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
JIS G 3462:1988	STBA 25	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
JIS G 3467:1988	STFA 25	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
ISO 2604-II:1975	TS 37	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	Al 0.02

5.8.7B Mechanical Properties of 5Cr-½Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 213/A 213M-03a	T5	---	K41545	A, IA, NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
	T5b	---	K51545	A, IA, NT	---	---	205	30	415	60	30	179 HB max 89 HRB max
ASTM A 335/A 335M-03	P5	---	K41545	FA, IA or NT	---	---	205	30	415	60	≥ 8mm (5⁄16 in) 30 L; 20 T	---
EN 10216-2:2002	X11CrMo5+I	1.7362+I	---	I	≤ 16	---	175	---	430-580	---	22 L; 20 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	175	---				
					40 < t ≤ 60	---	175	---				
					60 < t ≤ 100	---	175	---				
	X11CrMo5+NT1	1.7362+NT1	---	NT	≤ 16	---	280	---	480-640	---	20 L; 18 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	280	---				
					40 < t ≤ 60	---	280	---				
					60 < t ≤ 100	---	280	---				
	X11CrMo5+NT2	1.7362+NT2	---	NT, QT	≤ 16	---	390	---	570-740	---	18 L; 16 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	390	---				
					40 < t ≤ 60	---	390	---				
					60 < t ≤ 100	---	390	---				
JIS G 3458:1988	STPA 25	---	---	IA, FA or NT	---	---	205	---	410	---	30	---
JIS G 3462:1988	STBA 25	---	---	IA, A or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
JIS G 3467:1988	STFA 25	---	---	IA, A, or NT	---	---	205	---	410	---	30	---
ISO 2604-II:1975	TS 37	---	---	A	---	---	205	---	410-560	---	20	---

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

5.8.8A Chemical Composition of 9Cr-1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	T9	---	S50400	0.15	0.30-0.60	0.25-1.00	0.025	0.025	8.00-10.00	---	0.90-1.10	---
ASTM A 335/A 335M-03	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 10216-2:2002	X11CrMo9-1+I	1.7386+I	---	0.08-0.15	0.30-0.60	0.25-1.00	0.025	0.020	8.00-10.00	---	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	0.020	8.00-10.00	---	0.90-1.10	Al 0.040; Cu 0.30
JIS G 3458:1988	STPA 26	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	---
JIS G 3462:1988	STBA 26	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	---
JIS G 3467:1988	STFA 26	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	---
ISO 2604-II:1975	TS 38	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	Al 0.02
ASTM A 213/A 213M-03a	T91	---	---	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 0.06-0.1; N 0.030-0.070; Al 0.04
EN 10216-2:2002	X10CrMoVNb9-1	1.4903	---	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; Nb 0.06-0.10; N 0.030-0.070; Al 0.040; Cu 0.30

5.8.8B Mechanical Properties of 9Cr-1Mo Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 213/A 213M-03a	T9	---	S50400	A, IA, NT	---	---	205	30	415	60	30	179 HB max 89 HRB max
ASTM A 335/A 335M-03	P9	---	S50400	FA, IA or NT	---	---	205	30	415	60	≥ 8mm (5⁄16 in) 30 L; 20 T	---
EN 10216-2:2002	X11CrMo9-1+I	1.7386+I	---	I	≤ 16	---	210	---	460-640	---	20 L; 18 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	210	---				
					40 < t ≤ 60	---	210	---				
	X11CrMo9-1+NT	1.7386+NT	---	NT, QT	≤ 16	---	390	---	590-740	---	18 L; 16 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	390	---				
					40 < t ≤ 60	---	390	---				
JIS G 3458:1988	STPA 26	---	---	IA, FA or NT	---	---	205	---	410	---	30	---
JIS G 3462:1988	STBA 26	---	---	IA, A or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
JIS G 3467:1988	STFA 26	---	---	IA, A, or NT	---	---	205	---	410	---	30	---
ISO 2604-II:1975	TS 38	---	---	A	---	---	135	---	410-560	---	20	---
ASTM A 213/A 213M-03a	T91	---	---	NT	---	---	415	60	585	85	20	250 HB max 25 HRC max
EN 10216-2:2002	X10CrMoVNb9-1	1.4903	---	NT, QT	≤ 16	---	450	---	630-830	---	19 L; 17 T	L: 40 J at 20°C T: 27 J at 20°C
					16 < t ≤ 40	---	450	---				
					40 < t ≤ 60	---	450	---				

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 268/A 268M-03	TP409	---	S40900	0.08	1.00	1.00	0.045	0.030	10.5-11.7	0.50	---	Ti 6 x C to 0.75
ASTM A 803/A 803M-03	TP409	---	S40900	0.08	1.00	1.00	0.045	0.030	10.5-11.7	0.50	---	Ti 6 x C to 0.75
JIS G 3463:1994	SUS409TB	---	---	0.08	1.00	1.00	0.040	0.030	10.50-11.75	---	---	Ti 6 x C to 0.75
AFNOR NF A 49-217:1987	TU Z 12 C 13	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.50	---	---
ASTM A 268/A 268M-03	TP410	---	S41000	0.15	1.00	1.00	0.040	0.030	11.5-13.5	---	---	---
ISO 2604-II:1975	TS 39	---	---	0.08	1.00	1.00	0.040	0.030	11.5-14.0	0.50	---	---
JIS G 3463:1994	SUS410TB	---	---	0.015	1.00	1.00	0.040	0.030	11.50-13.50	---	---	---
AFNOR NF A 49-217:1987	TU Z 10 C 17	---	---	0.12	1.00	1.00	0.040	0.030	16.00-18.00	0.50	---	---
ASTM A 268/A 268M-03	TP430	---	S43000	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	---	---
JIS G 3463:1994	SUS430TB	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	---	---	---
JIS G 3463:1994	SUS430LXTB	---	---	0.030	1.00	0.75	0.040	0.030	16.00-19.00	---	---	Ti or Nb 0.10-1.00
ASTM A 803/A 803M-03	TP XM-27	---	S44627	0.01	0.40	0.40	0.02	0.02	25.0-27.5	0.5	0.75-1.50	Cu 0.20; N 0.015; Cb 0.05-0.20
JIS G 3463:1994	SUSXM27TB	---	---	0.010	0.40	0.40	0.030	0.020	25.00-27.50	---	0.75-1.50	N 0.015

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 268/A 268M-03	TP409	---	S40900	HT	---	---	470	25	380	55	20	207 HB; 95 HRB max
ASTM A 803/A 803M-03	TP409	---	S40900	SA	---	---	205	30	380	55	20	207 HB max; 95 HRB max
JIS G 3463:1994	SUS409TB	---	---	A	O.D. < 10	---	205	---	410	---	12	---
					10 ≤ O.D. < 20	---					15	---
					O.D. ≥ 20	---					20	---
AFNOR NF A 49-217:1987	TU Z 12 C 13	---	---	HF + CR + T	---	---	210	---	420-670	---	17	---
ASTM A 268/A 268M-03	TP410	---	S41000	HT	---	---	215	30	415	60	20	207 HB; 95 HRB max
ISO 2604-II:1975	TS 39	---	---	A	---	---	245	---	440-590	---	20	---
				QT	---	---	390	---	590-740	---	18	---
JIS G 3463:1994	SUS410TB	---	---	A	O.D. < 10	---	205	---	410	---	12	---
					10 ≤ O.D. < 20	---					15	---
					O.D. ≥ 20	---					20	---
AFNOR NF A 49-217:1987	TU Z 10 C 17	---	---	HF + CR + T	---	---	250	---	420-670	---	17	---
ASTM A 268/A 268M-03	TP430	---	S43000	HT	---	---	240	35	415	60	20	190 HB; 90 HRB max
JIS G 3463:1994	SUS430TB	---	---	A	O.D. < 10	---	245	---	410	---	12	---
					10 ≤ O.D. < 20	---					15	---
					O.D. ≥ 20	---					20	---
JIS G 3463:1994	SUS430LXTB	---	---	A	O.D. < 10	---	175	---	360	---	12	---
					10 ≤ O.D. < 20	---					15	---
					O.D. ≥ 20	---					20	---
ASTM A 803/A 803M-03	TP XM-27	---	S44627	SA	---	---	275	40	450	65	20	241 HB max; 100 HRB max
JIS G 3463:1994	SUSXM27TB	---		A	O.D. < 10	---	245	---	410	---	12	---
					10 ≤ O.D. < 20	---					15	---
					O.D. ≥ 20	---					20	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	TP304	---	S30400	0.08	2.00	0.75	0.040	0.030	18.0-20.0	8.00-11.0	---	---
ASTM A 249/A 249M-03	TP304	---	S30400	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A 312/A 312M-03	TP304	---	S30400	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A 358/A 358M-01	304	---	S30400	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10
ASTM A 376/A 376M-02a	TP304	---	---	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.00-11.0	---	---
ASTM A 409/A 409M-01	TP304	---	S30400	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.00-11.0	---	---
ASTM A 688/A 688M-03	TP304	---	S30400	0.08	2.00	0.75	0.040	0.030	18.00-20.00	8.00-11.00	---	---
JIS G 3459:1997	SUS304TP	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	8.00-11.00	---	---
JIS G 3463:1994	SUS304TB	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	8.00-11.00	---	---
JIS G 3467:1988	SUS 304 TF	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	8.00-11.00	---	---
JIS G 3468:1994	SUS304	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
BS 3605-1:1991 AMD 2:1997	304S31	---	---	0.070	2.00	1.00	0.040	0.030	17.00-19.00	8.00-11.00	---	---
BS 3605-2:1992 AMD 1:1997	304S31	---	---	0.070	2.00	1.00	0.04	0.03	17.00-19.00	8.00-11.00	---	---
DIN 17457:1985	X 5 CrNi 18 10	1.4301	---	0.07	---	---	---	---	17.0-19.0	8.5-10.5	---	---
DIN 17458:1985	X 5 CrNi 18 10	1.4301	---	0.07	---	---	---	---	17.0-19.0	8.5-10.5	---	---
DIN 28180:1985	X 5 CrNi 18 10	1.4301	---	0.07	---	---	---	---	17.0-19.0	8.5-10.5	---	---
DIN 28181:1985	X 5 CrNi 18 10	1.4301	---	0.07	---	---	---	---	17.0-19.0	8.5-10.5	---	---
AFNOR NF A 49-217:1987	TU Z 6 CN 18 09	---	---	0.080	2.00	1.00	0.040	0.030	17.00-20.00	8.00-11.00	---	---
AFNOR NF A 49-244:1993	X7CrNi18-9	---	---	0.070	2.00	0.75	0.040	0.015	17.0-19.0	8.0-10.0	---	---
AFNOR NF A 49-247:1981	TS Z 6 CN 18-09	---	---	0.080	2.00	1.00	0.040	0.030	17-20.0	8-11.00	---	---
ISO 2604-II:1975	TS 47	---	---	0.07	2.00	1.00	0.045	0.030	17.00-19.00	8.00-12.00	---	---
ISO 2604-V:1978	TW 47	---	---	0.07	2.00	1.00	0.045	0.030	17.00-19.00	8.00-11.00	---	---

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	TP304L	---	S30403	0.035	2.00	0.75	0.040	0.030	18.0-20.0	8.00-13.0	---	---
ASTM A 249/A 249M-03	TP304L	---	S30403	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.0-13.0	---	---
ASTM A 312/A 312M-03	TP304L	---	S30403	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.00-13.0	---	---
ASTM A 358/A 358M-01	304L	---	S30403	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10
ASTM A 409/A 409M-01	TP304L	---	S30403	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.00-12.0	---	---
ASTM A 688/A 688M-03	TP304L	---	S30403	0.035	2.00	0.75	0.040	0.030	18.00-20.00	8.00-13.00	---	---
JIS G 3459:1997	SUS304LTP	---	---	0.030	2.00	1.00	0.040	0.030	18.00-20.00	9.00-13.00	---	---
JIS G 3463:1994	SUS304LTB	---	---	0.030	2.00	1.00	0.040	0.030	18.00-20.00	9.00-13.00	---	---
JIS G 3468:1994	SUS304L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	9.00-13.00	---	---
BS 3605-1:1991 AMD 2:1997	304S11	---	---	0.030	2.00	1.00	0.040	0.030	17.00-19.00	9.00-12.00	---	---
BS 3605-2:1992 AMD 1:1997	304S11	---	---	0.030	2.00	1.00	0.04	0.03	17.00-19.00	9.00-12.00	---	---
DIN 17457:1985	X 2 CrNi 19 11	1.4306	---	0.030	---	---	---	---	18.0-20.0	10.0-12.5	---	---
DIN 17458:1985	X 2 CrNi 19 11	1.4306	---	0.030	---	---	---	---	18.0-20.0	10.0-12.5	---	---
AFNOR NF A 49-217:1987	TU Z 2 CN 18 10	---	---	0.030	2.00	1.00	0.040	0.030	17.00-20.00	9.00-12.00	---	---
AFNOR NF A 49-244:1993	X3CrNi18-10	---	---	0.030	2.00	0.75	0.040	0.015	17.0-19.0	9.0-11.0	---	---
AFNOR NF A 49-247:1981	TS Z 2 CN 18-10	---	---	0.030	2.00	1.00	0.040	0.030	17-20.0	9-12.00	---	---
ISO 2604-II:1975	TS 46	---	---	0.03	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	---
ISO 2604-V:1978	TW 46	---	---	0.03	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	---
ASTM A 213/A 213M-03a	TP304LN	---	S30453	0.035	2.00	0.75	0.040	0.030	18.0-20.0	8.00-11.0	---	N 0.10-0.16
ASTM A 249/A 249M-03	TP304LN	---	S30453	0.030	2.00	1.00	0.045	0.030	18.0	20.0	---	N 0.10-0.16
ASTM A 376/A 376M-02a	TP304LN	---	---	0.035	2.00	0.75	0.045	0.030	18.0-20.0	8.00-11.0	---	N 0.10-0.16
ASTM A 688/A 688M-03	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
DIN 17457:1985	X 2 CrNiN 18 10	1.4311	---	0.030	---	---	---	---	17.0-19.0	8.5-11.5	---	N 0.12-0.22
DIN 17458:1985	X 2 CrNiN 18 10	1.4311	---	0.030	---	---	---	---	17.0-19.0	8.5-11.5	---	N 0.12-0.22
AFNOR NF A 49-217:1987	TU Z 2 CN 18 10 AZ	---	---	0.030	2.00	1.00	0.040	0.030	17.00-19.00	9.00-11.00	---	N 0.10-0.20
AFNOR NF A 49-244:1993	X3CrNiN18-10	---	---	0.030	2.00	0.75	0.040	0.015	17.0-19.0	9.0-11.0	---	N 0.12-0.20
	X6CrNiN19-9	---	---	0.030	2.0	0.75	0.040	0.015	18.0-20.0	8.0-11.0	---	N 0.12-0.20

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	TP304H	---	S30409	0.04-0.10	2.00	0.75	0.040	0.030	18.0-20.0	8.00-11.0	---	---
ASTM A 249/A 249M-03	TP304H	---	S30409	0.04-0.10	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A 312/A 312M-03	TP304H	---	S30409	0.04-0.10	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A 358/A 358M-01	304H	---	S30409	0.04-0.10	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	---
ASTM A 376/A 376M-02a	TP304H	---	S30409	0.04-0.10	2.00	0.75	0.045	0.030	18.0-20.0	8.00-11.0	---	---
JIS G 3459:1997	SUS304HTP	---	---	0.04-0.10	2.00	0.75	0.040	0.030	18.00-20.00	8.00-11.00	---	---
JIS G 3463:1994	SUS304HTB	---	---	0.04-0.10	2.00	0.75	0.040	0.030	18.00-20.00	8.00-11.00	---	---
JIS G 3467:1988	SUS 304H TF	---	---	0.04-0.10	2.00	0.75	0.040	0.030	18.00-20.00	8.00-11.00	---	---
BS 3605-1:1991 AMD 2:1997	304S51	---	---	0.04-0.10	2.00	1.00	0.040	0.030	17.00-19.00	8.00-11.00	---	---
DIN 17459:1992	X 6 CrNi 18 11	1.4948	---	0.04-0.08	2.0	0.75	0.035	0.015	17.0-19.0	10.0-12.0	---	---
AFNOR NF A 49-214:1978	Z 6 CN 19-10	---	---	0.04-0.08	2.0	1.0	0.035	0.030	18-20	8-11	---	---
ISO 2604-II:1975	TS 48	---	---	0.04-0.09	2.00	0.75	0.045	0.030	17.00-20.00	8.00-12.00	---	---
ASTM A 249/A 249M-03	---	---	S30615	0.16-0.24	2.00	3.2-4.0	0.030	0.030	17.0-19.5	13.5-16.0	---	---
AFNOR NF A 49-217:1987	TU Z 1 CNS 18 15	---	---	0.015	2.00	3.50-4.50	0.030	0.020	16.50-18.50	13.80-16.00	0.50	---
ASTM A 213/A 213M-03a	TP309S	---	S30908	0.08	2.00	0.75	0.045	0.030	24.0-26.0	12.00-15.00	0.75	---
ASTM A 249/A 249M-03	TP309S	---	S30908	0.08	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASTM A 312/A 312M-03	TP309S	---	S30908	0.08	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	0.75	
ASTM A 358/A 358M-01	309S	---	S30908	0.08	2.00	0.75	0.045	0.030	22.0-24.0	12.0-15.0	---	---
JIS G 3459:1997	SUS309STP	---	---	0.08	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 3463:1994	SUS309STB	---	---	0.08	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 3468:1994	SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
ASTM A 213/A 213M-03a	TP309H	---	S30909	0.04-0.10	2.00	0.75	0.045	0.030	22.00-24.00	12.00-15.00	0.75	---
ASTM A 249/A 249M-03	TP309H	---	S30909	0.04-0.10	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
JIS G 3459:1997	SUS309TP	---	---	0.15	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 3463:1994	SUS309TB	---	---	0.15	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---
AFNOR NF A 49-244:1993	X15CrNi24-13	---	---	0.15	2.00	0.75	0.035	0.015	22.0-24.0	12.0-14.0	---	---
ASTM A 213/A 213M-03a	TP310S	---	S31008	0.08	2.00	0.75	0.045	0.030	24.00-26.00	19.00-22.00	0.75	---
ASTM A 249/A 249M-03	TP310S	---	S31008	0.08	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A 312/A 312M-03	TP310S	---	S31008	0.08	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	0.75	
ASTM A 358/A 358M-01	310S	---	S31008	0.08	2.00	1.50	0.045	0.030	24.0-26.0	19.0-22.0	---	---
JIS G 3459:1997	SUS310STP	---	---	0.08	2.00	1.50	0.040	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 3463:1994	SUS310STB	---	---	0.08	2.00	1.50	0.040	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 3468:1994	SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	TP310H	---	S31009	0.04-0.10	2.00	0.75	0.040	0.030	24.00-26.00	19.0-22.00	---	---
AFNOR NF A 49-244:1993	X1CrNi25-20	---	---	0.015	2.00	0.40	0.025	0.010	24.0-26.0	19.0-22.0	0.5	---
JIS G 3463:1994	SUS310TB	---	---	0.15	2.00	1.50	0.040	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 3467:1988	SUS310TF	---	---	0.15	2.00	1.50	0.040	0.030	24.00-26.00	19.00-22.00	---	---
ISO 2604-II:1975	TS 68	---	---	0.15	2.00	0.75	0.045	0.030	24.00-26.00	19.00-22.00	---	---
ASTM A 249/A 249M-03	---	---	S31050	0.030	2.00	0.40	0.030	0.015	24.0-26.0	21.0-23.0	2.00-3.00	0.10-0.16
AFNOR NF A 49-217:1987	TU Z 1 CND 25 22 AZ	---	---	0.020	1.50-2.00	0.40	0.020	0.015	24.50-26.00	21.50-23.00	1.90-2.40	N 0.10-0.15
ASTM A 249/A 249M-03	---	---	S31254	0.020	1.00	0.80	0.030	0.010	19.5-20.5	17.5-18.5	6.0-6.5	N 0.18-0.25; Cu 0.50-1.00
ASTM A 688/A 688M-03	---	---	S31254	0.020	1.00	0.80	0.030	0.010	19.5-20.5	17.5-18.5	6.0-6.5	N 0.18-0.22; Cu 0.50-1.00
AFNOR NF A 49-217:1987	TU Z 1 CNDU 20 18 06 AZ	---	---	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
ASTM A 213/A 213M-03a	TP316	---	S31600	0.08	2.00	0.75	0.040	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
ASTM A 249/A 249M-03	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 A 312/A 312M-03	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 A 358/A 358M-01	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 A 376/A 376M-02a	TP316	---	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
ASTM A 409/A 409M-01	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 A 688/A 688M-03	TP316	---	S31600	0.08	2.00	0.75	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 3459:1997	SUS316TP	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 3463:1994	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 3467:1988	SUS 316 TF	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 3468:1994	SUS316	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
BS 3605-1:1991 AMD 2:1997	316S31	---	---	0.070	2.00	1.00	0.040	0.030	16.50-18.50	10.50-13.50	2.00-2.50	---
	316S33	---	---	0.070	2.00	1.00	0.040	0.030	16.50-18.50	11.00-14.00	2.50-3.00	---
BS 3605-2:1992 AMD 1:1997	316S31	---	---	0.070	2.00	1.00	0.04	0.03	16.50-18.50	10.50-13.50	2.00-2.50	---
	316S33	---	---	0.070	2.00	1.00	0.04	0.03	16.50-18.50	11.00-14.00	2.50-3.00	---
DIN 17457:1985	X 5 CrNiMo 17 12 2	1.4401	---	0.07	---	---	---	---	16.5-18.5	10.5-13.5	2.0-2.5	---
DIN 17458:1985	X 5 CrNiMo 17 12 2	1.4401	---	0.07	---	---	---	---	16.5-18.5	10.5-13.5	2.0-2.5	---
DIN 17457:1985	X 5 CrNiMo17 13 3	1.4436	---	0.07	---	---	---	0.025	16.5-18.5	11.0-14.0	2.5-3.0	---
DIN 17458:1985	X 5 CrNiMo17 13 3	1.4436	---	0.07	---	---	---	0.025	16.5-18.5	11.0-14.0	2.5-3.0	---
DIN 28180:1985	X 5 CrNiMo 17 12 2	1.4401	---	0.07	---	---	---	---	16.5-18.5	10.5-13.5	2.0-2.5	---
DIN 28181:1985	X 5 CrNiMo 17 12 2	1.4401	---	0.07	---	---	---	---	16.5-18.5	10.5-13.5	2.0-2.5	---
AFNOR NF A 49-217:1987	TU Z 6 CND 17 11	---	---	0.070	2.00	1.00	0.040	0.030	16.00-18.00	10.00-12.50	2.00-2.40	---
AFNOR NF A 49-244:1993	X7CrNiMo17-11-2	---	---	0.070	2.00	0.75	0.040	0.015	16.0-18.0	10.0-12.0	2.00-2.50	---
AFNOR NF A 49-247:1981	TS Z 6 CND 17-11	---	---	0.070	2.00	1.00	0.040	0.030	16-18.0	10-12.50	2.00-2.40	---

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 2604-II:1975	TS 60	---	---	0.07	2.00	1.00	0.045	0.030	16.00-18.50	11.00-14.00	2.00-2.50	---
	TS 61	---	---	0.07	2.00	1.00	0.045	0.030	16.00-18.50	11.00-14.50	2.50-3.00	---
ISO 2604-V:1978	TW 60	---	---	0.07	2.00	1.00	0.045	0.030	16.00-18.50	10.50-14.00	2.00-2.50	---
	TW 61	---	---	0.07	2.00	1.00	0.045	0.030	16.00-18.50	11.00-14.50	2.50-3.00	---
ASTM A 213/A 213M-03a	TP316L	---	S31603	0.035	2.00	0.75	0.040	0.030	16.0-18.0	10.0-15.0	2.00-3.00	---
ASTM A 249/A 249M-03	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 A 312/A 312M-03	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 A 358/A 358M-01	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 A 409/A 409M-01	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 A 688/A 688M-03	TP316L	---	S31603	0.035	2.00	0.75	0.040	0.030	16.00-18.00	10.00-15.00	2.00-3.00	---
JIS G 3459:1997	SUS316LTP	---	---	0.030	2.00	1.00	0.040	0.030	16.00-18.00	12.00-16.00	2.00-3.00	---
JIS G 3463:1994	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 3468:1994	SUS316L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
BS 3605-1:1991 AMD 2:1997	316S11	---	---	0.030	2.00	1.00	0.040	0.030	16.50-18.50	11.00-14.00	2.00-2.50	---
	316S13	---	---	0.030	2.00	1.00	0.040	0.030	16.50-18.50	11.50-14.50	2.50-3.00	---
BS 3605-2:1992 AMD 1:1997	316S11	---	---	0.030	2.00	1.00	0.04	0.03	16.50-18.50	11.00-14.00	2.00-2.50	---
	316S13	---	---	0.030	2.00	1.00	0.04	0.03	16.50-18.50	11.50-14.50	2.50-3.00	---
DIN 17457:1985	X 2 CrNiMo 17 13 2	1.4404	---	0.030	---	---	---	---	16.5-18.5	11.0-14.0	2.0-2.5	---
DIN 17458:1985	X 2 CrNiMo 17 13 2	1.4404	---	0.030	---	---	---	---	16.5-18.5	11.0-14.0	2.0-2.5	---
DIN 17457:1985	X 2 CrNiMo 18 14 3	1.4435	---	0.030	---	---	---	0.025	17.0-18.5	12.5-15.0	2.5-3.0	---
DIN 17458:1985	X 2 CrNiMo 18 14 3	1.4435	---	0.030	---	---	---	0.025	17.0-18.5	12.5-15.0	2.5-3.0	---
AFNOR NF A 49-217:1987	TU Z 2 CND 17 12	---	---	0.030	2.00	1.00	0.040	0.030	16.00-18.00	10.50-13.00	2.00-2.40	---
AFNOR NF A 49-244:1993	X3CrNiMo17-11-2	---	---	0.030	2.00	0.75	0.040	0.015	16.0-18.0	10.0-12.0	2.00-2.50	---
	X3CrNiMo17-12-3	---	---	0.030	2.00	0.75	0.040	0.015	16.5-18.5	11.0-13.0	2.5-3.00	---
	X3CrNiMo18-12-3	---	---	0.030	2.00	0.75	0.040	0.015	16.5-18.5	11.0-13.0	2.25-2.75	---
	TU Z 2 CND 18 14	---	---	0.030	2.00	1.00	0.020	0.015	17.00-18.50	13.00-16.00	2.20-3.00	---
AFNOR NF A 49-247:1981	TS Z 2 CND 17-12	---	---	0.030	2.00	1.00	0.040	0.030	16-18.0	10.5-13.00	2.00-2.40	---
ISO 2604-II:1975	TS 57	---	---	0.03	2.00	1.00	0.045	0.030	16.00-18.50	11.00-14.00	2.00-2.50	---
	TS 58	---	---	0.03	2.00	1.00	0.045	0.030	16.00-18.50	11.50-14.50	2.50-3.00	---
ISO 2604-V:1978	TW 57	---	---	0.03	2.00	1.00	0.045	0.030	16.00-18.50	11.00-14.00	2.00-2.50	---
	TW 58	---	---	0.03	2.00	1.00	0.045	0.030	16.00-18.50	11.50-14.50	2.50-3.00	---

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	TP316LN	-	S31653	0.035	2.00	0.75	0.040	0.030	16.0-18.0	11.0-14.0	2.00-3.00	0.10-0.16
ASTM A 249/A 249M-03	TP316LN	---	S31653	0.080	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 A 376/A 376M-02a	TP316LN	---	---	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 A 688/A 688M-03	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
DIN 17457:1985	X 2 CrNiMoN 17 13 3	1.4429	---	0.030	---	---	---	0.025	16.5-18.5	11.5-14.5	2.5-3.0	N 0.14-0.22
DIN 17458:1985	X 2 CrNiMoN 17 13 3	1.4429	---	0.030	---	---	---	0.025	16.5-18.5	11.5-14.5	2.5-3.0	N 0.14-0.22
AFNOR NF A 49-217:1987	TU Z 2 CND 17 12 AZ	---	---	0.030	2.00	1.00	0.040	0.030	16.00-18.00	11.00-13.50	2.00-2.40	N 0.10-0.20
AFNOR NF A 49-244:1993	X3CrNiMoN17-11	---	---	0.030	2.00	0.75	0.040	0.015	16.0-18.0	10.0-12.0	2.00-2.5	N 0.12-0.20
	X3CrNiMoN17-12	---	---	0.030	2.00	0.75	0.040	0.015	16.0-18.0	11.0-13.0	2.5-3.0	N 0.12-0.20
ASTM A 213/A 213M-03a	TP316H	---	S31609	0.04-0.10	2.00	0.75	0.040	0.030	186.0-18.0	11.0-14.0	2.00-3.00	---
ASTM A 249/A 249M-03	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 A 312/A 312M-03	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 A 358/A 358M-01	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 A 376/A 376M-02a	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	---
JIS G 3459:1997	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 3463:1994	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 3467:1988	SUS 316H TF	---	---	0.04-0.10	2.00	0.75	0.030	0.030	16.00-18.00	11.00-14.00	2.00-3.00	---
BS 3605-1:1991 AMD 2:1997	316S51	---	---	0.04-0.10	2.00	1.00	0.040	0.030	16.50-18.50	10.50-13.50	2.00-2.50	---
DIN 17459:1992	X 6 CrNiMo 17 13	1.4919	---	0.04-0.08	2.0	0.75	0.035	0.015	16.0-18.0	12.0-14.0	2.0-2.5	---
AFNOR NF A 49-214:1978	Z 6 CND 17-12 B	---	---	0.04-0.08	2.0	1.0	0.035	0.030	16-18	11-14	2.0-3.0	---
ISO 2604-II:1975	TS 63	---	---	0.04-0.09	1.00-2.00	0.75	0.045	0.030	16.00-18.00	12.00-14.00	2.00-2.75	---
BS 3605-1:1991 AMD 2:1997	316S52	---	---	0.04-0.10	2.00	1.00	0.040	0.030	16.50-18.50	10.50-13.50	2.00-2.50	B 0.0015-0.006
DIN 17459:1992	X 3 CrNiMoN 17 13	1.4910	---	0.04	2.0	0.75	0.035	0.015	16.0-18.0	12.0-14.0	2.0-2.8	B 0.0015-0.0050; N 0.10-0.18
JIS G 3459:1997	SUS316TiTP	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti 5 x C min
JIS G 3463:1994	SUS316TiTB	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-1400	2.00-3.00	Ti 5 x C min
DIN 17457:1985	X 6 CrNiMoTi 17 12 2	1.4571	---	0.08	---	---	---	---	16.5-18.5	10.5-13.5	2.0-2.5	Ti 5 x C to 0.80
DIN 17458:1985	X 6 CrNiMoTi 17 12 2	1.4571	---	0.08	---	---	---	---	16.5-18.5	10.5-13.5	2.0-2.5	Ti 5 x C to 0.80
DIN 28180:1985	X 6 CrNiMoTi 17 12 2	1.4571	---	0.08	---	---	---	---	16.5-18.5	10.5-13.5	2.0-2.5	Ti 5 x C to 0.80
DIN 28181:1985	X 6 CrNiMoTi 17 12 2	1.4571	---	0.08	---	---	---	---	16.5-18.5	10.5-13.5	2.0-2.5	Ti 5 x C to 0.80
AFNOR NF A 49-214:1978	Z 8 CNDT 17-13 B	---	---	0.05-0.10	2.0	1.0	0.035	0.030	16-18	12-15	2.0-3.0	Ti 4 x C to 0.75
AFNOR NF A 49-244:1993	X6CrNiMo17-11-2	---	---	0.060	2.00	0.75	0.040	0.015	16.0-18.0	10.5-12.5	2.00-2.5	Ti 5 (C+N) to 0.70; Ti/C+N to 15

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	TP317	---	S31700	0.08	2.00	0.75	0.040	0.030	18.0-20.0	11.0-14.0	3.00-4.00	---
ASTM A 249/A 249M-03	TP317	---	S31700	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.00-4.00	---
ASTM A 312/A 312M-03	TP317	---	S31700	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-14.0	3.0-4.0	---
ASTM A 409/A 409M-01	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 3459:1997	SUS317TP	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 3463:1994	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 3468:1994	SUS317	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
ASTM A 213/A 213M-03a	TP317L	---	S31703	0.035	2.00	0.75	0.040	0.030	18.0-20.0	11.0-15.0	3.00-4.00	---
ASTM A 249/A 249M-03	TP317L	---	S31703	0.030	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.00-4.00	---
ASTM A 312/A 312M-03	TP317L	---	S31703	0.035	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
JIS G 3459:1997	SUS317LTP	---	---	0.030	2.00	1.00	0.040	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 3463:1994	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 3468:1994	SUS317L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
AFNOR NF A 49-244:1993	X3CrNiMo19-15-4	---	---	0.030	2.00	0.75	0.035	0.010	17.5-19.5	14.0-16.0	3.00-4.00	---
AFNOR NF A 49-247:1981	TS Z 2 CND 19-15	---	---	0.030	2.00	1.00	0.040	0.030	17.5-19.5	14-16	3.0-4.0	---
ASTM A 213/A 213M-03a	TP321	---	S32100	0.08	2.00	0.75	0.040	0.030	17.0-20.0	9.00-13.0	---	Ti 5 X C-0.60
ASTM A 249/A 249M-03	TP321	---	S32100	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.00-12.0	---	N 0.10; Ti 5 x (C+N) to 0.70
ASTM A 312/A 312M-03	TP321	---	S32100	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	N 0.10; Ti 5 x C to 0.70
ASTM A 358/A 358M-01	321	---	S32100	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x (C+N) to 0.70; N 0.10
ASTM A 376/A 376M-02a	TP321	---	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.00-13.0	---	Ti 5 x C to 0.70
ASTM A 409/A 409M-01	TP321	---	S32100	0.08	2.00	1.00	0.045	0.030	17.0-20.0	9.00-12.0	---	Ti 5 x C to 0.70
JIS G 3459:1997	SUS321TP	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C min
JIS G 3463:1994	SUS321TB	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C min
JIS G 3467:1988	SUS 321 TF	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C min
JIS G 3468:1994	SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C min
BS 3605-1:1991 AMD 2:1997	321S31	---	---	0.080	2.00	1.00	0.040	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80
BS 3605-2:1992 AMD 1:1997	321S31	---	---	0.080	2.00	1.00	0.04	0.03	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80
DIN 17457:1985	X 6 CrNiTi 18 10	1.4541	---	0.08	---	---	---	---	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.80
DIN 17458:1985	X 6 CrNiTi 18 10	1.4541	---	0.08	---	---	---	---	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.80
DIN 28180:1985	X 6 CrNiTi 18 10	1.4541	---	0.08	---	---	---	---	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.80
DIN 28181:1985	X 6 CrNiTi 18 10	1.4541	---	0.08	---	---	---	---	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.80
AFNOR NF A 49-217:1987	TU Z 6 CNT 18 10	---	---	0.080	2.00	1.00	0.040	0.030	17.00-20.00	9.00-12.00	---	Ti 5 x C to 0.6
AFNOR NF A 49-244:1993	X6CrNiTi18-10	---	---	0.060	2.00	0.75	0.040	0.015	17.0-19.0	9.0-11.0	---	Ti 5 x (C+N) to 0.70; Ti/C+N to 15
AFNOR NF A 49-247:1981	TS Z 6 CNT 18-10	---	---	0.080	2.00	1.00	0.040	0.030	17-20.0	9-12.00	---	Ti 5 x C to 0.6
ISO 2604-II:1975	TS 53	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C to 0.80
ISO 2604-V:1978	TW 53	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	TP321H	---	S32109	0.04-0.10	2.00	0.75	0.040	0.030	17.0-20.0	9.00-13.0	---	Ti 4 X C-0.60
ASTM A 249/A 249M-03	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 5 x (C+N) to 0.70
ASTM A 312/A 312M-03	TP321H	---	S32109	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.60
ASTM A 376/A 376M-02a	TP321H	---	S32109	0.04-0.10	2.00	0.75	0.040	0.030	17.0-19.0	9.00-13.0	---	Ti 4 x C to 0.70
JIS G 3459:1997	SUS321HTP	---	---	0.04-0.10	2.00	0.75	0.030	0.030	17.00-20.00	9.00-13.00	---	Ti 4 x C to 0.60
JIS G 3463:1994	SUS321HTB	---	---	0.04-0.10	2.00	0.75	0.030	0.030	17.00-20.00	9.00-13.00	---	Ti 4 x C to 0.60
JIS G 3467:1988	SUS 321H TF	---	---	0.04-0.10	2.00	0.75	0.030	0.030	17.00-20.00	9.00-13.00	---	Ti 4 x C to 0.60
BS 3605-1:1991 AMD 2:1997	321S51	---	---	0.04-0.10	2.00	1.00	0.040	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80
AFNOR NF A 49-214:1978	Z 6 CNT 18-12 B	---	---	0.04-0.08	2.0	1.0	0.035	0.030	17-19	10-13	---	Ti 4 x C to 0.60
ISO 2604-II:1975	TS 54	---	---	0.04-0.10	2.00	0.20-0.80	0.045	0.030	17.00-20.00	9.00-13.00	---	Ti 4 x C to 0.60
JIS G 3463:1994	SUS329J3LTB	---	---	0.030	1.50	1.00	0.040	0.030	21.00-24.00	4.50-6.50	2.50-3.50	N 0.08-0.20
AFNOR NF A 49-217:1987	TU Z 2 CND 22 05 03	---	---	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
JIS G 3463:1994	SUS329J4LTB	---	---	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
AFNOR NF A 49-217:1987	TU Z 2 CND 25 07 03	---	---	0.030	1.70	0.70	0.030	0.020	23.50-25.50	5.50-7.50	2.50-3.50	N 0.15-0.25
ASTM A 213/A 213M-03a	TP347	---	S34700	0.08	2.00	0.75	0.040	0.030	17.0-20.0	9.00-13.0	---	Cb+Ta 10 X C -1.00
ASTM A 249/A 249M-03	TP347	---	S34700	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.00-12.0	---	N 0.40-0.60; Cb 0.10; Cb 10 x C to 1.10
ASTM A 312/A 312M-03	TP347	---	S34700	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 10 x C to 1.00
ASTM A 358/A 358M-01	347	---	S34700	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 10 x C to 1.00
ASTM A 376/A 376M-02a	TP347	---	---	0.08	2.00	0.75	0.040	0.030	17.0-19.0	9.00-13.0	---	Cb 10 x C to 1.10
ASTM A 409/A 409M-01	TP347	---	S34700	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.00-12.0	---	(Cb+Ta) 10 x C to 1.10
JIS G 3459:1997	SUS347TP	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C min
JIS G 3463:1994	SUS347TB	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C min
JIS G 3467:1988	SUS 347 TF	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C min
JIS G 3468:1994	SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C min
BS 3605-1:1991 AMD 2:1997	347S31	---	---	0.080	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C to 1.00
BS 3605-2:1992 AMD 1:1997	347S31	---	---	0.080	2.00	1.00	0.04	0.03	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00
DIN 17457:1985	X 6 CrNiNb 18 10	1.4550	---	0.08	---	---	---	---	17.0-19.0	9.0-12.0	---	Nb 10 x C to 1.00
DIN 17458:1985	X 6 CrNiNb 18 10	1.4550	---	0.08	---	---	---	---	17.0-19.0	9.0-12.0	---	Nb 10 x C to 1.00
ISO 2604-II:1975	TS 50	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C to 1.00
ISO 2604-V:1978	TW 50	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-03a	TP347H	---	S34709	0.04-0.10	2.00	0.75	0.040	0.030	17.0-20.0	9.00-13.0	---	Cb+Ta 8 X C -1.0
ASTM A 249/A 249M-03	TP347H	---	S34709	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.00-12.0	---	Cb 8 x C to 1.0
ASTM A 312/A 312M-03	TP347H	---	S34709	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 8 x C to 1.00
ASTM A 376/A 376M-02a	TP347H	---	S34709	0.04-0.10	2.00	0.75	0.045	0.030	17.0-19.0	9.00-13.0	---	Cb 8 x C to 1.10
JIS G 3459:1997	SUS347HTP	---	---	0.04-0.10	2.00	1.00	0.030	0.030	17.00-20.00	9.00-13.00	---	Nb 8 x C to 1.00
JIS G 3463:1994	SUS347HTB	---	---	0.04-0.10	2.00	1.00	0.030	0.030	17.00-20.00	9.00-13.00	---	Nb 8 x C to 1.00
JIS G 3467:1988	SUS 347H TF	---	---	0.04-0.10	2.00	0.75	0.030	0.030	17.00-20.00	9.00-13.00	---	Nb 8 x C to 1.00
BS 3605-1:1991 AMD 2:1997	347S51	---	---	0.04-0.10	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C to 1.20
DIN 17459:1992	X 8 CrNiNb 16 13	1.4961	---	0.04-0.10	1.5	0.30-0.60	0.035	0.015	15.0-17.0	12.0-14.0		Nb 10 x C to 1.2
AFNOR NF A 49-214:1978	Z 6 CN Nb 18-12 B	---	---	0.04-0.08	2.0	1.0	0.035	0.030	17-19	10-13	---	(Nb+Ta) 8 x C to 1.00
ISO 2604-II:1975	TS 56	---	---	0.04-0.10	2.00	0.20-0.80	0.045	0.030	16.00-20.00	11.00-14.00	---	Nb 10 x C to 1.4
ASTM A 213/A 213M-03a	---	---	S31725	0.03	2.00	0.75	0.040	0.030	18.0-20.0	13.5-17.5	4.0-5.00	N 0.10; Cu 0.75
ASTM A 249/A 249M-03	---	---	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
ASTM A 312/A 312M-03	---	---	S31725	0.03	2.00	1.00	0.040	0.030	18.0-20.0	13.5-17.5	4.0-5.0	N 0.10; Cu 0.75
ASTM A 358/A 358M-01	---	---	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 A 376/A 376M-02a	---	---	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; Cu 0.75
ASTM A 409/A 409M-01	---	---	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
DIN 17457:1985	X 2 CrNiMoN 17 13 5	1.4439	---	0.030	---	---	---	0.025	16.5-18.5	12.5-14.5	4.0-5.0	N 0.12-0.22
DIN 17458:1985	X 2 CrNiMoN 17 13 5	1.4439	---	0.030	---	---	---	0.025	16.5-18.5	12.5-14.5	4.0-5.0	N 0.12-0.22
AFNOR NF A 49-244:1993	X3CrNiMoN18-14-5	---	---	0.030	2.00	0.75	0.035	0.010	17.0-19.0	13.0-15.0	4.0-5.0	N 0.12-0.20
ASTM A 358/A 358M-01	---	---	N08904	0.020	2.00	1.00	0.045	0.035	19.0-23.0	23.0-28.0	4.0-5.0	Cu 1.0-2.0; N 0.10
ASTM A 249/A 249M-03	---	---	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
JIS G 3459:1997	SUS890LTP	---	---	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
JIS G 3463:1994	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
AFNOR NF A 49-244:1993	X2NiCrMoCu25-20	---	---	0.020	2.00	0.40	0.035	0.010	19.0-21.0	24.0-26.0	4.0-5.0	Cu 1.00-2.00
ASTM A 240/A 240M-03c	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
JIS G 3467:1988	NCF 800 TF	---	---	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
DIN 17459:1992	X 5 NiCrAlTi 31 20	1.4958	---	0.03-0.08	1.5	0.70	0.015	0.010	19.0-22.0	30.0-32.5	---	Al 0.20-0.50; Ti 0.20-0.50; Al+Ti 0.70;
AFNOR NF A 49-244:1993	X5NiCr32-21	---	---	0.05	1.50	0.75	0.035	0.015	19.0-24.0	30.0-33.0	---	Al 0.15-0.60; Ti 0.15-0.60
DIN 17459:1992	X 8 NiCrAlTi 32 21	1.4959	---	0.05-0.10	1.5	0.70	0.015	0.010	19.0-22.0	30.0-34.0	---	Al 0.25-0.65; Ti 0.25-0.65; Co 0.5;
ASTM A 240/A 240M-03c	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;
JIS G 3467:1988	NCF 800H TF	---	---	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
ASTM A 249/A 249M-03	---	---	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 A 312/A 312M-03	---	---	N08926	0.020	2.00	0.50	0.030	0.010	24.0-26.0	19.0-21.0	6.0-7.0	N 0.15-0.25; Cu 0.50-1.50
ASTM A 688/A 688M-03	---	---	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 3463:1994	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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 213/A 213M-03a	TP304	---	S30400	ST	---	---	205	30	515	75	35	95 HRB
ASTM A 249/A 249M-03	TP304	---	S30400	H + RC	---	---	205	30	515	75	35	90 HRB max
ASTM A 312/A 312M-03	TP304	---	S30400	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 358/A 358M-01	304	---	S30400	H, HT, HT-O or HT-SO	---	---	205	30	515	75	40	---
ASTM A 376/A 376M-02a	TP304	---	---	see standard	---	---	205	30	515	75	35	---
ASTM A 409/A 409M-01	TP304	---	S30400	H, HT, HT-O or HT-SO	---	---	205	30	515	75	---	---
ASTM A 688/A 688M-03	TP304	---	S30400	SA	---	---	205	30	515	75	35	90 HRB max
JIS G 3459:1997	SUS304TP	---	---	ST	---	---	205	---	520	---	35	---
JIS G 3463:1994	SUS304TB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	
					O.D. ≥ 20	---					35	
JIS G 3467:1988	SUS 304 TF	---	---	ST	---	---	205	---	520	---	35	---
JIS G 3468:1994	SUS304	---	---	AM	---	---	205	---	520	---	35	---
BS 3605-1:1991 AMD 2:1997	304S31	---	---	ST or HF	---	---	230	---	490-690	---	35	---
BS 3605-2:1992 AMD 1:1997	304S31	---	---	AW or ST	---	---	230	---	490-690	---	35	---
DIN 17457:1985	X 5 CrNi 18 10	1.4301	---	SA & Q	≤ 50	---	195	---	500-720	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 5 CrNi 18 10	1.4301	---	SA & Q	≤ 50	---	195	---	500-700	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
DIN 28180:1985	X 5 CrNi 18 10	1.4301	---	SA & Q	≤ 50	---	195	---	500-700	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
DIN 28181:1985	X 5 CrNi 18 10	1.4301	---	SA & Q	≤ 50	---	195	---	500-720	---	40 L; 35 T	85 J at RT, L 55 J at RT, T
AFNOR NF A 49-217:1987	TU Z 6 CN 18 09	---	---	HF + CR + Q (HY)	---	---	200	---	490-740	---	45	90 HRB max
AFNOR NF A 49-244:1993	X7CrNi18-9	---	---	ST or TT	< 3	---	215	---	520-720	---	40	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	215	---			45	
					5 < t ≤ 75	---	205	---			45	
AFNOR NF A 49-247:1981	TS Z 6 CN 18-09	---	---	Q (HY)	---	---	215	---	530-730	---	40	---
ISO 2604-II:1975	TS 47	---	---	Q	---	---	195	---	490-690	---	30	---
ISO 2604-V:1978	TW 47	---	---	Q	---	---	195	---	490-690	---	30	---

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 213/A 213M-03a	TP304L	---	S30403	ST	---	---	170	25	485	70	35	90 HRB
ASTM A 249/A 249M-03	TP304N	---	S30451	H + RC	---	---	240	35	550	80	35	90 HRB max
ASTM A 312/A 312M-03	TP304 L	---	S30403	HF or CF + A	---	---	170	25	485	70	35	---
ASTM A 358/A 358M-01	304L	---	S30403	H, HT, HT-O or HT-SO	---	---	170	25	485	70	40	---
ASTM A 409/A 409M-01	TP304L	---	S30403	H, HT, HT-O or HT-SO	---	---	170	25	485	70	---	---
JIS G 3459:1997	SUS304LTP	---	---	ST	---	---	175	---	480	---	35	---
JIS G 3463:1994	SUS304LTB	---	---	ST	O.D. < 10	---	175	---	480	---	27	---
					10 ≤ O.D. < 20	---					30	
					O.D. ≥ 20	---					35	
JIS G 3468:1994	SUS304L	---	---	AM	---	---	175	---	480	---	35	---
BS 3605-1:1990 Issue 2, 1997	304S11	---	---	ST or HF	---	---	215	---	480-680	---	35	---
BS 3605-2:1992 AMD 1:1997	304S11	---	---	AW or ST	---	---	215	---	480-680	---	35	---
DIN 17457:1985	X 2 CrNi 19 11	1.4306	---	SA & Q	≤ 50	---	180	---	460-680	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 2 CrNi 19 11	1.4306	---	SA & Q	≤ 50	---	180	---	460-680	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-217:1987	TU Z 2 CN 18 10	---	---	HF + CR + Q (HY)	---	---	175	---	470-720	---	45	90 HRB 100 J at -196°C
AFNOR NF A 49-244:1993	X3CrNiN18-10	---	---	ST or TT	< 3	---	280	---	570-770	---	40	L: 100 J at -196°C T: 80 J at -196°C
					3 ≤ t ≤ 5	---	280	---			45	
					5 < t ≤ 75	---	270	---			45	
AFNOR NF A 49-247:1981	TS Z 2 CN 18-10	---	---	Q (HY)	---	---	205	---	520-720	---	40	---
ISO 2604-II:1975	TS 46	---	---	Q	---	---	175	---	490-690	---	30	---
ISO 2604-V:1978	TW 46	---	---	Q	---	---	175	---	490-690	---	30	---
ASTM A 213/A 213M-03a	TP304LN	---	S30453	ST	---	---	205	30	515	75	35	90 HRB
ASTM A 249/A 249M-03	TP304LN	---	S30453	H + RC	---	---	205	30	515	75	35	90 HRB max
ASTM A 376/A 376M-02a	TP304LN	---	---	see standard	---	---	205	30	515	75	35	---
ASTM A 688/A 688M-03	TP304LN	---	S30453	SA	---	---	205	30	515	75	35	90 HRB max
DIN 17457:1985	X 2 CrNiN 18 10	1.4311	---	SA & Q	≤ 50	---	270	---	550-760	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 2 CrNiN 18 10	1.4311	---	SA & Q	≤ 50	---	270	---	550-760	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-217:1987	TU Z 2 CN 18 10 AZ	---	---	---	---	---	240	---	550-800	---	40	---

NOTE: This section continued on next page

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
AFNOR NF A 49-244:1993	X3CrNiN18-10	---	---	ST or TT	< 3	---	280	---	570-770	---	40	L: 100 J at -196°C T: 80 J at -196°C
					3 ≤ t ≤ 5	---	280	---			45	
					5 < t ≤ 75	---	270	---			45	
	X6CrNiN19-9	---	---	ST or TT	< 3	---	300	---	590-790	---	35	L: 100 J at -196°C T: 80 J at -196°C
					3 ≤ t ≤ 5	---	300	---			40	
					5 < t ≤ 75	---	290	---			40	
ASTM A 213/A 213M-03a	TP304H	---	S30409	ST	---	---	205	30	515	75	35	90 HRB
ASTM A 249/A 249M-03	TP304H	---	S30409	ST	---	---	205	30	515	75	35	90 HRB max
ASTM A 312/A 312M-03	TP304H	---	S30409	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 358/A 358M-01	304H	---	S30409	H, HT, HT-O or HT-SO	---	---	205	30	515	75	40	---
ASTM A 376/A 376M-02a	TP304H	---	S30409	see standard	---	---	205	30	515	75	35	---
JIS G 3459:1997	SUS304HTP	---	---	ST	---	---	205	---	520	---	35	---
JIS G 3463:1994	SUS304HTB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 304H TF	---	---	ST	---	---	205	---	520	---	35	---
BS 3605-1:1990 Issue 2, 1997	304S51	---	---	ST or HF	---	---	230	---	490-690	---	35	---
DIN 17459:1992	X 6 CrNi 18 11	1.4948	---	SHT	≤ 50	---	185	---	500-700	---	40 L; 30 T	L: 90 J at RT T: 60 J at RT
AFNOR NF A 49-214:1978	Z 6 CN 19-10	---	---	L or F/H + RC	---	---	195	---	490-690	---	40	---
ISO 2604-II:1975	TS 48	---	---	Q	---	---	195	---	490-690	---	30	---
ASTM A 249/A 249M-03	---	---	S30615	H + RC	---	---	275	40	620	90	35	95 HRB max
AFNOR NF A 49-217:1987	TU Z 1 CNS 18 15	---	---	HF + CR + Q (HY)	---	---	220	---	540-740	---	40	---
ASTM A 213/A 213M-03a	TP309S	---	S30908	ST	---	---	205	30	515	75	35	90 HRB
ASTM A 249/A 249M-03	TP309S	---	S30908	H + RC	---	---	205	30	515	75	35	90 HRB max
ASTM A 312/A 312M-03	TP309S	---	S30908	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 358/A 358M-01	309S	---	S30908	H, HT, HT-O or HT-SO	---	---	205	30	515	75	40	---
JIS G 3459:1997	SUS309STP	---	---	ST	---	---	205	---	520	---	35	---
JIS G 3463:1994	SUS309STB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3468:1994	SUS309S	---	---	AM	---	---	205	---	520	---	35	---

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 213/A 213M-03a	TP309H	---	S30909	ST	---	---	205	30	515	75	35	90 HRB
ASTM A 249/A 249M-03	TP309H	---	S30909	ST	---	---	205	30	515	75	35	90 HRB max
JIS G 3459:1997	SUS309TP	---	---	ST	---	---	205	---	520	---	35	---
JIS G 3463:1994	SUS309TB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
AFNOR NF A 49-244:1993	X15CrNi24-13	---	---	ST or TT	< 3	---	240	---	540-740	---	30	---
					3 ≤ t ≤ 5	---	240	---			35	
					5 < t ≤ 75	---	240	---			35	
ASTM A 213/A 213M-03a	TP310S	---	S31008	ST	---	---	205	30	515	75	35	90 HRB
ASTM A 249/A 249M-03	TP310S	---	S31008	H + RC	---	---	205	30	515	75	35	90 HRB max
ASTM A 312/A 312M-03	TP310S	---	S31008	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 358/A 358M-01	310S	---	S31008	H, HT, HT-O or HT-SO	---	---	205	30	515	75	40	---
JIS G 3459:1997	SUS310STP	---	---	ST	---	---	205	---	520	---	35	---
JIS G 3463:1994	SUS310STB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3468:1994	SUS310S	---	---	AM	---	---	205	---	520	---	35	---
ASTM A 213/A 213M-03a	TP310H	---	S31009	ST	---	---	205	30	515	75	35	90 HRB
AFNOR NF A 49-244:1993	X1CrNi25-20	---	---	ST or TT	< 3	---	205	---	480-680	---	35	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	205	---			40	
					5 < t ≤ 75	---	205	---			40	
JIS G 3463:1994	SUS310TB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 310 TF	---	---	ST	---	---	205	---	520	---	35	---
ISO 2604-II:1975	TS 68	---	---	Q	---	---	205	---	510-710	---	30	---
ASTM A 249/A 249M-03	---	---	S31050	H + RC	---	t ≤ 0.25	270	39	580	84	25	95 HRB max
					---	t > 0.25	255	37	540	78	25	95 HRB max
AFNOR NF A 49-217:1987	TU Z 1 CND 25 22 AZ	---	---	HF + CR + Q (HY)	---	---	260	---	540-740	---	30	---
ASTM A 249/A 249M-03	---	---	S31254	H + WQ or RC	---	t ≤ 0.187	310	45	675	98	35	100 HRB max
						t > 0.187	300	45	655	95		
ASTM A 688/A 688M-03	---	---	S31254	H + WQ or RC	---	t ≤ 0.187	310	45	690	100	35	90 HRB max
						t > 0.187	310	45	655	95	35	
AFNOR NF A 49-217:1987	TU Z 1 CNDU 20 18 06 AZ	---	---	HF + CR + Q (HY)	---	---	300	---	650-850	---	35	---

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 213/A 213M-03a	TP316	---	S31600	ST	---	---	205	30	515	75	35	90
ASTM A 249/A 249M-03	TP316	---	S31600	H + RC	---	---	205	30	515	75	35	90 HRB max
ASTM A 312/A 312M-03	TP316	---	S31600	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 358/A 358M-01	316	---	S31600	H, HT, HT-O or HT-SO	---	---	205	30	515	75	40	---
ASTM A 376/A 376M-02a	TP316	---	---	see standard	---	---	205	30	515	75	35	---
ASTM A 409/A 409M-01	TP316	---	S31600	H, HT, HT-O or HT-SO	---	---	205	30	515	75	---	---
ASTM A 688/A 688M-03	TP316	---	S31600	SA	---	---	205	30	515	75	35	90 HRB max
JIS G 3459:1997	SUS316TP	---	---	ST	---	---	205	---	520	---	35	---
JIS G 3463:1994	SUS316TB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 316 TF	---	---	ST	---	---	205	---	520	---	35	---
JIS G 3468:1994	SUS316	---	---	AM	---	---	205	---	520	---	35	---
BS 3605-1:1990 Issue 2, 1997	316S31	---	---	ST or HF	---	---	240	---	510-710	---	35	---
	316S33	---	---	ST or HF	---	---	240	---	510-710	---	35	---
BS 3605-2:1992 AMD 1:1997	316S31	---	---	AW or ST	---	---	240	---	510-710	---	35	---
	316S33	---	---	AW or ST	---	---	240	---	510-710	---	35	---
DIN 17457:1985	X 5 CrNiMo 17 12 2	1.4401	---	SA & Q	≤ 50	---	205	---	510-710	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 5 CrNiMo 17 12 2	1.4401	---	SA & Q	≤ 50	---	205	---	510-710	---	40 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 17457:1985	X 5 CrNiMo17 13 3	1.4436	---	SA & Q	≤ 50	---	205	---	510-710	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 5 CrNiMo17 13 3	1.4436	---	SA & Q	≤ 50	---	205	---	510-710	---	40 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 28180:1985	X 5 CrNiMo 17 12 2	1.4401	---	SA & Q	≤ 50	---	205	---	510-710	---	40 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 28181:1985	X 5 CrNiMo 17 12 2	1.4401	---	SA & Q	≤ 50	---	205	---	510-710	---	40 L; 30 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-217:1987	TU Z 6 CND 17 11	---	---	HF + CR + Q (HY)	---	---	190	---	490-740	---	45	90 HRB max
AFNOR NF A 49-244:1993	X7CrNiMo17-11-2	---	---	ST or TT	< 3	---	225	---	540-740	---	40	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	225	---			45	
					5 < t ≤ 75	---	215	---			45	
AFNOR NF A 49-247:1981	TS Z 6 CND 17-11	---	---	Q (HY)	---	---	225	---	540-740	---	40	---
ISO 2604-II:1975	TS 60	---	---	Q	---	---	205	---	510-710	---	30	---
	TS 61	---	---	Q	---	---	205	---	510-710	---	30	---
ISO 2604-V:1978	TW 60	---	---	Q	---	---	205	---	510-710	---	30	---
	TW 61	---	---	Q	---	---	205	---	510-710	---	30	---

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 213/A 213M-03a	TP316L	---	S31603	ST	---	---	170	25	485	70	35	90 HRB
ASTM A 249/A 249M-03	TP316L	---	S31603	H + RC	---	---	170	25	485	70	35	90 HRB max
ASTM A 312/A 312M-03	TP316L	---	S31603	HF or CF + A	---	---	170	25	485	70	35	---
ASTM A 358/A 358M-01	316L	---	S31603	H, HT, HT-O or HT-SO	---	---	170	25	485	70	40	---
ASTM A 409/A 409M-01	TP316L	---	S31603	H, HT, HT-O or HT-SO	---	---	170	25	485	70	---	---
ASTM A 688/A 688M-03	TP316L	---	S31603	SA	---	---	175	25	485	70	35	90 HRB max
JIS G 3459:1997	SUS316LTP	---	---	ST	---	---	175	---	480	---	35	---
JIS G 3463:1994	SUS316LTB	---	---	ST	O.D. < 10	---	175	---	480	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3468:1994	SUS316L	---	---	AM	---	---	175	---	480	---	35	---
BS 3605-1:1990 Issue 2, 1997	316S11	---	---	ST or HF	---	---	225	---	490-690	---	35	---
	316S13	---	---	ST or HF	---	---	225	---	490-690	---	35	---
BS 3605-2:1992 AMD 1:1997	316S11	---	---	AW or ST	---	---	225	---	490-690	---	35	---
	316S13	---	---	AW or ST	---	---	225	---	490-690	---	35	---
DIN 17457:1985	X 2 CrNiMo 17 13 2	1.4404	---	SA & Q	≤ 50	---	190	---	490-690	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 2 CrNiMo 17 13 2	1.4404	---	SA & Q	≤ 50	---	190	---	490-690	---	40 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 17457:1985	X 2 CrNiMo 18 14 3	1.4435	---	SA & Q	≤ 50	---	190	---	490-690	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 2 CrNiMo 18 14 3	1.4435	---	SA & Q	≤ 50	---	190	---	490-690	---	40 L; 30 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-217:1987	TU Z 2 CND 17 12	---	---	HF + CF + Q (HY)	---	---	175	---	470-720	---	45	90 HRB max
AFNOR NF A 49-244:1993	X3CrNiMo17-11-2	---	---	ST or TT	< 3	---	215	---	510-710	---	40	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	215	---			45	
					5 < t ≤ 75	---	205	---			45	
	X3CrNiMo17-12-3	---	---	ST or TT	< 3	---	215	---	510-710	---	40	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	215	---			45	
					5 < t ≤ 75	---	205	---			45	
	X3CrNiMo18-12-3	---	---	ST or TT	< 3	---	215	---	510-710	---	40	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	215	---			45	
					5 < t ≤ 75	---	205	---			45	
	TU Z 2 CND 18 14	---	---	HF + CF + Q (HY)	---	---	210	---	490-690	---	45	---
AFNOR NF A 49-247:1981	TS Z 2 CND 17-12	---	---	Q (HY)	---	---	215	---	520-720	---	40	---
ISO 2604-II:1975	TS 57	---	---	Q	---	---	185	---	490-690	---	30	---
	TS 58	---	---	Q	---	---	185	---	490-690	---	30	---
ISO 2604-V:1978	TW 57	---	---	Q	---	---	185	---	490-690	---	30	---
	TW 58	---	---	Q	---	---	185	---	490-690	---	30	---

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 213/A 213M-03a	TP316LN	---	S31653	ST	---	---	205	30	515	75	35	90 HRB
ASTM A 249/A 249M-03	TP316LN	---	S31653	H + RC	---	---	205	30	515	75	35	90 HRB max
ASTM A 376/A 376M-02a	TP316LN	---	---	see standard	---	---	205	30	515	75	35	---
ASTM A 688/A 688M-03	TP316LN	---	S31653	SA	---	---	205	30	515	75	35	90 HRB max
DIN 17457:1985	X 2 CrNiMoN 17 13 3	1.4429	---	SA & Q	≤ 50	---	295	---	580-800	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 2 CrNiMoN 17 13 3	1.4429	---	SA & Q	≤ 50	---	295	---	580-800	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-217:1987	TU Z 2 CND 17 12 AZ	---	---	HF + CF + Q (HY)	---	---	280	---	600-800	---	40	---
AFNOR NF A 49-244:1993	X3CrNiMoN17-11	---	---	ST or TT	< 3	---	290	---	590-790	---	35	L: 100 J at -196°C T: 80 J at -196°C
					3 ≤ t ≤ 5	---	290	---			40	
					5 < t ≤ 75	---	290	---			40	
	X3CrNiMoN17-12	---	---	ST or TT	< 3	---	290	---	590-790	---	35	L: 100 J at -196°C T: 80 J at -196°C
					3 ≤ t ≤ 5	---	290	---			40	
					5 < t ≤ 75	---	290	---			40	
ASTM A 213/A 213M-03a	TP316H	---	S31609	ST	---	---	205	30	515	75	35	90 HRB
ASTM A 249/A 249M-03	TP316H	---	S31609	ST	---	---	205	30	515	75	35	90 HRB max
ASTM A 312/A 312M-03	TP316H	---	S31609	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 358/A 358M-01	316H	---	S31609	H, HT, HT-O or HT-SO	---	---	205	30	515	75	40	---
ASTM A 376/A 376M-02a	TP316H	---	S31609	see standard	---	---	205	30	515	75	35	---
JIS G 3459:1997	SUS316HTP	---	---	ST	---	---	205	---	520	---	35	---
JIS G 3463:1994	SUS316HTB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 316H TF	---	---	ST	---	---	205	---	520	---	35	---
BS 3605-1:1990 Issue 2, 1997	316S51	---	---	ST or HF	---	---	240	---	510-710	---	35	---
DIN 17459:1992	X 6 CrNiMo 17 13	1.4919	---	SHT	≤ 50	---	205	---	490-690	---	35 L; 30 T	L: 90 J at RT T: 60 J at RT
AFNOR NF A 49-214:1978	Z 6 CND 17-12 B	---	---	L or F/H + RC	---	---	195	---	490-690	---	40	---
ISO 2604-II:1975	TS 63	---	---	Q	---	---	205	---	510-710	---	30	---
BS 3605-1:1990 Issue 2, 1997	316S52	---	---	ST or HF	---	---	240	---	510-710	---	35	---
DIN 17459:1992	X 3 CrNiMoN 17 13	1.4910	---	SHT	≤ 50	---	260	---	550-750	---	35 L; 30 T	L: 120 J at RT T: 80 J at RT

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
JIS G 3459:1997	SUS316TiTP	---	---	ST	---	---	205	---	520	---	35	---
JIS G 3463:1994	SUS316TiTB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
DIN 17457:1985	X 6 CrNiMoTi 17 12 2	1.4571	---	SA & Q	≤ 50	---	210	---	500-730	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 6 CrNiMoTi 17 12 2	1.4571	---	SA & Q	≤ 50	---	210	---	500-730	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
					≤ 50	---	190	---	490-690	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 28180:1985	X 6 CrNiMoTi 17 12 2	1.4571	---	SA & Q	≤ 50	---	210	---	500-730	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
				SA & Q	≤ 50	---	190	---	490-690	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 28181:1985	X 6 CrNiMoTi 17 12 2	1.4571	---	SA & Q	≤ 50	---	210	---	500-730	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-214:1978	Z 8 CNDT 17-13 B	---	---	L or F/H + RC	---	---	195	---	540-740	---	40	---
AFNOR NF A 49-244:1993	X6CrNiMo17-11-2	---	---	ST or TT	< 3	---	225	---	540-740	---	35	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	225	---			40	
					5 < t ≤ 75	---	215	---			40	
ASTM A 213/A 213M-03a	TP317	---	S31700	ST	---	---	205	30	515	75	35	90 HRB
ASTM A 249/A 249M-03	TP317	---	S31700	H + RC	---	---	205	30	515	75	35	90 HRB max
ASTM A 312/A 312M-03	TP317	---	S31700	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 409/A 409M-01	TP317	---	S31700	H, HT, HT-O or HT-SO	---	---	205	30	515	75	---	---
JIS G 3459:1997	SUS317TP	---	---	ST	---	---	205	---	520	---	35	---
JIS G 3463:1994	SUS317TB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3468:1994	SUS317	---	---	AM	---	---	205	---	520	---	35	---
ASTM A 213/A 213M-03a	TP317L	---	S31703	ST	---	---	205	30	515	75	35	90 HRB
ASTM A 249/A 249M-03	TP317L	---	S31703	H + RC	---	---	205	30	515	75	35	90 HRB max
ASTM A 312/A 312M-03	TP317L	---	S31703	HF or CF + A	---	---	205	30	515	75	35	---
JIS G 3459:1997	SUS317LTP	---	---	ST	---	---	175	---	480	---	35	---
JIS G 3463:1994	SUS317LTB	---	---	ST	O.D. < 10	---	175	---	480	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3468:1994	SUS317L	---	---	AM	---	---	175	---	480	---	35	---

NOTE: This section continued on next page

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
AFNOR NF A 49-244:1993	X3CrNiMo19-15-4	---	---	ST or TT	< 3	---	215	---	510-710	---	40	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	215	---			45	
					5 < t ≤ 75	---	205	---			45	
AFNOR NF A 49-247:1981	TS Z 2 CND 19-15	---	---	Q (HY)	---	---	225	---	520-720	---	35	---
ASTM A 213/A 213M-03a	TP321	---	S32100	ST	---	---	205	30	515	75	35	90 HRB
ASTM A 249/A 249M-03	TP321	---	S32100	H + RC	---	---	205	30	515	75	35	90 HRB max
ASTM A 312/A 312M-03	TP321 Seamless	---	S32100	A	---	≤ ⅜	205	30	515	75	35	---
ASTM A 358/A 358M-01	321	---	S32100	H, HT, HT-O or HT-SO	---	---	205	30	515	75	40	---
ASTM A 376/A 376M-02a	TP321	---	---	see standard	---	≤ ⅜	205	30	515	75	35	---
ASTM A 409/A 409M-01	TP321	---	S32100	H, HT, HT-O or HT-SO	---	---	205	30	515	75	---	---
JIS G 3459:1997	SUS321TP	---	---	ST	---	---	205	---	520	---	35	---
JIS G 3463:1994	SUS321TB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 321 TF	---	---	ST	---	---	205	---	520	---	35	---
JIS G 3468:1994	SUS321	---	---	AM	---	---	205	---	520	---	35	---
BS 3605-1:1990 Issue 2, 1997	321S31	---	---	ST or HF	---	---	235	---	510-710	---	35	---
BS 3605-2:1992 AMD 1:1997	321S31	---	---	AW or ST	---	---	235	---	510-710	---	35	---
DIN 17457:1985	X 6 CrNiTi 18 10	1.4541	---	SA & Q	≤ 50	---	200	---	500-730	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 6 CrNiTi 18 10	1.4541	---	SA & Q	≤ 50	---	200	---	500-730	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
					≤ 50	---	180	---	460-680	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 28180:1985	X 6 CrNiTi 18 10	1.4541	---	SA & Q	≤ 50	---	200	---	500-730	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
				SA & Q	≤ 50	---	180	---	460-680	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 28181:1985	X 6 CrNiTi 18 10	1.4541	---	SA & Q	≤ 50	---	200	---	500-730	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-217:1987	TU Z 6 CNT 18 10	---	---	HF + CR + Q (HY)	---	---	190	---	490-740	---	45	90 HRB max
AFNOR NF A 49-244:1993	X6CrNiTi18-10	---	---	ST or TT	< 3	---	220	---	530-730	---	35	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	220	---			40	
					5 < t ≤ 75	---	210	---			40	
AFNOR NF A 49-247:1981	TS Z 6 CNT 18-10	---	---	Q (HY)	---	---	220	---	530-730	---	35	---
ISO 2604-II:1975	TS 53	---	---	Q	---	---	195	---	510-710	---	30	---
ISO 2604-V:1978	TW 53	---	---	Q	---	---	195	---	510-710	---	30	---

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 213/A 213M-03a	TP321H	---	S32109	ST	---	---	205	30	515	75	35	90 HRB
ASTM A 249/A 249M-03	TP321H	---	S32109	ST	---	---	205	30	515	75	35	90 HRB max
ASTM A 312/A 312M-03	TP321H Welded	---	S32109	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 376/A 376M-02a	TP321H	---	S32109	see standard	---	≤ ⅜	205	30	515	75	35	---
					---	> ⅜	170	25	480	70	35	---
JIS G 3459:1997	SUS321HTP	---	---	CF or HF + ST	---	---	205	---	520	----	35	---
JIS G 3463:1994	SUS321HTB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 321H TF	---	---	CF or HF,ST	---	---	205	---	520	---	35	---
BS 3605-1:1990 Issue 2, 1997	321S51	---	---	ST or HF	---	---	235	---	510-710	---	35	---
AFNOR NF A 49-214:1978	Z 6 CNT 18-12 B	---	---	L or F/H + RC	---	---	195	---	490-690	---	40	---
ISO 2604-II:1975	TS 54	---	---	Q	---	---	155	---	490-690	---	30	---
JIS G 3463:1994	SUS329J3LTB	---	---	ST	O.D. < 10	---	450	---	620	---	10	---
					10 ≤ O.D. < 20	---					13	---
					O.D. ≥ 20	---					18	---
AFNOR NF A 49-217:1987	TU Z 2 CND 22 05 03	---	---	HF + CR + Q (HY)	---	---	450	---	680-880	---	25	---
JIS G 3463:1994	SUS329J4LTB	---	---	ST	O.D. < 10	---	450	---	620	---	10	---
					10 ≤ O.D. < 20	---					13	---
					O.D. ≥ 20	---					18	---
AFNOR NF A 49-217:1987	TU Z 2 CND 25 07 03	---	---	HF + CR + Q (HY)	---	---	450	---	700-900	---	25	---
ASTM A 213/A 213M-03a	TP347	---	S34700	ST	---	---	205	30	515	75	35	90 HRB
ASTM A 249/A 249M-03	TP347	---	S34700	H + RC	---	---	205	30	515	75	35	90 HRB max
ASTM A 312/A 312M-03	TP347	---	S34700	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 358/A 358M-01	347	---	S34700	H, HT, HT-O or HT-SO	---	---	205	30	515	75	40	---
ASTM A 376/A 376M-02a	TP347	---	S34700	see standard	---	---	205	30	515	75	35	---
ASTM A 409/A 409M-01	TP347	---	S34700	H, HT, HT-O or HT-SO	---	---	205	30	515	75	---	---
JIS G 3459:1997	SUS347TP	---	---	ST	---	---	205	---	520	---	35	---
JIS G 3463:1994	SUS347TB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 347 TF	---	---	ST	---	---	205	---	520	---	35	---
JIS G 3468:1994	SUS347	---	---	AM	---	---	205	---	520	---	35	---
BS 3605-1:1990 Issue 2, 1997	347S31	---	---	ST or HF	---	---	240	---	510-710	---	35	---
BS 3605-2:1990 Issue 2, 1997	347S31	---	---	ST	---	---	240	---	510-710	---	35	---

NOTE: This section continued on next page

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
DIN 17457:1985	X 6 CrNiNb 18 10	1.4550	---	SA & Q	≤ 50	---	205	---	510-740	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 6 CrNiNb 18 10	1.4550	---	SA & Q	≤ 50	---	205	---	510-740	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
ISO 2604-II:1975	TS 50	---	---	Q	---	---	205	---	510-710	---	30	---
ISO 2604-V:1978	TW 50	---	---	Q	---	---	205	---	510-710	---	30	---
ASTM A 213/A 213M-03a	TP347H	---	S34709	ST	---	---	205	30	515	75	35	90 HRB
ASTM A 249/A 249M-03	TP347H	---	S34709	ST	---	---	205	30	515	75	35	90 HRB max
ASTM A 312/A 312M-03	TP347H	---	S34709	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 376/A 376M-02a	TP347H	---	S34709	see standard	---	---	205	30	515	75	35	---
JIS G 3459:1997	SUS347HTP	---	---	CF or HF + ST	---	---	205	---	520	---	35	---
JIS G 3463:1994	SUS347HTB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 347H TF	---	---	CF or HF, ST	---	---	205	---	520	---	35	---
BS 3605-1:1990 Issue 2, 1997	347S51	---	---	ST or HF	---	---	240	---	510-710	---	35	---
DIN 17459:1992	X 8 CrNiNb 16 13	1.4961	---	SHT	≤ 50	---	205	---	510-690	---	35 L; 22 T	65 J at RT, L 45 J at RT, T
AFNOR NF A 49-214:1978	Z 6 CN Nb 18-12 B	---	---	L or F/H + RC	---	---	195	---	490-690	---	40	---
ISO 2604-II:1975	TS 56	---	---	Q	---	---	205	---	510-710	---	30	---
ASTM A 213/A 213M-03a	---	---	S31725	ST	---	---	205	30	515	75	35	90 HRB
ASTM A 249/A 249M-03	---	---	S31725	ST	---	---	205	30	515	75	35	90 HRB
ASTM A 312/A 312M-03	---	---	S31725	SA	---	---	205	30	515	75	---	---
ASTM A 358/A 358-01	---	---	S31725	see standard	---	---	205	30	515	75	---	---
ASTM A 376/A 376M-02a	---	---	S31725	HT	---	---	205	30	515	75	35	---
ASTM A 409/A 409M-01	---	---	S31725	H, HT, HT-O or HT-SO	---	---	205	30	515	75	---	---
DIN 17457:1985	X 2 CrNiMoN 17 13 5	1.4439	---	SA & Q	≤ 50	---	285	---	580-800	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 2 CrNiMoN 17 13 5	1.4439	---	SA & Q	≤ 50	---	285	---	580-800	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-244:1993	X3CrNiMoN18-14-5	---	---	ST or TT	< 3	---	290	---	580-780	---	35	L: 100 J at -196°C T: 80 J at -196°C
					3 ≤ t ≤ 5	---	290	---			40	
					5 < t ≤ 75	---	280	---			40	

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 358/A 358M-01	---	---	N08904	H, HT, HT-O or HT-SO	---	---	220	31	490	71	35	---
ASTM A 249/A 249M-03	---	---	N08904	H + WQ or RC	---	---	215	31	490	71	35	90 HRB max
JIS G 3459:1997	SUS890LTP	---	---	ST	---	---	215	---	490	---	35	---
JIS G 3463:1994	SUS890LTB	---	---	ST	O.D. < 10	---	215	---	490	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
AFNOR NF A 49-244:1993	X2NiCrMoCu25-20	---	---	ST or TT	< 3	---	230	---	530-730	---	30	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	230	---			35	
					5 < t ≤ 75	---	230	---			35	
ASTM A 240/A 240M-03c	800	---	N08800	---	---	---	205	30	520	75	30	---
JIS G 3467:1988	NCF 800 TF	---	---	CF, A	---	---	205	---	520	---	30	---
				HF, A	---	---	175	---	450	---	30	---
DIN 17459:1992	X 5 NiCrAlTi 31 20 RK	1.4958 RK	---	A/R	≤ 50	---	210	---	500-750	---	35 L; 30 T	L: 120 J at RT T: 80 J at RT
	X 5 NiCrAlTi 31 20	1.4958	---	SHT	≤ 50	---	170	---	500-750	---	35 L; 30 T	L: 120 J at RT T: 80 J at RT
AFNOR NF A 49-244:1993	X5NiCr32-21	---	---	ST or TT	< 3	---	200	---	490-690	---	25	---
					3 ≤ t ≤ 5	---	200	---			30	
					5 < t ≤ 75	---	200	---			30	
DIN 17459:1992	X 8 NiCrAlTi 32 21	1.4959	---	SHT	≤ 50	---	170	---	500-750	---	35 L; 30 T	L: 120 J at RT T: 80 J at RT
ASTM A 240/A 240M-03c	800H	---	N08810	---	---	---	170	25	450	65	30	---
JIS G 3467:1988	NCF 800H TF	---	---	S	---	---	175	---	450	---	30	---
ASTM A 249/A 249M-03	---	---	N08367	SA	---	t ≤ 0.187	310	45	690	100	30	100 HRB max
					---	t > 0.187	310	45	655	95	30	100 HRB max
	---	---	N08926	SA	---	---	295	43	650	94	35	100 HRB max
ASTM A 312/A 312M-03	---	---	N08926	HT	---	---	295	43	650	94	35	---
ASTM A 688/A 688M-03	---	---	N08367	SA	---	t ≤ 0.187	310	45	655	95	30	---
					---	t > 0.187	310	45	655	95	30	100 HRB max
	---	---	N08926	SA	---	---	295	43	650	94	35	---
JIS G 3463:1994	SUS836LTB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---

5.10 Line Pipe Steels

5.10.1A Mechanical Properties of Line Pipe Steels Without Notch Toughness Requirements

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
API 5L-2004	A25 Class I - PSL 1 A25 Class II - PSL 1	---	---	see standard	---	---	172	25	310	45	see standard	---
ISO 3183-1:1996	L175, Class I L175, Class I	---	---	see standard	---	---	175	---	315	---	27	---
API 5L-2004	A - PSL 1	---	---	see standard	---	---	207	30	331	48	see standard	---
EN 10208-1:1997	L210GA	1.0319	---	see standard	---	---	210	---	335-475	---	25	---
ISO 3183-1:1996	L210	---	---	see standard	---	---	210	---	335	---	25	---
API 5L-2004	B - PSL 1	---	---	see standard	---	---	241	35	414	60	see standard	---
CSA Z245.1-2002	241 - Category I	---	---	see standard	---	---	241-495	---	414-760	---	see standard	---
EN 10208-1:1997	L245GA	1.0459	---	see standard	---	---	245	---	415-555	---	22	---
ISO 3183-1:1996	L245	---	---	see standard	---	---	245	---	415	---	21	---
API 5L-2004	X42 - PSL 1	---	---	see standard	---	---	290	42	414	60	see standard	---
CSA Z245.1-2002	290 - Category I	---	---	see standard	---	---	290-495	---	414-760	---	see standard	---
EN 10208-1:1997	L290GA	1.0483	---	see standard	---	---	290	---	415-555	---	21	---
ISO 3183-1:1996	L290	---	---	see standard	---	---	290	---	415	---	21	---
API 5L-2004	X46 - PSL 1	---	---	see standard	---	---	317	46	434	63	see standard	---
CSA Z245.1-2002	317 - Category I	---	---	see standard	---	---	317	---	434	---	see standard	---
ISO 3183-1:1996	L320	---	---	see standard	---	---	320	---	435	---	20	---
API 5L-2004	X52 - PSL 1	---	---	see standard	---	---	359	52	455	66	see standard	---
CSA Z245.1-2002	359 - Category I	---	---	see standard	---	---	359-530	---	455-760	---	see standard	---
EN 10208-1:1997	L360GA	1.0499	---	see standard	---	---	360	---	460-620	---	20	---
ISO 3183-1:1996	L360	---	---	see standard	---	---	360	---	460	---	19	---
API 5L-2004	X56 - PSL 1	---	---	see standard	---	---	386	56	490	71	see standard	---
CSA Z245.1-2002	386 - Category I	---	---	see standard	---	---	386-540	---	490-760	---	see standard	---
ISO 3183-1:1996	L390	---	---	see standard	---	---	390	---	490	---	18	---
API 5L-2004	X60 - PSL 1	---	---	see standard	---	---	414	60	517	75	see standard	---
CSA Z245.1-2002	414 - Category I	---	---	see standard	---	---	414-565	---	517-760	---	see standard	---
ISO 3183-1:1996	L415	---	---	see standard	---	---	415	---	520	---	17	---
API 5L-2004	X65 - PSL 1	---	---	see standard	---	---	448	65	531	77	see standard	---
CSA Z245.1-2002	448 - Category I	---	---	see standard	---	---	448-600	---	531-760	---	see standard	---
ISO 3183-1:1996	L450	---	---	see standard	---	---	450	---	535	---	17	---
API 5L-2004	X70 - PSL 1	---	---	see standard	---	---	483	70	565	82	see standard	---
CSA Z245.1-2002	483 - Category I	---	---	see standard	---	---	483-620	---	565-760	---	see standard	---
ISO 3183-1:1996	L485	---	---	see standard	---	---	485	---	570	---	16	---
CSA Z245.1-2002	550 - Category I	---	---	see standard	---	---	550-690	---	620-830	---	see standard	---
ISO 3183-1:1996	L555	---	---	see standard	---	---	555	---	625-825	---	15	27 J at 0°C see standard

5.10 Line Pipe Steels

5.10.1B Chemical Composition of Line Pipe Steels Without Notch Toughness Requirements

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
API 5L-2004	A25, Class I, PSL 1 seamless	---	---	0.21	0.60	---	0.030	0.030	---	---	---	---
	A25, Class II, PSL 1 seamless	---	---	0.21	0.60	---	0.045-0.080	0.030	---	---	---	---
	A25, Class I, PSL 1 welded	---	---	0.21	0.60	---	0.030	0.030	---	---	---	---
	A25, Class II, PSL 1 welded	---	---	0.21	0.60	---	0.045-0.080	0.030	---	---	---	---
ISO 3183-1:1996	L175, Class I S/NE/CE*	---	---	0.21	0.30-0.60	---	0.030	0.030	---	---	---	see standard
	L175, Class II S/NE/CE*	---	---	0.21	0.30-0.60	---	0.045-0.080	0.030	---	---	---	see standard
	L175, Class I W/EW/CW*	---	---	0.21	0.30-0.60	---	0.030	0.030	---	---	---	see standard
	L175, Class II W/EW/CW*	---	---	0.21	0.30-0.60	---	0.045-0.080	0.030	---	---	---	see standard
API 5L-2004	A, PSL 1 seamless	---	---	0.22	0.90	---	0.030	0.030	---	---	---	---
	A, PSL 1 welded	---	---	0.22	0.90	---	0.030	0.030	---	---	---	---
EN 10208-1:1997	L210GA	1.0319	---	0.21	0.90	0.40	0.030	0.030	---	---	---	AL 0.015-0.060; Nb+V+Ti 0.15
ISO 3183-1:1996	L210 S/NE/CE*	---	---	0.22	0.90	---	0.030	0.030	---	---	---	see standard
	L210 W/NE/CE*	---	---	0.21	0.90	---	0.030	0.030	---	---	---	see standard
API 5L-2004	B, PSL 1 seamless	---	---	0.28	1.20	---	0.030	0.030	---	---	---	Cb+V 0.03; Ti 0.04; Cb+V+Ti 0.15
	B, PSL 1 welded	---	---	0.26	1.20	---	0.030	0.030	---	---	---	Cb+V 0.03; Ti 0.04; Cb+V+Ti 0.15
CSA Z245.1-2002	241 - Category I	---	---	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 10208-1:1997	L245GA	1.0459	---	0.20	1.15	0.40	0.030	0.030	---	---	---	AL 0.015-0.060; Nb+V+Ti 0.15
ISO 3183-1:1996	L245 S/NE/CE*	---	---	0.27	1.15	---	0.030	0.030	---	---	---	see standard
	L245 W/NE/CE*	---	---	0.26	1.15	---	0.030	0.030	---	---	---	see standard
API 5L-2004	X 42, PSL 1 seamless	---	---	0.28	1.30	---	0.030	0.030	---	---	---	Ti 0.04; Cb+V+Ti 0.15
	X 42, PSL 1 welded	---	---	0.26	1.30	---	0.030	0.030	---	---	---	Ti 0.04; Cb+V+Ti 0.15
CSA Z245.1-2002	290 - Category I	---	---	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 10208-1:1997	L290GA	1.0483	---	0.20	1.40	0.40	0.030	0.030	---	---	---	AL 0.015-0.060; Nb+V+Ti 0.15
ISO 3183-1:1996	L290 S/NE*	---	---	0.29	1.25	---	0.030	0.030	---	---	---	see standard
	L290 S/CE*	---	---	0.29	1.25	---	0.030	0.030	---	---	---	see standard
	L290 W/NE/CE*	---	---	0.28	1.25	---	0.030	0.030	---	---	---	see standard

*: See "Heat Treatment Terms" table at the beginning of the chapter.

5.10 Line Pipe Steels

5.10.1B Chemical Composition of Line Pipe Steels Without Notch Toughness Requirements (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
API 5L-2004	X46, PSL 1 seamless	---	---	0.28	1.40	---	0.030	0.030	---	---	---	Ti 0.04; Cb+V+Ti 0.15
	X46, PSL 1 welded	---	---	0.26	1.40	---	0.030	0.030	---	---	---	Ti 0.04; Cb+V+Ti 0.15
CSA Z245.1-2002	317 - Category I	---	---	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)
ISO 3183-1:1996	L320, S/NE*	---	---	0.31	1.35	---	0.030	0.030	---	---	---	see standard
	L320 S/CE*	---	---	0.29	1.25	---	0.030	0.030	---	---	---	see standard
	L320 W/NE*	---	---	0.30	1.25	---	0.030	0.030	---	---	---	see standard
	L320 W/CE*	---	---	0.28	1.25	---	0.030	0.030	---	---	---	see standard
API 5L-2004	X52, PSL 1 seamless	---	---	0.28	1.40	---	0.030	0.030	---	---	---	Ti 0.04; Cb+V+Ti 0.15
	X52, PSL 1 welded	---	---	0.26	1.40	---	0.030	0.030	---	---	---	Ti 0.04; Cb+V+Ti 0.15
CSA Z245.1-2002	359 - Category I	---	---	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 10208-1:1997	L360GA	1.0499	---	0.22	1.45	0.55	0.030	0.030	---	---	---	AL 0.015-0.060; Nb+V+Ti 0.15
ISO 3183-1:1996	L 360 S/NE*	---	---	0.31	1.35	---	0.030	0.030	---	---	---	see standard
	L360 S/CE*	---	---	0.29	1.25	---	0.030	0.030	---	---	---	see standard
	L360 W/NE*	---	---	0.30	1.25	---	0.030	0.030	---	---	---	see standard
	L360 W/CE*	---	---	0.28	1.25	---	0.030	0.030	---	---	---	see standard
API 5L-2004	X56, PSL 1 seamless	---	---	0.28	1.40	---	0.030	0.030	---	---	---	Ti 0.04; Cb+V+Ti 0.15
	X56, PSL 1 welded	---	---	0.26	1.40	---	0.030	0.030	---	---	---	Ti 0.04; Cb+V+Ti 0.15
CSA Z245.1-2002	386 - Category I	---	---	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)
ISO 3183-1:1996	L390, S/NE/CE*	---	---	0.26	1.35	---	0.030	0.030	---	---	---	see standard
	L390, W/NE/CE*	---	---	0.26	1.35	---	0.030	0.030	---	---	---	see standard
API 5L-2004	X60, PSL 1 seamless	---	---	0.28	1.40	---	0.030	0.030	---	---	---	Ti 0.04; Cb+V+Ti 0.15
	X60, PSL 1 welded	---	---	0.26	1.40	---	0.030	0.030	---	---	---	Ti 0.04; Cb+V+Ti 0.15
CSA Z245.1-2002	414 - Category I	---	---	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)
ISO 3183-1:1996	L415 S/NE/CE*	---	---	0.26	1.35	---	0.030	0.030	---	---	---	see standard
	L415 W/NE/CE*	---	---	0.26	1.35	---	0.030	0.030	---	---	---	see standard
API 5L-2004	X65, PSL 1 seamless	---	---	0.28	1.40	---	0.030	0.030	---	---	---	Ti 0.06; Cb+V+Ti 0.15
	X65, PSL 1 welded	---	---	0.26	1.45	---	0.030	0.030	---	---	---	Ti 0.06; Cb+V+Ti 0.15
CSA Z245.1-2002	448 - Category I	---	---	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)
ISO 3183-1:1996	L450 S/NE/CE*	---	---	by agreement								
	L450 W/NE/CE*	---	---	0.26	1.40	---	0.030	0.030	---	---	---	see standard

*: See "Heat Treatment Terms" table at the beginning of the chapter.

5.10 Line Pipe Steels

5.10.1B Chemical Composition of Line Pipe Steels Without Notch Toughness Requirements (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
API 5L-2004	X70, PSL 1 seamless	---	---	0.28	1.40	---	0.030	0.030	---	---	---	Ti 0.04; Cb+V+Ti 0.15
	X70, PSL 1 welded	---	---	0.26	1.65	---	0.030	0.030	---	---	---	Ti 0.04; Cb+V+Ti 0.15
CSA Z245.1-2002	483 - Category I	---	---	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)
ISO 3183-1:1996	L485, S/NE/CE*	---	---	by agreement								
	L485 W/NE/CE*	---	---	0.23	1.60	---	0.030	0.030	---	---	---	see standard
CSA Z245.1-2002	550 - Category I	---	---	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)
ISO 3183-1:1996	L555 S/NE/CE*	---	---	by agreement								
	L555 W/NE/CE*	---	---	0.18	1.80	---	0.030	0.030	---	---	---	see standard

*: See "Heat Treatment Terms" table at the beginning of the chapter.

5.10 Line Pipe Steels

5.10.2A Mechanical Properties of Line Pipe Steels With Notch Toughness Requirements

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 1005/A 1005M-00	35	---	---	---	---	---	240-450	35-65	415	60	see standard	see standard
API 5L-2004	B - PSL 2	---	---	see standard	---	---	241-448	35-65	414-758	60-110	see standard	L: 41 J at 0°C; T: 27 J at 0°C see standard
CSA Z245.1-2002	241 - Category II or III	---	---	see standard	---	---	241-495	---	414-760	---	see standard	OD < 457 mm: 27 J at temp OD ≥ 457 mm: 40 J at temp see standard
ASTM A 984/A 984M-03	35	---	---	see standard	---	NPS < 8	240	35	415	60	see standard	see standard
					---	NPS ≤ 8	240-450	35-65				
EN 10208-2:1996	L245NB	1.0457	---	see standard	---	---	245-440	---	415	---	22	see standard
	L245MB	1.0418										
ISO 3183-2:1996	L245NB	---	---	see standard	---	---	245-440	---	415	---	22	see standard
	L245MB											
API 5L-2004	X42 - PSL 2	---	---	see standard	---	---	290-496	42-72	414-758	60-110	see standard	L: 41 J at 0°C; T: 27J at 0°C see standard
CSA Z245.1-2002	290 - Category II or III	---	---	see standard	---	---	290-495	---	414-760	---	see standard	OD < 457 mm: 27 J at temp OD ≥ 457 mm: 40 J at temp see standard
EN 10208-2:1996	L290NB	1.0484	---	see standard	---	---	290-440	---	415	---	21	see standard
	L290MB	1.0429										
ISO 3183-2:1996	L290NB	---	---	see standard	---	---	290-440	---	415	---	21	see standard
	L290MB											
API 5L-2004	X46 - PSL 2	---	---	see standard	---	---	317-524	46-76	434-758	63-110	see standard	L: 41 J at 0°C; T: 27J at 0°C see standard;
CSA Z245.1-2002	317 - Category II or III	---	---	see standard	---	---	317	---	434	---	see standard	OD < 457 mm: 27 J at temp OD ≥ 457 mm: 40 J at temp see standard

5.10 Line Pipe Steels

5.10.2A Mechanical Properties of Line Pipe Steels With Notch Toughness Requirements (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
API 5L-2004	X52 - PSL 2	---	---	see standard	---	---	359-531	52-77	455-758	66-110	see standard	L: 41 J at 0°C; T: 27J at 0°C see standard
CSA Z245.1-2002	359 - Category II or III	---	---	see standard	---	---	359-530	---	455-760	---	see standard	OD < 457 mm: 27 J at temp OD ≥ 457 mm: 40 J at temp see standard
EN 10208-2:1996	L360NB	1.0582	---	see standard	---	---	360-510	---	460	---	20	see standard
	L360QB	1.8948										
	L360MB	1.0578										
ISO 3183-2:1996	L360NB	---	---	see standard	---	---	360-510	---	460	---	20	see standard
	L360QB											
	L360MB											
ASTM A 984/A 984M-03	50	---	---	see standard	---	NPS < 8	345	50	485	70	see standard	see standard
					---	NPS ≤ 8	345-530	50-77				
API 5L-2004	X56 - PSL 2	---	---	see standard	---	---	386-544	56-79	490-758	71-110	see standard	L: 41 J at 0°C; T: 27J at 0°C see standard
CSA Z245.1-2002	386 - Category II or III	---	---	see standard	---	---	386-540	---	490-760	---	see standard	OD < 457 mm: 27 J at temp OD ≥ 457 mm: 40 J at temp see standard
API 5L-2004	X60 - PSL 2	---	---	see standard	---	---	414-565	60-82	517-758	75-110	see standard	L: 41 J at 0°C; T: 27J at 0°C see standard
CSA Z245.1-2002	414 - Category II or III	---	---	see standard	---	---	414-565	---	517-760	---	see standard	OD < 457 mm: 27 J at temp OD ≥ 457 mm: 40 J at temp see standard
ASTM A 1005/A 1005M-00	60	---	---	---	---	---	415-550	60-80	515	75	see standard	see standard
EN 10208-2:1996	L415NB	1.8972	---	see standard	---	---	415-565	---	520	---	18	see standard
	L415QB	1.8947										
	L415MB	1.8973										
ISO 3183-2:1996	L415NB	---	---	see standard	---	---	415-565	---	520	---	18	see standard
	L415QB											
	L415MB											

5.10 Line Pipe Steels

5.10.2A Mechanical Properties of Line Pipe Steels With Notch Toughness Requirements (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
API 5L-2004	X65 - PSL 2	---	---	see standard	---	---	448-600	65-87	531-758	77-110	see standard	L: 41 J at 0°C; T: 27J at 0°C see standard
CSA Z245.1-2002	448 - Category II or III	---	---	see standard	---	---	448-600	---	531-760	---	see standard	OD < 457 mm: 27 J at temp OD ≥ 457 mm: 40 J at temp see standard
ASTM A 984/A 984M-03	60	---	---	see standard	---	NPS < 8	415	60	515	75	see standard	see standard
					---	NPS ≤ 8	415-550	60-80				
EN 10208-2:1996	L450QB	1.8952	---	see standard	---	---	450-570	---	535	---	18	see standard
	L450MB	1.8975										
ISO 3183-2:1996	L450QB	---	---	see standard	---	---	450-570	---	535	---	18	see standard
	L450MB											
API 5L-2004	X70 - PSL 2	---	---	see standard	---	---	483-621	70-90	565-758	82-110	see standard	L: 41 J at 0°C; T: 27J at 0°C see standard
CSA Z245.1-2002	483 - Category II or III	---	---	see standard	---	---	483-620	---	565-760	---	see standard	OD < 457 mm: 27 J at temp OD ≥ 457 mm: 40 J at temp see standard
ASTM A 1005/A 1005M-00	70	---	---	---	---	---	485-600	70-87	550	80	see standard	see standard
EN 10208-2:1996	L485QB	1.8955	---	see standard	---	---	485-605	---	570	---	18	see standard
	L485MB	1.8977										
ISO 3183-2:1996	L485QB	---	---	see standard	---	---	485-605	---	570	---	18	see standard
	L485MB											
ASTM A 984/A 984M-03	80	---	---	see standard	---	NPS < 8	550	80	620	90	see standard	see standard
					---	NPS ≤ 8	550-670	80-97				
CSA Z245.1-2002	550 - Category II or III	---	---	see standard	---	---	550-690	---	620-830	---	see standard	OD < 457 mm: 27 J at temp OD ≥ 457 mm: 40 J at temp see standard
API 5L-2004	X80 - PSL 2	---	---	see standard	---	---	552-690	80-100	621-827	90-120	see standard	L: 101 J at 0°C; T: 68 J at 0°C see standard
EN 10208-2:1996	L555QB	1.8957	---	see standard	---	---	555-675	---	625	---	18	see standard
	L555MB	1.8978										
ISO 3183-2:1996	L555QB	---	---	see standard	---	---	555-675	---	625	---	18	see standard
	L555MB											
ASTM A 1005/A 1005M-00	80	---	---	---	---	---	550-670	80-97	620	90	see standard	see standard

5.10 Line Pipe Steels

5.10.2B Chemical Composition of Line Pipe Steels With Notch Toughness Requirements

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 1005/A 1005M-00	35	---	---	0.16	---	---	---	---	---	---	---	B 0.0007; CE 0.40 (see standard)
API 5L-2004	B, PSL 2 seamless	---	---	0.24	1.20	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Cb+V 0.06; Ti 0.04
	B, PSL 2 welded	---	---	0.22	1.20	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Cb+V 0.06; Ti 0.04
CSA Z245.1-2002	241 - Category II or III	---	---	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)
ASTM A 984/A 984M-03	35	---	---	0.22	---	---	0.025	0.015	---	---	---	B 0.0007; CE 0.40 (see standard)
EN 10208-2:1996	L245NB seamless and welded	1.0457	---	0.16	1.1	0.40	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Al:N ≥ 2; CEV 0.42 (see standard)
	L245MB welded	1.0418	---	0.16	1.5	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; V 0.04; Nb 0.04; Al:N ≥ 2; CEV 0.40 (see standard)
ISO 3183-2:1996	L245NB seamless and welded	---	---	0.16	1.1	0.40	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Al:N ≥ 2; CEV 0.42 (see standard)
	L245MB welded	---	---	0.16	1.5	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; V 0.04; Nb 0.04; Al:N ≥ 2; CEV 0.40 (see standard)
API 5L-2004	X 42, PSL 2 seamless	---	---	0.24	1.30	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Ti 0.04
	X 42, PSL 2 welded	---	---	0.22	1.30	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Ti 0.04
CSA Z245.1-2002	290 - Category II or III	---	---	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 10208-2:1996	L290NB seamless and welded	1.0484	---	0.17	1.2	0.40	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Ti 0.04; V 0.05; Nb 0.05; Al:N ≥ 2; CEV 0.42 (see standard)
	L290MB welded	1.0429	---	0.16	1.5	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; V 0.04; Nb 0.04; Al:N ≥ 2; CEV 0.40 (see standard)
ISO 3183-2:1996	L290NB seamless and welded	---	---	0.17	1.2	0.40	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Ti 0.04; V 0.05; Nb 0.05; Al:N ≥ 2; CEV 0.42 (see standard)
	L290MB welded	---	---	0.16	1.5	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; V 0.04; Nb 0.04; Al:N ≥ 2; CEV 0.40 (see standard)
API 5L-2004	X46, PSL 2 seamless	---	---	0.24	1.40	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Ti 0.04
	X46, PSL 2 welded	---	---	0.22	1.40	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Ti 0.04
CSA Z245.1-2002	317 - Category II or III	---	---	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)

5.10 Line Pipe Steels

5.10.2B Chemical Composition of Line Pipe Steels With Notch Toughness Requirements (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
API 5L-2004	X52, PSL 2 seamless	---	---	0.24	1.40	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Ti 0.04
	X52, PSL 2 welded	---	---	0.22	1.40	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Ti 0.04
CSA Z245.1-2002	359 - Category II or III	---	---	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 10208-2:1996	L360NB seamless and welded	1.0582	---	0.20	1.6	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Ti 0.04; V 0.10; Nb 0.05; Al:N ≥ 2; Nb+V+Ti 0.15; CEV 0.45 (see standard)
	L360QB seamless	1.8948	---	0.16	1.4	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Ti 0.04; V 0.05; Nb 0.05; Al:N ≥ 2; CEV 0.42 (see standard)
	L360MB welded	1.0578	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Ti 0.04; V 0.05; Nb 0.05; Al:N ≥ 2; CEV 0.41 (see standard)
ISO 3183-2:1996	L360NB seamless and welded	---	---	0.20	1.6	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Ti 0.04; V 0.10; Nb 0.05; Al:N ≥ 2; CEV 0.45 (see standard)
	L360QB seamless	---	---	0.16	1.4	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Ti 0.04; V 0.05; Nb 0.05; Al:N ≥ 2; Nb+V+Ti 0.15; CEV 0.42 (see standard)
	L360MB welded	---	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Ti 0.04; V 0.05; Nb 0.05; Al:N ≥ 2; CEV 0.41 (see standard)
ASTM A 984/A 984M-03	50	---	---	0.22	---	---	0.025	0.015	---	---	---	B 0.0007; CE 0.40 (see standard)
API 5L-2004	X56, PSL 2 seamless	---	---	0.24	1.40	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Ti 0.04
	X56, PSL 2 welded	---	---	0.22	1.40	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Ti 0.04
CSA Z245.1-2002	386 - Category II or III	---	---	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)

5.10 Line Pipe Steels

5.10.2B Chemical Composition of Line Pipe Steels With Notch Toughness Requirements (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
API 5L-2004	X60, PSL 2 seamless	---	---	0.24	1.40	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Ti 0.04
	X60, PSL 2 welded	---	---	0.22	1.40	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Ti 0.04
CSA Z245.1-2002	414 - Category II or III	---	---	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)
ASTM A 1005/A 1005M-00	60	---	---	0.16	---	---	---	---	---	---	---	B 0.0007; CE 0.40 (see standard)
EN 10208-2:1996	L415NB seamless and welded	1.8972	---	0.21	1.6	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15; Ti 0.04; V 0.15; Nb 0.05; Al:N ≥ 2; CEV by agreement (see standard)
	L415QB seamless	1.8947	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15; Ti 0.04; V 0.08; Nb 0.05; Al:N ≥ 2; CEV 0.43 (see standard)
	L415MB welded	1.8973	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15; Ti 0.06; V 0.08; Nb 0.05; Al:N ≥ 2; CEV 0.42 (see standard)
ISO 3183-2:1996	L415NB seamless and welded	---	---	0.21	1.6	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15; Ti 0.04; V 0.15; Nb 0.05; Al:N ≥ 2; CEV by agreement (see standard)
	L415QB seamless	---	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15; Ti 0.04; V 0.08; Nb 0.05; Al:N ≥ 2; CEV 0.43 (see standard)
	L415MB welded	---	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15; Ti 0.06; V 0.08 Nb 0.05; Al:N ≥ 2; CEV 0.42 (see standard)
API 5L-2004	X65, PSL 2 seamless	---	---	0.24	1.40	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Ti 0.06
	X65, PSL 2 welded	---	---	0.22	1.45	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Ti 0.06
CSA Z245.1-2002	448 - Category II or III	---	---	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)
ASTM A 984/A 984M-03	60	---	---	0.22	---	---	0.025	0.015	---	---	---	B 0.0007; CE 0.40 (see standard)
EN 10208-2:1996	L450QB seamless	1.8952	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15; CEV 0.45 (see standard); Al:N ≥ 2;
	L450MB welded	1.8975	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15; CEV 0.43 (see standard); Al:N ≥ 2;
ISO 3183-2:1996	L450QB seamless	---	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15; Ti 0.06; V 0.09; Nb 0.05; Al:N ≥ 2; CEV 0.45 (see standard)
	L450MB welded	---	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15; Ti 0.06; V 0.10; Nb 0.05; Al:N ≥ 2; CEV 0.43 (see standard)

5.10 Line Pipe Steels

5.10.2B Chemical Composition of Line Pipe Steels With Notch Toughness Requirements (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
API 5L-2004	X70, PSL 2 seamless	---	---	0.24	1.40	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Ti 0.06
	X70, PSL 2 welded	---	---	0.22	1.65	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Ti 0.06
CSA Z245.1-2002	483 - Category II or III	---	---	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)
ASTM A 1005/A 1005M-00	70	---	---	0.16	---	---	---	---	---	---	---	B 0.0007; CE 0.40 (see standard)
EN 10208-2:1996	L485QB seamless	1.8955	---	0.16	1.7	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15; Ti 0.06; V 0.10; Nb 0.05; Al:N ≥ 2 CEV 0.45 (see standard)
	L485MB welded	1.8977	---	0.16	1.7	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15; Ti 0.06; V 0.10; Nb 0.06; Al:N ≥ 2 CEV 0.43 (see standard)
ISO 3183-2:1996	L485QB seamless	---	---	0.16	1.7	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15; Ti 0.06; V 0.10; Nb 0.05; Al:N ≥ 2 CEV 0.45 (see standard)
	L485MB welded	---	---	0.16	1.7	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15; Ti 0.06; V 0.10; Nb 0.06; Al:N ≥ 2 CEV 0.43 (see standard)
ASTM A 984/A 984M-03	80	---	---	0.22	---	---	0.025	0.015	---	---	---	B 0.0007; CE 0.40 (see standard)
CSA Z245.1-2002	550 - Category II or III	---	---	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)
API 5L-2004	X80, PSL 2 seamless	---	---	0.24	1.40	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Ti 0.06
	X80, PSL 2 welded	---		0.22	1.85	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; Ti 0.06
EN 10208-2:1996	L555QB seamless	1.8957	---	0.16	1.8	0.45	0.025	0.020	0.50	0.60	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Al:N ≥ 2; Nb+V+Ti 0.15; CEV by agreement (see standard)
	L555MB welded	1.8978	---	0.16	1.8	0.45	0.025	0.020	0.30	0.30	0.10	V 0.10; Nb 0.06; Ti 0.06; Al:N ≥ 2; Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV by agreement (see standard)
ISO 3183-2:1996	L555QB seamless	---	---	0.16	1.8	0.45	0.025	0.020	0.50	0.60	0.35	V 0.10; Nb 0.05; Ti 0.06; Al:N ≥ 2; Nb+V+Ti 0.15; CEV by agreement (see standard)
	L555MB welded	---	---	0.16	1.8	0.45	0.025	0.020	0.30	0.30	0.10	V 0.10; Nb 0.06; Ti 0.06; Al:N ≥ 2; Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV by agreement (see standard)
ASTM A 1005/A 1005M-00	80	---	---	0.16	---	---	---	---	---	---	---	B 0.0007; CE 0.40 (see standard)

5.11 Non-Comparable Carbon Steel Tubes for General and Structural Applications

ASTM A 512-96 (2001) – Cold-Drawn Buttweld Carbon Steel Mechanical Tubing												
Grade	10S10	15S10	18S10	37S10	1115	1117	---	---	---	---	---	---
UNS Number	1.0711	1.0710	1.0712	1.0713	G11150	G11170	---	---	---	---	---	---
ASTM A 519-03 – Seamless Carbon and Alloy Steel Mechanical Tubing												
Grade, Class, Type	1330	1335	1340	1345	4145	---	---	---	---	---	---	---
UNS Number	G13300	G13350	G13400	G13450	G41450	---	---	---	---	---	---	---
ASTM A 595-98 (2002) – Steel Tubes, Low-Carbon, Tapered for Structural Use												
Grade, Class, Type	C	---	---	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
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												
Steel Name	E275M	E355M	E355K2	E420M	E460M	E460K2	---	---	---	---	---	---
Steel Number	1.8895	1.8896	1.0920	1.8897	1.8898	1.8891	---	---	---	---	---	---
EN 10297-1:2003 – Seamless Circular Steel Tubes for Mechanical and General Engineering Purposes - Technical Delivery Conditons – Part 1: Non-Alloy and Alloy Steel Tubes												
Steel Name	C10E	C15E	C15R	C60E	---	---	---	---	---	---	---	---
Steel Number	1.1121	1.1141	1.1140	1.1221	---	---	---	---	---	---	---	---
EN 10305-1:2002 – Steel Tubes for Precision Applications, Technical Delivery Conditions – Part 1: Seamless Cold Drawn Tubes												
Steel Name	C45E	---	---	---	---	---	---	---	---	---	---	---
Steel Number	1.1191	---	---	---	---	---	---	---	---	---	---	---

5.12 Non-Comparable Alloy Steel Tubes for General and Structural Applications

ASTM A 513-03a – Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing												
Grade, Class, Type	4118	5130	8620	8630	---	---	---	---	---	---	---	---
UNS Number	G41180	G51300	G86200	G86300	---	---	---	---	---	---	---	---
ASTM A 519-03 – Seamless Carbon and Alloy Steel Mechanical Tubing												
Grade, Class, Type	3140	E3310	4012	4023	4024	4027	4037	4042	4047	4063	4118	4147
UNS Number	G31400	G33106	G40120	G40230	G40240	G40270	G40370	G40420	G40470	G40630	G41180	G41470
Grade, Class, Type	4150	4320	4337	E4337	4340	E4340	4422	4427	4520	4615	4617	4620
UNS Number	G41500	G43200	G43370	G43376	G43400	G43406	G44220	G44270	G45200	G46150	G46170	G46200
Grade, Class, Type	4621	4718	4720	4815	4817	4820	5015	5046	5115	5120	5130	5132
UNS Number	G46210	G47180	G47200	G48150	G48170	G48200	G50150	G50460	G51150	G51200	G51300	G51320
Grade, Class, Type	5135	5140	5145	5147	5150	5155	5160	E50100	E51100	E52100	6118	6120
UNS Number	G51350	G51400	G51450	G51470	G51500	G51550	G51600	G50986	G51986	G52986	G61180	G61200
Grade, Class, Type	6150	E7140	8115	8615	8617	8620	8622	8625	8627	8630	8637	8640
UNS Number	G61500	K24065	G81150	G86150	G86170	G86200	G86220	G86250	G86270	G86300	G86370	G86400
Grade, Class, Type	8642	8645	8650	8655	8660	8720	8735	8740	8742	8822	9255	9260
UNS Number	G86420	G86450	G86500	G86550	G86600	G87200	G87350	G87400	G87420	G88220	G92550	G92600
Grade, Class, Type	9262	E9310	9840	9850	50B40	50B44	50B46	50B50	50B60	51B61	81B45	86B45
UNS Number	G92620	G93106	G98400	G98500	G50401	G50441	G50461	G50501	G50601	G50611	G81451	G86451
Grade, Class, Type	94B15	94B17	94B30	94B40	---	---	---	---	---	---	---	---
UNS Number	G94151	G94171	G94301	G94401	---	---	---	---	---	---	---	---
EN 10297-1:2003 – Seamless Circular Steel Tubes for Mechanical and General Engineering Purposes - Technical Delivery Conditons – Part 1: Non-Alloy and Alloy Steel Tubes												
Steel Name	E355K2	E460K2	E730K2	16MnCr5	16MnCrS5	20NiCrMo2-2	30CrNiMo8	36CrNiMo4	41Cr4	41NiCrMo7-3-2	---	---
Steel Number	1.0920	1.8891	1.8893	1.7131	1.7139	1.6523	1.6580	1.6511	1.7035	1.6563	---	---
EN 10305-1:2002 – Steel Tubes for Precision Applications, Technical Delivery Conditions – Part 1: Seamless Cold Drawn Tubes												
Steel Name	1340	---	---	---	---	---	---	---	---	---	---	---
Steel Number	---	---	---	---	---	---	---	---	---	---	---	---
JIS G 3441:1988 – Alloy Steel Tubes for Machine Purposes												
Grade Designation	S Cr 420 TK	S CM 415 TK	---	---	---	---	---	---	---	---	---	---

5.13 Non-Comparable Stainless Steel Tubes for General and Structural Applications

ASTM A 268/A 268M-03 – Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service												
Grade, Class, Type	TP403Ti	TP429	TP443	TP446-1	TP446-2	TP468	TPXM-27	TPXM-33	18Cr-2Mo	25-4-4	26-3-3	29-4
UNS Number	S43036	S42900	S44300	S44600	S44600	S46800	S44627	S44626	S44400	S44635	S44660	S44700
Grade, Class, Type	29-4-2	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S44800	S32803	S40800	S40977	S41500	S42035	S43940	S44735	---	---	---	---
ASTM A 269-02a – Seamless and Welded Austenitic Stainless Steel Tubing for General Service												
Grade, Class, Type	TP317	TP348	TPXM-10	TPXM-11	TPXM-15	TPXM-19	TPXM29	---	---	---	---	---
UNS Number	S31700	S34800	S21900	S21904	S38100	S20910	S24000	S31254	S31726	S30600	S24565	S32654
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S35045	N08367	N08926	N08904	---	---	---	---	---	---	---	---
ASTM A 511-96 – Seamless Stainless Steel Mechanical Tubing												
Grade, Class, Type	MT 302	MT 303Se	MT 305	MT 309S	MT 310S	MT 317	MT 403	MT 414	MT 416Se	MT 431	MT 440A	MT 429
UNS Number	S30200	---	S30500	S30908	S31008	S31700	S40300	S41400	S41623	S43100	S44002	S42900
Grade, Class, Type	MT 443	MT 446-1	MT 446-2	29-4	29-4-2	---	---	---	---	---	---	---
UNS Number	S44300	S44600	S44600	S44700	S44800	---	---	---	---	---	---	---
ASTM A 554-03 – Welded Stainless Steel Mechanical Tubing												
Grade, Class, Type	MT-301	MT-302	MT-305	MT-309S	MT-309S-Cb	MT-310S	MT-317	MT-330	MT-429	MT-430-Ti	---	---
UNS Number	S30100	S30200	---	S30908	S30940	S31008	S31700	---	S42900	S43036	---	---
ASTM A 632-02a – Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service												
Grade, Class, Type	TP 310	TP 317	TP 348	---	---	---	---	---	---	---	---	---
UNS Number	S31000	S31700	S34800	---	---	---	---	---	---	---	---	---
ASTM A 778-01 – Welded, Unannealed Austenitic Stainless Steel Tubular Products												
Grade, Class, Type	TP 317L	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S31703	---	---	---	---	---	---	---	---	---	---	---
JIS G 3446:1994 – Stainless Steel pipes for Machine and Structural Purposes												
Symbol of Grade	SUS420J1TKA	SUS420J2TKA	---	---	---	----	---	---	---	---	---	---
AFNOR NF A 49-647:1979 – Structural Welded Tubes, Circular, Square, Rectangular or Oval, in Ferritic or Austenitic Stainless Steels - Dimensions - Technical Delivery Conditions												
Designation	TS Z 12 CN 17-07			---	---	---	---	---	---	---	---	---

5.14 Non-Comparable Carbon Steel Tubes and Pipes for Low-Temperature Service

EN 10216-3:2002 – Seamless Steel Tubes for Pressure Purposes, Technical Delivery Condtions – Part 3: Alloy Fine Grain Steel Tubes												
Steel Name	P275NL1	P355N	P355NH	P355NL1	P355NL2	P460N	P460NH	P460NL1	P460NL2	P620Q	P620QH	P620QL
Steel Number	1.0488	1.0562	1.0565	1.1106	1.0566	1.8905	1.8935	1.8915	1.8918	1.8876	1.8877	1.8890
Steel Name	P690Q	P690QH	P690QL1	P690QL2	---	---	---	---	---	---	---	---
Steel Number	1.8879	1.8880	1.8881	1.8888	---	---	---	---	---	---	---	---

5.15 Non-Comparable Alloy Steel Tubes and Pipes for Low-Temperature Service

ASTM A 333/A 333M-99 – Seamless and Welded Steel Pipe for Low-Temperature Service												
Grade	4	7	9	10	11	P23	P92	P122	P911	---	---	---
UNS Number	K11267	K21903	K22035	---	---	K41650	K92460	K92930	K91061	---	---	---
ASTM A 334/A 334M-99 – Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service												
Grade, Class, Type	7	9	11	---	---	---	---	---	---	---	---	---
UNS Number	K21903	K22035	--	---	---	---	---	---	---	---	---	---
ISO 9329-3:1997 – Seamless Steel Tubes for Pressure Purposes, Technical Delivery conditions Part 3: Unalloyed and Alloyed Steels with Specified Low Temperature Properties												
Type Number	PL 26	---	---	---	---	---	---	---	---	---	---	---
ISO 9330-3:1997 – Welded Steel Tubes for Pressure Purposes, Technical Conditions for Delivery – Part 3: Electric Resistance and Induction Wellded Unalloyed and Alloyed Steel Tube with Specified Low Temperature Properties												
Type Number	PL 26	---	---	---	---	---	---	---	---	---	---	---
ISO 9330-5:2000 – Welded Steel Tubes for Pressure Purposes, Technical Conditions for Delivery – Part 5: Submerged Arc-Welded Unalloyed and Alloyed Steel Tube with Specified Low Temperature Properties												
Type Number	PL 26	---	---	---	---	---	---	---	---	---	---	---

5.16 Non-Comparable Carbon Steel Tubes and Pipes for Pressure Purposes at High Temperatures

JIS G 3467:1988 – Steel Tubes for Fired Heater												
Symbol of Class	SUS 309 TF	---	---	---	---	---	---	---	---	---	---	---
ISO 2604-II:1975 – Steel Products for Pressure Purposes - Quality Requirements - Part 2 - Wrought Seamless Tubes												
Steel Type	TS 40	TS 43	TS 45	TS 67	TS 69	---	---	---	---	---	---	---

5.17 Non-Comparable Alloy Steel Tubes and Pipes for Pressure Purposes at High Temperatures

ASTM A 213/A 213M-03a – Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes												
Grade, Class, Type	T5c	T17	T21	T23	T24	T92	T122	T911	TP201	TP202	TP304N	TP309Cb
UNS Number	K41245	K12047	K31545	---	---	K92460	---	K91061	S20100	S20200	S30451	S30940
Grade, Class, Type	TP309HCb	TP310Cb	TP310HCb	TP310HCbN	TP316N	TP347LN	TP347HFG	TP348	TP348H	XM-15	XM-19	---
UNS Number	S30941	S31040	S31041	S31042	S31651	S34751	---	S34800	S34809	S38100	S20910	S21500
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S25700	S30432	S30615	S30815	S31002	S31050	S31254	S31272	S31726	S32050	S32615	S33228
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S34565	S44400	---	---	---	---	---	---	---	---	---	---
ASTM A 335/A 335M-03 – Seamless Ferritic Alloy-steel Pipe for High-Temperature Service												
Grade	P5b	P5c	P15	P21	P91	---	---	---	---	---	---	---
UNS Number	K51545	K41245	K11578	K31545	K91560	---	---	---	---	---	---	---
EN 10216-2:2002 – Seamless Steel Tubes for Pressure Purposes, Technical Delivery Conditons – Part 2: Non-Alloy and Alloy Steel Tubes with Specified elevated Temperature Properties												
Steel Name	15NiCuMoNb5-6-4	20MnNb6	20CrMoV13-5-5	X20CrMoV11-1	25CrMo4	---	---	---	---	---	---	---
Steel Number	1.6368	1.0471	1.7779	1.4922	1.7218	---	---	---	---	---	---	---
EN 10217-3:2002 – Welded Steel Tubes for Pressure Purposes, Technical Delivery Conditions – Part 3: Alloy Fine Grain Steel Tubes												
Steel Name	P275NL1	P275NL2	P355N	P355NH	P355NL1	P355NL2	P460N	P460NH	P460NL1	P460NL2	---	---
Steel Number	1.0488	1.1104	1.0562	1.0565	1.0566	1.1106	1.8905	1.8935	1.8915	1.8918	---	---

5.18 Non-Comparable Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures

ASTM A 249/A 249M-03 – Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes												
Grade, Class, Type	TP201	TP202	TP305	TP309Cb	TP309HCb	TP310Cb	TP310H	TP310HCb	TP316N	TP348	TP348H	TPXM-15
UNS Number	S20100	S20200	S30500	S30940	S30941	S31040	S31009	S31041	S31651	S34800	S34809	S38100
Grade, Class, Type	TPXM-19	TPXM-29	---	---	---	---	---	---	---	---	---	---
UNS Number	S20910	S24000	S24565	S30415	S30815	S31726	S32050	S32654	S33228	S34565	---	---
ASTM A 312/A 312M-03 – Seamless and Welded Austenitic Stainless Steel Pipes												
Grade	TP304N	TP304LN	TP309Cb	TP309H	TP309HCb	TP310Cb	TP310H	TP310HCb	TP316N	TP316LN	TP347LN	TP348
UNS Number	S30451	S30453	S30940	S30909	S30941	S31040	S31009	S31041	S31651	S31653	S31751	S34800
Grade	TP348H	TPXM-10	TPXM-11	TPXM-15	TPXM-19	TPXM-29	---	---	---	---	---	---
UNS Number	S34809	S21900	S21904	S38100	S20910	S24000	S20400	S30415	S30600	S30615	S30815	S31002
Grade	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S31050	S31254	S31272	S31635	S31726	S32615	S32654	S33228	S34565	S35045	S35315	N08367
Grade	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	N08904	---	---	---	---	---	---	---	---	---	---	---
ASTM A 358/A 358M-01 – Electric-Fusion–Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service												
Grade	304N	304LN	309Cb	310Cb	316N	316LN	348	XM-19	XM-29	---	---	---
UNS Number	S30451	S30453	S30940	S31040	S31651	S31653	S34800	S20910	S28300	S20400	S31254	S30815
Grade	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S30600	S31726	S24565	S30415	S32654	S31266	S32050	N08367	N08926	N08800	N08810	N08020
ASTM A 376/A 376M-02a – Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service												
Grade	TP316N	TP348	16-8-2H	---	---	---	---	---	---	---	---	---
UNS Number	S31651	S34800	S16800	S31726	S34565	---	---	---	---	---	---	---
ASTM A 409/A 409M-01 – Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service												
Grade	TP309Cb	TP309S	TP310Cb	TP310S	TP348	---	---	---	---	---	---	---
UNS Number	S30940	S30908	S31040	S31008	S34800	S31254	S30815	S31726	S24565	N08367	---	---
ASTM A 688/A 688M-03 – Welded Austenitic Stainless Steel Feedwater Heater Tubes												
Grade, Class, Type	TP XM-29	TP 316N	---	---	---	---	---	---	---	---	---	---
UNS Number	S24000	S31651	S32654	---	---	---	---	---	---	---	---	---
ASTM A 803/A 803M-03 – Welded Ferritic Stainless Steel Feedwater Heater Tubes												
Grade, Class, Type	TP XM-33	25-4-4	26-3-3	29-4	29-4-2	18-2	29-4C	TP439	---	---	---	---
UNS Number	S44626	S44635	S44660	S44700	S44800	S44400	S44735	S43035	---	---	---	---
BS 3605-1:1991 AMD 2:1997 – Austenitic Stainless Steel Pipes and Tubes for Pressure Purposes. Part 1. Specification for Seamless Tubes												
Steel Type	215S15	---	---	---	---	---	---	---	---	---	---	---
DIN 17458:1985 – Seamless Circular Austenitic Stainless Steel Tubes Subject to Special Requirements - Technical Delivery Conditions												
Symbol	X 6 CrNiMoNb 17 12 2		---	---	---	---	---	---	---	---	---	---
Material Number	1.4580		---	---	---	---	---	---	---	---	---	---

5.18 Non-Comparable Stainless Steel Tubes and Pipes for Pressure Purposes and High Temperatures (Continued)

DIN 17459:1992 – Seamless Circular High-Temperature Austenitic Steel Tubes - Technical Delivery Conditions												
Symbol	X 3 CrNiN 18 11		X 8 CrNiTi 18 10		X 8 CrNiMoNb 16 16		X 8 CrNiMoVNb 16 13		---	---	---	---
Material Number	1.4949		1.4941		1.4981		1.4988		---	---	---	---
JIS G 3459: 1997 – Stainless Steel Pipes												
Symbol of Grade	SUS310TP	SUS836LTP	SUS321J1TP	SUS321J3LTP	SUS321J4LTP	SUS405TP	SUS409LTP	SUS430TP	SUS430LXTP	SUS430J1LTP	SUS436LTP	SUS444TP
JIS G 3463:1994 – Stainless Steel Boiler and Heat Exchanger Tubes												
Symbol of Class	SUSXM15J1TB	SUS329J1TB	SUS405TB	SUS409LTB	SUS410TiTB	SUS430J1LTB	SUS436LTB	SUS444TB	SUSXM8TB	---	---	---
JIS G 3468:1994 – Large Diameter Welded Stainless Steel Pipes												
Symbol of Grade	SUS329J1	---	---	---	---	---	---	---	---	---	---	---
AFNOR NF A 49-214:1978 – Seamless Austenitic Steel Tubes for Use at High Temperatures. Dimensions (With Normal Tolerances) - Technical Conditions of Delivery												
Designation	Z 10 CNWT 17-13 B		---		---	---	---	---	---	---	---	---
AFNOR NF A 49-217:1987 – Seamless Tubes for Heat Exchangers - Stainless Ferritic, Austenic or Ferritic-Austenitic Steel Grades Dimensions - Technical Delivery Conditions												
Designation	TU Z 2 CN Nb 25 20		TU Z 2 CNDU 17 16		TU Z 1 NCDU 25 20 04		TU Z 1 NCDU 31 27 03		TU Z 2 CND 18 05 03		TU Z 5 CNDU 21 08 02	
AFNOR NF A 49-244:1993 – Welded Austenitic Stainless and Austenitic Ferritic Steel Rolled Tubes for Pressure Service - Dimensions, Technical Conditions for Delivery												
Designation	X3CrNiN23-4		X3CrNiMoN22-5		X3CrNiMoN25-6		X3CrNiMoN25-7		X3CrNiMoCu22-7		X3CrNiMoCuN25-6	
Designation	X3CrNiMoCuN25-7		X3CrNiMoN19-14		X4CrMnNi18-8-7		X8CrNi25-20		---		---	
ISO 2604-V:1975 – Steel Products for Pressure Purposes - Quality Requirements - Part 5: Longitudinally Welded Austenitic Stainless Steel Tubes												
Steel Type	TW 69	---	---	---	---	---	---	---	---	---	---	---

5.19 Non-Comparable Line Pipe Steels

ASTM A 1005/A 1005M-00 – Steel Line Pipe, Black, Plain End, Longitudinal and Helical Seam, Double Submerged-Arc Welded												
Grade	50	---	---	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 984/A 984M-03 – Steel Line Pipe, Black, Plain-End, Electric-Resistance-Welded												
Grade, Class, Type	70	---	---	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
CSA Z245.1-2002 – Steel Line Pipe												
Grade	620 CategoryI, II or III		690 Category I, II or III		---	---	---	---	---	---	---	---
EN 10208-1:1997– Steel Pipes for Pipelines for Combustible Fluids. Technical Delivery Conditions. Part 1 : Pipes of Requirement Class A												
Steel Name	L235GA	---	---	---	---	---	---	---	---	---	---	---
Steel Number	1.0458	---	---	---	---	---	---	---	---	---	---	---

Chapter 6

STEEL FORGINGS

ASTM Standards

ASTM A 105/A 105M-03	Carbon Steel Forgings for Piping Applications
ASTM A 181/A 181M-01	Carbon Steel Forgings, for General-Purpose Piping
ASTM A 182/A 182M-02	Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A 266/A 266M-03a	Carbon Steel Forgings for Pressure Vessel Components
ASTM A 336/A 336M-03a	Alloy Steel Forgings for Pressure and High-Temperature Parts
ASTM A 350/A 350M-02b	Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components
ASTM A 473-01	Stainless Steel Forgings
ASTM A 508/A 508M-03a	Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels
ASTM A 541/A 541M-95 (1999)	Quenched and Tempered Carbon and Alloy Steel Forgings for Pressure Vessel Components
ASTM A 668/A 668M-03	Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A 705/A705M-95 (2000)	Age-Hardening Stainless Steel Forgings
ASTM A 965/A 965M-02	Steel Forgings, Austenitic, for Pressure and High Temperature Parts

JIS Standards

JIS G 3201:1988 (1991)	Carbon steel Forgings for General Use
JIS G 3202:1988 (1991)	Carbon Steel Forgings for Pressure Vessels
JIS G 3203:1988	Alloy Steel Forgings for Pressure Vessels for High-Temperature Service
JIS G 3204:1988	Quenched and Tempered Alloy Steel Forgings for Pressure Vessels
JIS G 3205:1988	Carbon and Alloy Steel Forgings for Pressure Vessels for Low-Temperature Service
JIS G 3206:1993	High Strength Chromium-Molybdenum Alloy Steel Forgings for Pressure Vessels Under High-Temperature Service
JIS G 3214:1991	Stainless Steel Forgings for Pressure Vessels
JIS G 3221:1988	Chromium Molybdenum Steel Forgings for General Use

CEN 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	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

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

Heat Treatment Terms Applicable to this Chapter

Standard	Heat Treatment Terms
ASTM A 105/A 105M-03	---
ASTM A 181/A 181M-01	---
ASTM A 182/A 182M-02	A: annealed; NT: normalized and tempered; QT: quenched and tempered; ST+Q: solution treated and quenched
ASTM A 266/A 266M-03a	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
ASTM A 336/A 336M-03a	A: annealed; NT: normalized and tempered
ASTM A 350/A 350M-02b	N: normalized; NT: normalized and tempered; QT: quenched and tempered
ASTM A 473-01	ST: solution treated; NT: normalized and tempered
ASTM A 508/A 508M-03a	QT: quenched and tempered
ASTM A 541/A 541M-95 (1999)	QT: quenched and tempered
ASTM A 668/A 668M-03	A: annealed; N: normalized; NT: normalized and tempered; NNT: double-normalized and tempered; QT: quenched and tempered; NQT: normalized, quenched and tempered
ASTM A 705/A705M-95 (2000)	ST: solution treated; HXXXX: precipitation hardened at specified temperature
ASTM A 965/A 965M-02	ST solution treated; QT: quenched
JIS G 3201:1988	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
JIS G 3202:1988	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
JIS G 3203:1988	A: annealed; NT: normalized and tempered
JIS G 3204:1988	QT: quenched and tempered
JIS G 3205:1988	A: annealed; NT: normalized and tempered; QT: quenched and tempered
JIS G 3206:1993	NT: normalized and tempered; QT: quenched and tempered
JIS G 3214:1991	QT: quenched and tempered; S: solution treated; HXXXX: precipitation hardened at specified temperature
JIS G 3221:1988	HT: hardening and tempering
EN 10222-2:1999	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
EN 10222-3:1998	N: normalized; NT: normalized and tempered; QT: quenched and tempered
EN 10222-4:1998 A1:2001	N: normalized; QT: quenched and tempered
EN 10222-5:1999	QT: quenched and tempered; QT+T: quenched and double tempered; ST: solution treated
EN 10250-2:1999	N: normalized; NT: normalized and tempered; QT: quenched and tempered
EN 10250-3:1999	QT: quenched and tempered
EN 10250-4:1999	A: annealed; QTXXX: quenched, tempered at specified temperature; ST: solution annealed PXXX: precipitation hardened at specified temperature; SA: solution annealed
ISO 9327-2:1999	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
ISO 9327-3:1999	N: normalized; NT: normalized and tempered; NNT: double-normalized and tempered; N(+T): normalized and (if appropriate) tempered; QT: quenched and tempered
ISO 9327-4:1999	N: normalized; QT: quenched and tempered
ISO 9327-5:1999	Q: quenched

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 668/A 668M-03	A	---	---	---	≤ 500	≤ 20	---	---	325	47	---	183 HB max
JIS G 3201:1988	SF 340 A	---	---	A, N, or NT	---	---	175	---	340-440	---	27	90 HB min
EN 10250-2:1999	S235JRG2	1.0038	---	N	≤ 100	---	215	---	340	---	24	35 J at -20°C
					100 < t ≤ 250	---	175	---	340	---	23	30 J at -20°C
					250 < t ≤ 500	---	165	---	340	---	23	27 J at -20°C
	S235J2G3	1.0116	---	N	≤ 100	---	215	---	340	---	24	35 J at -20°C
					100 < t ≤ 250	---	175	---	340	---	23	30 J at -20°C
					250 < t ≤ 500	---	165	---	340	---	23	27 J at -20°C
JIS G 3201:1988	SF 390 A	---	---	A, N, or NT	---	---	195	---	390-490	---	25	105 HB min
EN 10250-2:1999	C22	1.0402	---	N or NT	≤ 100	---	210	---	410	---	25	---
ISO 9327-2:1999	PH 26	---	---	N or QT	≤ 16	---	265	---	410-530	---	26	40 J at 0°C
					16 < t ≤ 40	---	255	---			26	
					40 < t ≤ 60	---	245	---			25	
					60 < t ≤ 100	---	215	---			24	
					100 < t ≤ 150	---	200	---	390-520	---	24	
					150 < t ≤ 250	---	200	---			23	
ASTM A 668/A 668M-03	B	---	---	A, N, or NT	≤ 508	≤ 20	205	30	415	60	24	120-174 HB
JIS G 3201:1988	SF 440 A	---	---	A, N, or NT	---	---	225	---	440-540	---	24	121 HB min
EN 10250-2:1999	C25	1.0406	---	N or NT	≤ 100	---	230	---	440	---	23	35 J at 23°C
					100 < t ≤ 250	---	210	---	420	---	23	30 J at 23°C
					250 < t ≤ 500	---	190	---	400	---	23	25 J at 23°C
					500 < t ≤ 1000	---	180	---	390	---	22	20 J at 23°C
	C25E	1.1158	---	N or NT	≤ 100	---	230	---	440	---	23	35 J at 23°C
					100 < t ≤ 250	---	210	---	420	---	23	30 J at 23°C
					250 < t ≤ 500	---	190	---	400	---	23	25 J at 23°C
					500 < t ≤ 1000	---	180	---	390	---	22	20 J at 23°C
				QT	≤ 70	---	270	---	450	---	25	45 J at 23°C
					70 < t ≤ 160	---	220	---	410	---	25	38 J at 23°C
					160 < t ≤ 330	---	210	---	390	---	24	33 J at 23°C
ASTM A 668/A 668M-03	C	---	---	A, N, or NT	≤ 203	≤ 12	230	33	455	66	23	137-183 HB
					305 < t ≤ 508	12 < t ≤ 20	230	33	455	66	22	137-183 HB
ISO 9327-2:1999	PH 29	---	---	N or QT	≤ 16	---	290	---	460-580	---	24	40 J at 0°C
					16 < t ≤ 40	---	285	---			24	
					40 < t ≤ 60	---	280	---			24	
					60 < t ≤ 100	---	255	---			23	
					100 < t ≤ 150	---	230	---	440-570	---	23	
					150 < t ≤ 250	---	220	---			22	

6.1 Carbon Steel Forgings

6.1.1A Mechanical Properties of Carbon Steel Forgings for General Use (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10250-2:1999	C30	1.0528	---	N or NT	≤ 100	---	250	---	480	---	21	---
					100 < t ≤ 250	---	230	---	460	---	21	---
JIS G 3201:1988	SF 490 A	---	---	A, N, or NT	---	---	245	---	490-590	---	22	134 HB min
ISO 9327-2:1999	PH 31	---	---	N or QT	≤ 16	---	315	---	490-610	---	23	40 J at 0°C
					16 < t ≤ 40	---	310	---			23	
					40 < t ≤ 60	---	305	---			23	
					60 < t ≤ 100	---	280	---			22	
					100 < t ≤ 150	---	255	---	470-600	---	22	
					150 < t ≤ 250	---	245	---	460-590		21	
ASTM A 668/A 668M-03	D	---	---	A, N, or NT	≤ 203	≤ 8	260	37.5	515	75	24	149-207 HB
					203 < t ≤ 305	8 < t ≤ 12					22	
					305 < t ≤ 508	12 < t ≤ 20					20	
					≥ 508	≥ 20					19	
EN 10250-2:1999	C35	1.0501	---	N or NT	≤ 100	---	270	---	520	---	19	30 J at 23°C
					100 < t ≤ 250	---	245	---	500	---	19	25 J at 23°C
					250 < t ≤ 500	---	220	---	480	---	19	20 J at 23°C
					500 < t ≤ 1000	---	210	---	470	---	18	17 J at 23°C
	C35E	1.1181	---	N or NT	≤ 100	---	270	---	520	---	19	30 J at 23°C
					100 < t ≤ 250	---	245	---	500	---	19	25 J at 23°C
					250 < t ≤ 500	---	220	---	480	---	19	20 J at 23°C
					500 < t ≤ 1000	---	210	---	470	---	18	17 J at 23°C
JIS G 3201:1988	SF 540 A	---	---	A, N, or NT	---	---	275	---	540-640	---	20	152 HB min
	SF 540 B	---	---	QT	< 100	---	335	---	540-690	---	21	152 HB min
					100 ≤ t < 250	---	315	---			21	
					250 ≤ t < 400	---	295	---			20	
EN 10250-2:1999	C35E	1.1181	---	QT	≤ 70	---	320	---	550	---	20	35 J at 23°C
					70 < t ≤ 160	---	290	---	490	---	22	31 J at 23°C
					160 < t ≤ 330	---	270	---	470	---	21	25 J at 23°C
	C40	1.0511	---	N or NT	≤ 100	---	290	---	550	---	17	---
					100 < t ≤ 250	---	260	---	530	---	17	---

6.1 Carbon Steel Forgings

6.1.1A Mechanical Properties of Carbon Steel Forgings for General Use (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10250-2:1999	C45	1.0503	---	N or NT	≤ 100	---	305	---	580	---	16	---
					100 < t ≤ 250	---	275	---	560	---	16	18 J at 23°C
					250 < t ≤ 500	---	240	---	540	---	16	15 J at 23°C
					500 < t ≤ 1000	---	230	---	530	---	15	12 J at 23°C
	C45E	1.1191	---	N or NT	≤ 100	---	305	---	580	---	16	---
					100 < t ≤ 250	---	275	---	560	---	16	18 J at 23°C
					250 < t ≤ 500	---	240	---	540	---	16	15 J at 23°C
					500 < t ≤ 1000	---	230	---	530	---	15	12 J at 23°C
ASTM A 668/A 668M-03	E	---	---	NT or NNT	≤ 203	≤ 8	305	44	585	85	25	174-217 HB
					203 < t ≤ 305	8 < t ≤ 12	295	43	570	83	23	
					305 < t ≤ 508	12 < t ≤ 20	295	43	570	83	22	
JIS G 3201:1988	SF 590 A	---	---	A, N, or NT	---	---	295	---	590-690	---	18	167 HB min
	SF 590 B	---	---	QT	< 100	---	360	---	590-740	---	19	167 HB min
					100 ≤ t < 250	---	335	---			19	
					250 ≤ t < 400	---	325	---			18	
EN 10250-2:1999	C50	1.0540	---	N or NT	≤ 100	---	320	---	610	---	14	---
					100 < t ≤ 250	---	290	---	590	---	14	---
ASTM A 668/A 668M-03	F	---	---	QT or NQT	≤ 102	≤ 4	380	55	620	90	20	187-235 HB
					102 < t ≤ 178	4 < t ≤ 7	345	50	585	85	20	174-217 HB
					178 < t ≤ 254	7 < t ≤ 10	345	50	585	85	19	174-217 HB
					254 < t ≤ 508	10 < t ≤ 20	330	48	565	82	19	174-217 HB
EN 10250-2:1999	C45E	1.1191	---	QT	≤ 70	---	370	---	630	---	17	25 J at 23°C
					70 < t ≤ 160	---	340	---	590	---	18	22 J at 23°C
					160 < t ≤ 330	---	320	---	540	---	17	20 J at 23°C
JIS G 3201:1988	SF 640 B	---	---	QT	< 100	---	390	---	640-780	---	16	183 HB min
					100 ≤ t < 250	---	360	---			16	
					250 ≤ t < 400	---	345	---			15	
EN 10250-2:1999	C55	1.0535	---	N or NT	≤ 100	---	330	---	640	---	12	---
					100 < t ≤ 250	---	300	---	620	---	12	---
					250 < t ≤ 500	---	260	---	600	---	12	---
					500 < t ≤ 1000	---	250	---	590	---	11	---
	C55E	1.0535	---	N or NT	≤ 100	---	330	---	640	---	12	---
					100 < t ≤ 250	---	300	---	620	---	12	---
					250 < t ≤ 500	---	260	---	600	---	12	---
					500 < t ≤ 1000	---	250	---	590	---	11	---

6.1 Carbon Steel Forgings

6.1.1B Chemical Composition of Carbon Steel Forgings for General Use

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 668/A 668M-03	A	---	---	---	1.35	---	0.050	0.050	---	---	---	---
JIS G 3201:1988	SF 340 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
EN 10250-2:1999	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 to 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 to 0.48
JIS G 3201:1988	SF 390 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
EN 10250-2:1999	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 to 0.63
ISO 9327-2:1999	PH 26	---	---	0.20	0.50-1.40	0.35	0.035	0.030	0.30	0.30	0.08	Al 0.020; Cu 0.30; Cr+Cu+Mo+Ni to 0.70
ASTM A 668/A 668M-03	B	---	---	---	1.35	---	0.050	0.050	---	---	---	---
JIS G 3201:1988	SF 440 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
EN 10250-2:1999	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 to 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 to 0.63
ASTM A 668/A 668M-03	C	---	---	---	1.35	---	0.050	0.050	---	---	---	---
ISO 9327-2:1999	PH 29	---	---	0.20	0.90-1.50	0.40	0.035	0.030	0.30	0.30	0.08	Al 0.020; Cu 0.30; Cr+Cu+Mo+Ni to 0.70
EN 10250-2:1999	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 to 0.63
JIS G 3201:1988	SF 490 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
ISO 9327-2:1999	PH 31	---	---	0.20	0.90-1.60	0.10-0.50	0.035	0.030	0.30	0.30	0.08	Al 0.020; Cu 0.30; Cr+Cu+Mo+Ni to 0.70
ASTM A 668/A 668M-03	D	---	---	---	1.35	---	0.050	0.050	---	---	---	---
EN 10250-2:1999	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 to 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 to 0.63
JIS G 3201:1988	SF 540 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
	SF 540 B	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
EN 10250-2:1999	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 to 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 to 0.63
EN 10250-2:1999	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 to 0.63
	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 to 0.63
ASTM A 668/A 668M-03	E	---	---	---	1.35	---	0.050	0.050	---	---	---	---
JIS G 3201:1988	SF 590 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
	SF 590 B	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
EN 10250-2:1999	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 to 0.63
ASTM A 668/A 668M-03	F	---	---	---	1.35	---	0.050	0.050	---	---	---	---
EN 10250-2:1999	C45E	1.1191	---	0.42-0.50	0.50-0.80	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni to 0.63
JIS G 3201:1988	SF 640 B	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
EN 10250-2:1999	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 to 0.63
	C55E	1.0535	---	0.52-0.60	0.60-0.90	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni to 0.63

6.1 Carbon Steel Forgings

6.1.2A Mechanical Properties of Carbon Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10222-4:1998 A1:2001	P285QH	1.0478	---	QT	70 < t ≤ 100	---	245	---	370-510	---	22	63 J at 20°C 55 J at 0°C 47 J at -20°C 34 J at –40°C
					100 < t ≤ 250	---	225	---				
					250 < t ≤ 400	---	205	---				
	P285NH	1.0477	---	N	≤ 16	---	285	---	390-510	---	24	55 J at 20°C 47 J at 0°C 40 J at -20°C 28 J at -40°C
					16 < t ≤ 35	---	285	---				
					35 < t ≤ 70	---	265	---				
ISO 9327-4:1999	P 28, PH 28	---	---	N	≤ 16	---	285	---	390-510	---	26	55 J at 22°C 47 J at 0°C 40 J at -20°C
					16 < t ≤ 35	---	285	---				
	PL 28	---	---	QT	35 < t ≤ 50	---	275	---	390-510	---	26	63 J at 22°C 55 J at 0°C
					50 < t ≤ 70	---	265	---				
					70 < t ≤ 100	---	245	---	370-510	---	25	47 J at -20°C 35 J at -40°C 27 J at -50°C
					100 < t ≤ 250	---	225	---			24	
JIS G 3202:1988	SFVC 1	---	---	A, N, NT, or QT	---	---	205	---	410-560	---	21	---
EN 10222-2:1999	P245GH	1.0352	---	A, N, NT, or QT	≤ 35	---	245	---	410-530	---	25	32 J at RT
					35 < t ≤ 160	---	220	---	410-530	---	25	32 J at RT
ASTM A 181/A 181M-01	60	---	K03502	---	---	---	205	30	415	60	22	---
ASTM A 266/A 266M-03a	1	---	---	A, N, NT, or QT	---	---	205	30	415-585	60-85	23	---
ASTM A 350/A 350M-02b	LF1, Class 1	---	K03009	N, NT, or QT	---	---	205	30	415-585	60-85	25	18 J at -29°C
JIS G 3205:1988	SFL 1	---	---	A, NT, or QT	---	---	225	---	440-590	---	22	21 J at -30°C

6.1 Carbon Steel Forgings

6.1.2A Mechanical Properties of Carbon Steel Forgings for Piping, Pressure Vessel and Components (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10222-2:1999	P280GH	1.0426	---	N, NT, or QT	≤ 35	---	280	---	460-580	---	23	48 J at RT
					35 < t ≤ 160	---	255	---	460-580	---	23	48 J at RT
EN 10222-4:1998 A1:2001	P355QH1	1.0571	---	QT	70 < t ≤ 100	---	315	---	470-630	---	21	63 J at 20°C 55 J at 0°C 47 J at -20°C 34 J at -40°C
					100 < t ≤ 250	---	295	---				
					250 < t ≤ 400	---	275	---				
ASTM A 541/A 541M-95 (1999)	1	---	---	QT	≤ 75	≤ 3	250	36	480-660	70-95	20	20 J at 4°C
	1A	---	---	QT	≤ 75	≤ 3	250	36	480-660	70-95	20	20 J at 4°C
ASTM A 105/A 105M-03	---	---	K03504	---	---	---	250	36	485	70	22	187 HB max
ASTM A 266/A 266M-03a	2	---	K03506	A, N, NT, or QT	---	---	250	36	485-655	70-95	20	---
	4	---	K03017	A, N, NT, or QT	---	---	250	36	485-655	70-95	20	---
ASTM A 181/A 181M-01	70	---	K03502	---	---	---	250	36	485	70	18	---
ASTM A 350/A 350M-02b	LF2, Class 1	---	K03011	N, NT, or QT	---	---	250	36	485-655	70-95	22	20 J at -46°C
	LF2, Class 2											27 J at -18°C
ASTM A 508/A 508M-03a	1	---	K13502	QT	≤ 75	≤ 3	250	36	485-655	70-95	20	20 J at 4.4°C
	1a	---	K13502	QT	≤ 75	≤ 3	250	36	485-655	70-95	20	20 J at 4.4°C
JIS G 3202:1988	SFVC 2 A	---	---	A, N, NT, or QT	---	---	245	---	490-640	---	18	---
	SFVC 2 B	---	---	A, N, NT, or QT	---	---	245	---	490-640	---	18	27 J at 0°C
JIS G 3205:1988	SFL 2	---	---	A, NT, or QT	---	---	245	---	490-640	---	19	27 J at -45°C
EN 10222-2:1999	P305GH	1.0436	---	N or NT	≤ 35	---	305	---	490-610	---	22	---
					35 < t ≤ 160	---	280	---	490-610	---	22	48 J at RT
				QT	≤ 70	---	285	---	510-630	---	22	48 J at RT
EN 10222-4:1998 A1:2001	P355NH	1.0565	---	N	≤ 16	---	355	---	490-630	---	23	55 J at 20°C 47 J at 0°C 40 J at -20°C 28 J at -40°C
					16 < t ≤ 35	---	355	---				
					35 < t ≤ 70	---	335	---				
ISO 9327-4:1999	P 35, PH 35	---	---	N	≤ 16	---	355	---	490-610	---	22	55 J at 22°C 47 J at 0°C 40 J at -20°C
					16 < t ≤ 35	---	355	---	490-610	---	22	
				QT	35 < t ≤ 50	---	345	---	490-610	---	22	
	PL 35, PLH 35	---	---	QT	50 < t ≤ 70	---	325	---	490-610	---	22	63 J at 22°C 55 J at 0°C 47 J at -20°C 35 J at -40°C 27 J at -50°C
					70 < t ≤ 100	---	315	---	470-610	---	21	
					100 < t ≤ 250	---	295	---	470-610	---	20	

6.1 Carbon Steel Forgings

6.1.2A Mechanical Properties of Carbon Steel Forgings for Piping, Pressure Vessel and Components (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10222-4:1998 A1:2001	P420QH	1.8936	---	QT	70 < t ≤ 100	---	365	---	510-670	---	18	63 J at 20°C 55 J at 0°C 47 J at -20°C 34 J at –40°C
					100 < t ≤ 250	---	345	---				
					250 < t ≤ 400	---	325	---				
	P420NH	1.8932	---	N	≤ 16	---	420	---	530-580	---	20	55 J at 2°C 47 J at 0°C 40 J at -20°C 28 J at -40°C
					16 < t ≤ 35	---	410	---				
					35 < t ≤ 70	---	385	---				
ISO 9327-4:1999	P 42, PH 42	---	---	N	≤ 16	---	420	---	540-680	---	21	55 J at 22°C 47 J at 0°C 40 J at -20°C
					16 < t ≤ 35	---	410	---				
	PL 42, PLH 42	---	---	QT	35 < t ≤ 50	---	400	---	540-680	---	21	63 J at 22°C 55 J at 0°C 47 J at -20°C 35 J at -40°C 27 J at -50°C
					50 < t ≤ 70	---	380	---				
					70 < t ≤ 100	---	365	---	510-670	---	20	
					100 < t ≤ 250	---	345	---	510-670	---	19	

6.1 Carbon Steel Forgings

6.1.2B Chemical Composition of Carbon Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10222-4:1998 A1:2001	P285QH	1.0478	---	0.18	0.60	0.40	0.025	0.015	0.30	0.30	0.08	Al 0.020-0.060; N 0.020; Cu 0.20; Nb 0.03; V 0.05; Nb+V 0.05
	P285NH	1.0477	---									
ISO 9327-4:1999	P 28, PH 28	---	---	0.18	0.50-1.40	0.10-0.40	0.035	0.030	0.30	0.30	0.08	Al 0.020 min; Cu 0.30; N 0.020; Nb0.05; Ti 0.03; V 0.05; Cr+Cu+Mo to 0.45; Nb+Ti+V to 0.05
	PL 28	---	---	0.16			0.025	0.020				
JIS G 3202:1988	SFVC 1	---	---	0.30	0.40-1.35	0.35	0.030	0.030	---	---	---	---
EN 10222-2:1999	P245GH	1.0352	---	0.08-0.20	0.50-1.30	0.40	0.025	0.015	---	---	---	---
ASTM A 181/A 181M-01	60	---	K03502	0.35	1.10	0.10-0.35	0.05	0.05	---	---	---	---
ASTM A 266/A 266M-03a	1	---	---	0.30	0.40-1.05	0.15-0.35	0.025	0.025	---	---	---	---
ASTM A 350/A 350M-02b	LF1	---	K03009	0.30	0.60-1.35	0.15-0.30	0.035	0.040	0.30	0.40	0.12	Cu 0.40; Nb 0.02; V 0.08; Cu+Ni+Cr+Mo+V 1.00; Cr+Mo 0.32
JIS G 3205:1988	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	---	---	---	---
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	Al 0.020-0.060; N 0.020; Cu 0.20; Nb 0.05; V 0.10; Nb+V 0.12
ASTM A 541/A 541M-95 (1999)	1	---	---	0.35	0.40-0.90	0.15-0.35	0.025	0.025	0.25	0.40	0.10	V 0.05
	1A	---	---	0.30	0.70-1.35	0.15-0.40	0.025	0.025	0.25	0.40	0.10	V 0.05
ASTM A 105/A 105M-03	---	---	K03504	0.35	0.60-1.05	0.10-0.35	0.035	0.040	0.30	0.40	0.12	Cu 0.40; V 0.08; Cu+Ni+Cr+Mo+V 1.00; Cr+Mo 0.32
ASTM A 266/A 266M-03a	2	---	K03506	0.35	0.40-1.05	0.15-0.35	0.025	0.025	---	---	---	---
	4	---	K03017	0.30	0.80-1.35	0.15-0.40	0.025	0.025	---	---	---	---
ASTM A 181/A 181M-01	70	---	K03502	0.35	1.10	0.10-0.35	0.05	0.05	---	---	---	---
ASTM A 350/A 350M-02b	LF2		K03011	0.30	0.60-1.35	0.15-0.30	0.035	0.040	0.30	0.40	0.12	Cu 0.40; Nb 0.02; V 0.08; Cu+Ni+Cr+Mo+V 1.00; Cr+Mo 0.32
ASTM A 508/A 508M-03a	1	---	K13502	0.35	0.40-1.05	0.15-0.40	0.025	0.025	0.25	0.40	0.10	V 0.05
	1A	---	K13502	0.30	0.70-1.35	0.15-0.40	0.025	0.025	0.25	0.40	0.10	V 0.05
JIS G 3202:1988	SFVC 2 A	---	---	0.35	0.40-1.10	0.35	0.030	0.030	---	---	---	---
	SFVC 2 B	---	---	0.30	0.70-1.35	0.35	0.030	0.030	---	---	---	---
JIS G 3205:1988	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	---	---	---	---
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	Al 0.020-0.060; N 0.020; Cu 0.20; Nb 0.05; V 0.10; Nb+V 0.12
ISO 9327-4:1999	P 35, PH 35	---	---	0.20	0.90-1.70	0.10-0.50	0.035	0.030	0.30	0.30	0.08	Al 0.020 min; Cu 0.30; N 0.020; Nb 0.05; Ti 0.03; V 0.10; Cr+Cu+Mo 0.45; Nb+Ti+V 0.12
	PL 35, PLH 35	---	---	0.18			0.025	0.020				

6.1 Carbon Steel Forgings

6.1.2B Chemical Composition of Carbon Steel Forgings for Piping, Pressure Vessel and Components (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10222-4:1998 A1:2001	P420QH	1.8936	---	0.20	1.00-1.70	0.10-0.60	0.025	0.015	0.30	1.00	0.10	Al 0.020-0.060; N 0.020; Cu 0.20; Nb 0.05; V 0.20; Nb+V 0.22
	P420NH	1.8932	---									
ISO 9327-4:1999	P 42, PH 42	---	---	0.20	1.00-1.70	0.10-0.60	0.035	0.030	0.30	1.00	0.10	AL 0.020 min; Cu 0.30; N 0.020; Nb 0.05; Ti 0.20; V 0.20; Nb+Ti+V 0.22
	PL 42, PLH 42	---	---				0.025	0.020				

6.2 Alloy Steel Forgings

6.2.1A Chemical Composition of 1¼Cr-¼Mo Alloy Steel Forgings for General Use

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3221:1988	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	---
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	---	0.15-30	---
JIS G 3221:1988	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	---
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	---	0.15-30	---
JIS G 3221:1988	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	---
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	---	0.15-30	---
	50CrMo4	1.7228	---	0.46-0.54	0.50-0.80	0.40	0.035	0.035	0.90-1.20	---	0.15-30	---

6.2 Alloy Steel Forgings

6.2.1B Mechanical Properties of 1¼Cr-¼Mo Alloy Steel Forgings for General Use

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3221:1988	SFCM 690 S	---	---	HT	< 200	---	460	---	690-830	---	17	see standard for impact data, 201 HB min
				HT	200 ≤ t < 400	---	450	---			16	
				HT	400 ≤ t < 700	---	450	---			15	
EN 10250-3:1999	25CrMo4	1.7218	---	QT	≤ 70	---	450	---	700	---	15	50 J at RT
					70 < t ≤ 160	---	400	---	650	---	17 L; 13 T	L: 45 J at RT T: 27 J at RT
					160 < t ≤ 330	---	380	---	600	---	18 L; 14 T	L: 38 J at RT T: 22 J at RT
JIS G 3221:1988	SFCM 740 S	---	---	HT	< 200	---	510	---	740-880	---	16	see standard for impact data, 217 HB min
				HT	200 ≤ t < 400	---	500	---			15	
				HT	400 ≤ t < 700	---	490	---			14	
EN 10250-3:1999	42CrMo4	1.7225	---	QT	≤ 160	---	500	---	750	---	14 L; 10 T	L: 30 J at RT T: 16 J at RT
					160 < t ≤ 330	---	460	---	700	---	15 L; 11 T	L: 27 J at RT T: 14 J at RT
					330 < t ≤ 500	---	390	---	600	---	16 L; 12 T	L: 22 J at RT T: 12 J at RT
JIS G 3221:1988	SFCM 780 S	---	---	HT	< 200	---	560	---	780-930	---	15	see standard for impact data, 229 HB min
				HT	200 ≤ t < 400	---	550	---			14	
				HT	400 ≤ t < 700	---	540	---			13	
EN 10250-3:1999	34CrMo4	1.7220	---	QT	≤ 70	---	550	---	800	---	14	45 J at RT
					70 < t ≤ 160	---	450	---	700	---	15 L; 10 T	L: 40 J at RT T: 22 J at RT
					160 < t ≤ 330	---	410	---	650	---	16 L; 12 T	L: 33 J at RT T: 17 J at RT
	50CrMo4	1.7228	---	QT	≤ 160	---	550	---	800	---	13 L; 9 T	L: 25 J at RT T: 14 J at RT
					160 < t ≤ 330	---	540	---	750	---	14 L; 10 T	L: 20 J at RT T: 12 J at RT
					330 < t ≤ 500	---	490	---	700	---	15 L; 11 T	L: 15 J at RT T: 10 J at RT

6.2 Alloy Steel Forgings

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	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	---	---	0.25-0.35	---
ISO 9327-2:1999	16Mo3	---	---	0.12-0.20	0.40-0.90	0.35	0.035	0.030	0.30	---	0.25-0.35	Cu 0.30
JIS G 3203:1988	SFVA F 1	---	---	0.30	0.60-0.90	0.35	0.030	0.030	---	---	0.45-0.65	---
ASTM A 182/A 182M-02	F 1	---	K12822	0.28	0.60-0.90	0.15-0.35	0.045	0.045	---	---	0.44-0.65	---
ASTM A 336/A 336M-03a	F1	---	K12520	0.20-0.30	0.60-0.80	0.20-0.35	0.025	0.025	---	---	0.40-0.60	---

6.2.2.1B Mechanical Properties of Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10222-2:1999	16Mo3	1.5415	---	N, QT	≤ 35	---	295	---	440-570	---	23 L; 21 T	L: 50 J at 0°C T: 34 J at 0°C
					35 < t ≤ 70	---	285	---				
					70 < t ≤ 100	---	275	---				
				QT	≤ 250	---	265	---	440-570	---	23 L; 21 T	L: 50 J at 0°C T: 34 J at 0°C
					250 < t ≤ 500	---	250	---	420-550	---		
ISO 9327-2:1999	16Mo3	---	---	N or NT or QT	≤ 40	---	270	---	450-600	---	26 L; 24 T	L: 40 J at 20°C T: 27 J at 20°C
					40 < t ≤ 60	---	260	---			25 L; 23 T	
					60 < t ≤ 100	---	240	---	430-580	---	24 L; 22 T	
					100 < t ≤ 250	---	220	---	420-570	---	21 L; 19 T	
JIS G 3203:1988	SFVA F 1	---	---	A or NT	---	---	275	---	480-660	---	18	---
ASTM A 182/A 182M-02	F 1	---	K12822	A, NT	---	---	275	40	485	70	20.0	143-192 HB
ASTM A 336/A 336M-03a	F1	---	K12520	A, NT	---	---	275	40	485-660	70-95	20	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3203:1988	SFVA F 2	---	---	0.20	0.30-0.80	0.60	0.030	0.030	0.50-0.80	---	0.45-0.65	---
ASTM A 182/A 182M-02	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	---

6.2.2.2B Mechanical Properties of ½Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3203:1988	SFVA F 2	---	---	A or NT	---	---	275	---	480-660	---	18	---
ASTM A 182/A 182M-02	F 2	---	K12122	A, NT	---	---	275	40	485	70	20.0	143-192 HB

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
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	---	0.40-0.60	---
ISO 9327-2:1999	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	SFVA F 12	---	---	0.20	0.30-0.80	0.60	0.030	0.030	0.80-1.25	---	0.45-0.65	---
ASTM A 182/A 182M-02	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 A 336/A 336M-03a	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	---

6.2.2.3B Mechanical Properties 1Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10222-2:1999	13CrMo4-5	1.7335	---	NT	≤ 35	---	295	---	440-590	---	20 L; 18 T	L: 44 J at 0°C T: 27 J at 0°C
					35 < t ≤ 70	---	285	---				
				NT or QT	70 < t ≤ 100	---	275	---	440-590	---	20 L; 18 T	L: 44 J at 0°C T: 27 J at 0°C
					100 < t ≤ 250	---	265	---	440-590	---		
					250 < t ≤ 500	---	240	---	420-570	---		
ISO 9327-2:1999	14CrMo4-5	---	---	NT or QT	≤ 40	---	300	---	450-600	---	22 L; 20 T	L: 40 J at 20°C T: 27 J at 20°C
					40 < t ≤ 60	---	300	---			21 L; 19 T	
					60 < t ≤ 100	---	275	---	440-590	---	20 L; 18 T	
					100 < t ≤ 250	---	255	---	430-580	---	20 L; 18 T	
JIS G 3203:1988	SFVA F 12	---	---	A or NT	---	---	275	---	480-660	---	18	---
ASTM A 182/A 182M-02	F 12, Class 2	---	K11564	A, NT	---	---	275	40	485	70	20.0	143-207 HB
ASTM A 336/A 336M-03a	F12	---	K11564	A, NT	---	---	275	40	485-660	70-95	20	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3203:1988	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	---
ASTM A 182/A 182M-02	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	---
	F 11, Class 3											
ASTM A 336/A 336M-03a	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	---
	F11, Class 3											
JIS G 3203:1988	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 1¼Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3203:1988	SFVA F 11 A	---	---	A or NT	---	---	275	---	480-660	---	18	---
ASTM A 182/A 182M-02	F 11, Class 2	---	K11572	A, NT	---	---	275	40	485	70	20.0	143-207 HB
	F 11, Class 3						310	45	515	75	30	156-207 HB
ASTM A 336/A 336M-03a	F11, Class 2	---	K11572	A, NT	---	---	275	40	485-660	70-95	20	---
	F11, Class 3	---					310	45	515-690	75-100	18	---
JIS G 3203:1988	SFVA F 11 B	---	---	A or NT	---	---	315	---	520-690	---	18	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3203:1988	SFVA F 22 A	---	---	0.15	0.30-0.60	0.50	0.030	0.030	2.00-2.50	---	0.90-1.10	---
ASTM A 182/A 182M-02	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	---
ASTM A 336/A 336M-03a	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	---
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	---	0.90-1.10	---
ISO 9327-2:1999	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
ASTM A 182/A 182M-02	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 A 336/A 336M-03a	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	---
JIS G 3203:1988	SFVA F 22 B	---	---	0.15	0.30-0.60	0.50	0.030	0.030	2.00-2.50	---	0.90-1.10	---
JIS G 3206:1993	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
ASTM A 508/A 508M-03a	22, Class 3	---	K21590	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 A 541/A 541M-95 (1999)	22, Class 3	---	K21390	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	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
ASTM A 336/A 336M-03a	F22V	---	---	0.11-0.15	0.30-0.60	0.10	0.015	0.010	2.00-2.50	0.25	0.90-1.10	Cu 0.20; V 0.25-0.35; Cb 0.07; Ti 0.030; B 0.0020; Ca 0.015
ASTM A 541/A 541M-95 (1999)	22V	---	---	0.11-0.15	0.30-0.60	0.10	0.015	0.010	2.00-2.50	0.25	0.90-1.10	Cu 0.20; V 0.25-0.35; Cb 0.07; Ti 0.030; B 0.0020; Ca 0.015
ASTM A 182/A 182M-02	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	Cu 0.20; V 0.25-0.35; Cb 0.07; Ti 0.030; B 0.002; Ca 0.015

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
JIS G 3203:1988	SFVA F 22 A	---	---	A or NT	---	---	205	---	410-590	---	18	---
ASTM A 182/A 182M-02	F 22, Class 1	---	K21590	A, NT	---	---	205	30	415	60	20.0	170 HB max
ASTM A 336/A 336M-03a	F22, Class 1	---	K21590	A, NT	---	---	205	30	415-585	60-85	20	---
EN 10222-2:1999	11CrMo9-10	1.7383	---	NT or QT	200 < t ≤ 500	---	265	---	450-600	---	23 L; 21 T	L: 50 J at RT 40 J at 0°C T: 34 J at RT 27 J at 0°C
ISO 9327-2:1999	13CrMo9-10	---	---	NT or QT	≤ 60	---	265	---	480-620	---	20 L; 18 T	L: 40 J at 20°C T: 27 J at 20°C
					60 < t ≤ 100	---	260	---	470-620	---	20 L; 18 T	
					100 < t ≤ 150	---	250	---	460-610	---	20 L; 18 T	
					150 < t ≤ 300	---	240	---	450-600	---	20 L; 18 T	
ASTM A 182/A 182M-02	F 22, Class 3	---	---	A, NT	---	---	310	45	515	75	20.0	156-207 HB
ASTM A 336/A 336M-03a	F22, Class 3	---	---	A, NT	---	---	310	45	515-690	75-100	19	---
JIS G 3203:1988	SFVA F 22 B	---	---	A or NT	---	---	315	---	520-690	---	18	---
EN 10222-2:1999	11CrMo9-10	1.7383	---	NT	≤ 200	---	310	---	520-670	---	20 L; 20 T	L: 60 J at RT 47 J at 0°C T: 50 J at RT 27 J at 0°C
JIS G 3206:1993	SFVCM F22B	---	---	QT	---	---	380	---	580-760	---	16	54 J at -18°C
ASTM A 508/A 508M-03a	22, Class 3	---	K21590	QT	---	---	380	55	585-760	85-110	18	---
ASTM A 541/A 541M-95 (1999)	22, Class 3	---	K21390	QT	---	---	380	55	585-760	85-110	18	47 J at 4°C
JIS G 3206:1993	SFVCM F22V	---	---	NT	---	---	415	---	580-760	---	16	54 J at -18°C
ASTM A 336/A 336M-03a	F22V	---	---	A, NT	---	---	415	60	585-760	85-110	18	---
ASTM A 541/A 541M-95 (1999)	22V	---	---	QT	---	---	415	60	585-760	85-110	18	55 J at -18°C
ASTM A 182/A 182M-02	F 22V	---	K31835	NT, QT	---	---	415	60	585-780	85-110	18.0	HB 174-237

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3203:1988	SFVA F 21 A	---	---	0.15	0.30-0.60	0.50	0.030	0.030	2.65-3.35	---	0.80-1.00	---
ASTM A 336/A 336M-03a	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 A 182/A 182M-02	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 A 336/A 336M-03a	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	SFVA F 21 B	---	---	0.15	0.30-0.60	0.50	0.030	0.030	2.65-3.35	---	0.80-1.00	---
JIS G 3206:1993	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
ASTM A 182/A 182M-02	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 A 336/A 336M-03a	F3V	---	---	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 A 508/A 508M-03a	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 A 541/A 541M-95 (1999)	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

6.2.2.6B Mechanical Properties of 3Cr-1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3203:1988	SFVA F 21 A	---	---	A or NT	---	---	205	---	410-590	---	18	---
ASTM A 336/A 336M-03a	F21, Class 1	---	K31545	A, NT	---	---	205	30	415-585	60-85	20	---
ASTM A 182/A 182M-02	F 21	---	K31545	A, NT	---	---	310	45	515	75	20.0	156-207 HB
ASTM A 336/A 336M-03a	F21, Class 3	---	K31545	A, NT	---	---	310	45	515-690	75-100	19	---
JIS G 3203:1988	SFVA F 21 B	---	---	A or NT	---	---	315	---	520-690	---	18	---
JIS G 3206:1993	SFVCM F3V	---	---	NT	---	---	415	---	580-760	---	16	54 J at -18°C
ASTM A 182/A 182M-02	F 3V	---	K31830	A, NT	---	---	415	60	585-760	85-110	18	174-237 HB
ASTM A 336/A 336M-03a	F3V	---	---	A, NT	---	---	415	60	585-760	85-110	18	---
ASTM A 508/A 508M-03a	3V	---	K31830	QT	---	---	415	60	585-760	85-110	18	---
ASTM A 541/A 541M-95 (1999)	3V	---	K31830	QT	---	---	415	60	585-760	85-110	18	55 J at -18°C

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.7A Chemical Composition of 5Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10222-2:1999	X16CrMo5-1	1.7366	---	0.18	0.30-0.80	0.40	0.025	0.015	4.00-6.00	---	0.45-0.65	---
JIS G 3203:1988	SFVA F 5 A	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
ASTM A 336/A 336M-03a	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	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	SFVA F 5 B	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
ASTM A 182/A 182M-02	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 A 336/A 336M-03a	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	SFVA F 5 C	---	---	0.25	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
ASTM A 182/A 182M-02	F 5a	---	K42544	0.25	0.60	0.50	0.040	0.030	4.0-6.0	0.50	0.44-0.65	---
JIS G 3203:1988	SFVA F 5 D	---	---	0.25	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
EN 10222-2:1999	X16CrMo5-1	1.7366	---	0.18	0.30-0.80	0.40	0.025	0.015	4.00-6.00	---	0.45-0.65	---

6.2.2.7B Mechanical Properties of 5Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10222-2:1999	X16CrMo5-1	1.7366	---	A	≤ 300	---	205	---	410-510	---	18 L; 16 T	L: 40 J at RT T: 27 J at RT
JIS G 3203:1988	SFVA F 5 A	---	---	A or NT	---	---	245	---	410-590	---	18	---
ASTM A 336/A 336M-03a	F5	---	K41545	A, NT	---	---	250	30	415-585	60-85	20	---
ISO 9327-2:1999	X12CrMo5-1	---	---	A	≤ 150	---	175	---	430-580	---	20 L; 18 T	---
JIS G 3203:1988	SFVA F 5 B	---	---	A or NT	---	---	275	---	480-660	---	18	---
ASTM A 182/A 182M-02	F 5	---	K41545	A, NT	---	---	275	40	485	70	20.0	143-217 HB
ASTM A 336/A 336M-03a	F5A	---	K42544	A, NT	---	---	345	50	550-725	80-105	19	---
JIS G 3203:1988	SFVA F 5 C	---	---	A or NT	---	---	345	---	550-730	---	18	---
ASTM A 182/A 182M-02	F 5a	---	K42544	A, NT	---	---	450	65	620	90	22.0	187-248 HB
JIS G 3203:1988	SFVA F 5 D	---	---	A or NT	---	---	450	---	620-780	---	18	---
EN 10222-2:1999	X16CrMo5-1	1.7366	---	NT	≤ 300	---	420	---	640-780	---	16 L; 14 T	L: 40 J at RT T: 27 J at RT

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.8A Chemical Composition of 9Cr-1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 182/A 182M-02	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 A 336/A 336M-03a	F9	---	---	0.15	0.30-0.60	0.50-1.00	0.025	0.025	8.0-10.0	---	0.90-1.10	---
JIS G 3203:1988	SFVA F 9	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	8.00-10.00	---	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	Nb 0.06-0.10; V 0.18-0.25; N 0.030-0.070; Al 0.040

6.2.2.8B Mechanical Properties of 9Cr-1Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 182/A 182M-02	F 9	---	K90941	A, NT	---	---	380	55	585	85	20.0	179-217 HB
ASTM A 336/A 336M-03a	F9	---	---	A, NT	---	---	380	55	585-760	85-110	20	---
JIS G 3203:1988	SFVA F 9	---	---	A or NT	---	---	380	---	590-760	---	18	---
EN 10222-2:1999	X10CrMoVNb9-1	1.4903	---	NT	≤ 130	---	450	---	630-730	---	19 L; 17 T	L: 40 J at RT T: 27 J at RT

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	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
ISO 9327-2:1999	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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10222-2:1999	X20CrMoV11-1	1.4922	---	QT	≤ 100	---	500	---	700-850	---	16 L; 14 T	L: 39 J at RT T: 27 J at RT
					100 < t ≤ 250	---	500	---	700-850	---	16 L; 14 T	L: 31 J at RT T: 27 J at RT
					250 < t ≤ 350	---	500	---	700-850	---	16 L; 14 T	L: 27 J at RT T: 27 J at RT
ISO 9327-2:1999	X20CrMoV12-1	---	---	NT or QT	≤ 100	---	500	---	700-850	---	16 L; 14 T	L: 39 J at 20°C T: 27 J at 20°C
					100 < t ≤ 200	---	500	---	700-850	---	16 L; 14 T	L: 31 J at 20°C T: 27 J at 20°C
					200 < t ≤ 300	---	500	---	700-850	---	14 L; 14 T	L: 27 J at 20°C T: 24 J at 20°C

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.10A Chemical Composition of Ni Alloy Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	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	---	1.30-1.70	---	V 0.05
ISO 9327-3:1999	15NiMn6	---	---	0.18	0.80-1.50	0.35	0.025	0.020	---	1.30-1.70	---	V 0.05
ISO 9327-3:1999	12Ni14G1	---	---	0.15	0.30-0.80	0.35	0.025	0.020	---	3.25-3.75	---	V 0.05
	12Ni14G2	---	---									
EN 10222-3:1998	12Ni14	1.5637	---	0.15	0.30-0.80	0.35	0.020	0.010	---	3.25-3.75	---	V 0.05
ASTM A 350/A 350M-02b	LF3	---	K32025	0.20	0.90	0.20-0.35	0.035	0.040	0.30	3.3-3.7	0.12	Cu 0.40; Cb 0.02; V 0.03; Cr+Mo 0.32
JIS G 3205:1988	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	---	4.75-5.25	---	V 0.05
ISO 9327-3:1999	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	---	8.50-10.00	0.10	V 0.05
ISO 9327-3:1999	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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10222-3:1998	15NiMn6	1.6228	---	N, NT, QT	≤ 35	---	355	---	470-640	---	20	see standard for impact data
					35 < t ≤ 50	---	345	---				
ISO 9327-3:1999	15NiMn6	---	---	N, NT, QT	≤ 30	---	355	---	490-640	---	22	see standard for impact data
					30 < t ≤ 50	---	345	---				
ISO 9327-3:1999	12Ni14G1	---	---	N	≤ 30	---	285	---	450-600	---	23	see standard for impact data
				NT, QT	30 < t ≤ 50	---	275	---				
	12Ni14G2	---	---	N	≤ 30	---	355	---	470-620	---	22	see standard for impact data
				NT, QT	30 < t ≤ 50	---	345	---				
EN 10222-3:1998	12Ni14	1.5637	---	N	≤ 35	---	355	---	470-640	---	20	see standard for impact data
				NT	35 < t ≤ 50	---	345	---				
				QT	50 < t ≤ 70	---	335	---				
ASTM A 350/A 350M-02b	LF3, Class 1	---	K32025	N, NT or QT	---	---	260	37.5	485-655	70-95	22	20 J at -101°C
	LF3, Class 2											27 J at -101°C
JIS G 3205:1988	SFL 3	---	---	A, NT or QT	---	---	255	---	490-640	---	19	27 J at -101°C
EN 10222-3:1998	X12Ni5	1.5680	---	N, NT	≤ 35	---	390	---	510-710	---	19	see standard for impact data
				QT	35 < t ≤ 50	---	380	---				
ISO 9327-3:1999	12Ni19	---	---	N	≤ 30	---	390	---	510-710	---	19	see standard for impact data
				NT, QT	30 < t ≤ 50	---	380	---				
EN 10222-3:1998	X8Ni9	1.5662	---	N, NT	≤ 35	---	490	---	640-840	---	18	see standard for impact data
					35 < t ≤ 50	---	480	---				
				QT	50 < t ≤ 70	---	470	---				
ISO 9327-3:1999	X8Ni9	---	---	NNT	≤ 30	---	490	---	640-840	---	18	see standard for impact data
				QT	30 < t ≤ 50	---	480	---				

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 9327-3:1999	11MnNi5-3	---	---	0.14	0.70-1.50	0.50	0.025	0.020	---	0.30-0.80	---	Nb 0.05; V 0.05
EN 10222-3:1998	13MnNi6-3	1.6217	---	0.16	0.85-1.70	0.50	0.025	0.0015	---	0.30-0.85	---	Nb 0.05; V 0.05
ISO 9327-3:1999	13MnNi6-3	---	---	0.16	0.85-1.65	0.50	0.025	0.020	---	0.30-0.85	---	Nb 0.05; V 0.05

6.2.2.11B Mechanical Properties of Ni-Mn Alloy Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ISO 9327-3:1999	11MnNi5-3	---	---	N (+T)	≤ 30	---	285	---	420-530	---	24	see standard for impact data
					30 < t ≤ 50	---	275	---				
EN 10222-3:1998	13MnNi6-3	1.6217	---	NT	≤ 35	---	285	---	420-610	---	22	see standard for impact data
					35 < t ≤ 50	---	275	---				
					50 < t ≤ 70	---	265	---				
ISO 9327-3:1999	13MnNi6-3	---	---	N (+T)	≤ 30	---	355	---	490-610	---	22	see standard for impact data
					30 < t ≤ 50	---	345	---				

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.12A Chemical Composition of ¾Ni-½Cr-Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 541/A 541M-95 (1999)	2, Class 1 and 2	---	K12765	0.27	0.50-0.90	0.15-0.35	0.025	0.025	0.25-0.45	0.50-1.00	0.55-0.70	V 0.05
ASTM A 508/A 508M-03a	2, Class 1 and 2	---	K12766	0.27	0.50-1.00	0.15-0.40	0.025	0.025	0.25-0.45	0.50-1.00	0.55-0.70	V 0.05
JIS G 3204:1988	SFVQ 2A, 2B	---	---	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 ¾Ni-½Cr-Mo Alloy Steels Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 541/A 541M-95 (1999)	2, Class 1	---	K12765	QT	---	---	340	50	550-720	80-105	18	41 J at 4°C
ASTM A 508/A 508M-03a	2, Class 1	---	K12766	QT	---	---	345	50	550-725	80-105	18	---
JIS G 3204:1988 (1991)	SFVQ 2A	---	---	QT	---	---	345	---	550-730	---	16	40 J at 0°C
ASTM A 541/A 541M-95 (1999)	2, Class 2	---	K12765	QT	---	---	450	65	620-790	90-115	16	47 J at 21°C
JIS G 3204:1988	SFVQ 2B	---	---	QT	---	---	450	---	620-790	---	14	47 J at 20°C
ASTM A 508/A 508M-03a	2, Class 2	---	K12766	QT	---	---	450	65	620-795	90-115	16	---

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.13A Chemical Composition of ¾Ni-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 541/A 541M-95 (1999)	3, Class 1 and 2	---	K12045	0.25	1.20-1.50	0.15-0.35	0.025	0.025	0.25	0.40-1.00	0.45-0.60	V 0.05
ASTM A 508/A 508M-03a	3, Class 1 and 2	---	K12042	0.25	1.20-1.50	0.15-0.40	0.025	0.025	0.25	0.40-1.00	0.45-0.60	V 0.05
JIS G 3204:1988	SFVQ 1 A, 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 ¾Ni-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 541/A 541M-95 (1999)	3, Class 1	---	K12045	QT	---	---	340	50	550-720	80-105	18	41 J at 4°C
ASTM A 508/A 508M-03a	3, Class 1	---	K12042	QT	---	---	345	50	550-725	80-105	18	---
JIS G 3204:1988	SFVQ 1 A	---	---	QT	---	---	345	---	550-730	---	16	40 J at 0°C
ASTM A 541/A 541M-95 (1999)	3, Class 2	---	K12045	QT	---	---	450	65	620-790	90-115	16	47 J at 21°C
JIS G 3204:1988	SFVQ 1 B	---	---	QT	---	---	450	---	620-790	---	14	47 J at 20°C
ASTM A 508/A 508M-03a	3, Class 2	---	K12042	QT	---	---	450	65	620-795	90-115	16	---

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.14A Chemical Composition of 3¼Ni-1¾Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 541/A 541M-95 (1999)	4N, Class 3	---	---	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	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
ASTM A 508/A 508M-03a	4N, Class 3	---	---	0.23	0.20-0.40	---	0.020	0.020	1.50-2.00	2.8-3.9	0.40-0.60	V 0.03

6.2.2.14B Mechanical Properties of 3¼Ni-1¾Cr-½Mo Alloy Steel Forgings for Piping, Pressure Vessel and Components

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 541/A 541M-95 (1999)	4N, Class 3	---	---	QT	---	---	480	70	620-790	90-115	20	47 J at 4°C
JIS G 3204:1988	SFVQ 3	---	---	QT	---	---	490	---	620-790	---	18	47 J at -30°C
ASTM A 508/A 508M-03a	4N, Class 3	---	---	QT	---	---	485	70	620-795	90-115	20	---

6.3 Stainless Steel Forgings

6.3.1A Chemical Composition of Martensitic Stainless Steel Forgings

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3214:1991	SUS F 410-A, B, C, D	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.50	---	---
ASTM A 182/A 182M-02	F 6a	---	S41000	0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.50	---	---
ASTM A 473-01	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	---	---
ASTM A 1021-02	Grade A	---	S41000	0.15	1.00	1.00	0.018	0.015	11.5-13.5	0.75	---	---
	Grade B	---	---	0.10-0.15	0.25-0.80	0.50	0.018	0.015	11.5-13.5	0.50	---	---
ASTM A 182/A 182M-02	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	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
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
EN 10222-5:1999	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
ASTM A 182/A 182M-02	F 6NM	---	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	---
JIS G 3214:1991	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	---
ASTM A 473-01	---	---	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	---

6.3 Stainless Steel Forgings

6.3.1B Mechanical Properties of Martensitic Stainless Steel Forgings

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3214:1991	SUS F 410-A	---	---	QT	---	---	275	---	480	---	16	143-187 HB
	SUS F 410-B	---	---	QT	---	---	380	---	590	---	16	167-229 HB
	SUS F 410-C	---	---	QT	---	---	585	---	760	---	14	217-302 HB
	SUS F 410-D	---	---	QT	---	---	760	---	900	---	11	262-321 HB
ASTM A 182/A 182M-02	F 6a, Class 1	---	S41000	NT	---	---	275	40	485	70	18	143-207 HB
	F 6a, Class 2	---		NT	---	---	380	55	585	85	18	167-229 HB
	F 6a, Class 3	---		NT	---	---	585	85	760	110	15	235-302 HB
	F 6a, Class 4	---		NT	---	---	760	110	895	130	12	263-321 HB
ASTM A 473-01	410	---	S41000	A	---	---	275	40	485	70	20	223 HB max
EN 10250-4:1999	X12Cr13	1.4006	---	QT 650	≤ 160	---	450	---	650-850	---	15	25 J at RT
				A	---	---	---	---	730 max	---	---	220 HB max
ASTM A 1021-02	Grade A, Class 1	---	S41000	QT	---	---	485	70	690	100	20	30 ft-lb at RT 255 HB/26 HRC
	Grade A, Class 2	---	S41000	QT	---	---	550	80	760	110	18	25 J at RT 269 HB/28 HRC
	Grade B, Class 1	---	---	QT	---	---	620	90	760	110	18	30 ft-lb at RT 269 HB/28 HRC
ASTM A 182/A 182M-02	F 6b	---	S41026	NT	---	---	620	90	760-930	110-135	16	235-285 HB
JIS G 3214:1991	SUS F 6B	---	---	QT	---	---	620	---	760-930	---	15	217-285 HB
EN 10250-4:1999	X3CrNiMo13-4	1.4313	---	QT 650	≤ 450	---	520	---	650-830	---	15 L; 12 T	L: 70 J at RT T: 50 J at RT
				QT 780	≤ 450	---	620	---	780-980	---	15 L; 12 T	L: 70 J at RT T: 50 J at RT
				QT 900	≤ 450	---	800	---	900-1100	---	12	L: 50 J at RT T: 40 J at RT
				A	---	---	---	---	1100 max	---	---	320 HB max
EN 10222-5:1999	X3CrNiMo13-4	1.4313	---	QT+T	≤ 350	---	550	---	750-900	---	17 L; 16 T	L: 100 J at 20°C T: 80 J at 20°C
				QT	≤ 250	---	650	---	780-930	---	17 L; 15 T	L: 90 J at 20°C T: 70 J at 20°C
ASTM A 182/A 182M-02	F 6NM	---	S41500	NT	---	---	620	90	790	115	15	295 HB max
JIS G 3214:1991	SUS F 6NM	---	---	QT	---	---	620	---	790	---	14	295 HB max
ASTM A 473-01	---	---	S41500	NT	---	---	620	90	795	115	15	295 HB max

6.3 Stainless Steel Forgings

6.3.2A Chemical Composition of Ferritic Stainless Steel Forgings

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10250-4:1999	X6Cr17	1.4016	---	0.08	1.00	1.00	0.040	0.030	16.00-18.00	---	---	---
ASTM A 182/A 182M-02	430	---	S43000	0.12	1.00	0.75	0.040	0.030	16.0-18.0	0.50	---	---
ASTM A 473-01	430	---	S43000	0.12	1.00	1.00	0.040	0.030	16.0-18.0	0.75	---	---

6.3.2B Mechanical Properties of Ferritic Stainless Steel Forgings

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10250-4:1999	X6Cr17	1.4016	---	A	≤ 100	---	240	---	400-630	---	---	200 HB max
ASTM A 182/A 182M-02	430	---	S43000	A	---	---	240	35	415	60	20	190 HB max
ASTM A 473-01	430	---	S43000	A	---	---	240	35	485	70	20	217 HB max

6.3 Stainless Steel Forgings

6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10222-5:1999	X5CrNi18-10	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	X5CrNi18-9	---	---	0.07	2.00	1.00	0.045	0.030	17.00-19.00	8.00-11.00	---	---
ASTM A 182/A 182M-02	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 A 473-01	304	---	S30400	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10
ASTM A 965/A 965M-02	F 304	---	S30400	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10
JIS G 3214:1991	SUS F 304	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	8.00-11.00	---	---
EN 10250-4:1999	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
	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
JIS G 3214:1991	SUS F 304L	---	---	0.030	2.00	1.00	0.040	0.030	18.00-20.00	9.00-13.00	---	---
ISO 9327-5:1999	X2CrNi18-10	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	---
ASTM A 182/A 182M-02	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 A 473-01	304L	---	S30403	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-13.0	---	N 0.10
ASTM A 965/A 965M-02	F 304L	---	S30403	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-13.0	---	N 0.10
EN 10222-5:1999	X2CrNi18-9	1.4307	---	0.030	2.00	1.00	0.045	0.015	17.50-19.50	8.00-10.00	---	N 0.11
EN 10222-5:1999	X6CrNi18-10	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	X7CrNi18-9	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.00-19.00	8.00-11.00	---	---
ASTM A 182/A 182M-02	F 304H	---	S30409	0.04-0.10	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A 965/A 965M-02	F 304H	---	S30409	0.04-0.10	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
JIS G 3214:1991	SUS F 304H	---	---	0.04-0.10	2.00	1.00	0.040	0.030	18.00-20.00	8.00-12.00	---	---
ASTM A 182/A 182M-02	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 A 965/A 965M-02	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
JIS G 3214:1991	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
ASTM A 182/A 182M-02	F 304LN	---	S30453	0.03	2.00	1.00	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10-0.16
ASTM A 965/A 965M-02	F 304LN	---	S30453	0.03	2.00	1.00	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10-0.16
JIS G 3214:1991	SUS F 304LN	---	---	0.03	2.00	1.00	0.040	0.030	18.00-20.00	8.00-11.00	---	N 0.10-0.16
EN 10222-5:1999	X2CrNiN18-10	1.4311	---	0.03	2.00	1.00	0.045	0.015	17.00-19.50	8.50-11.50	---	N 0.12-0.22
ISO 9327-5:1999	X2CrNiN18-10	---	---	0.03	2.00	1.00	0.045	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
EN 10250-4:1999	X2CrNiN18-10	1.4311	---	0.03	2.00	1.00	0.045	0.030	17.00-19.50	8.50-11.50	---	N 0.12-0.22

6.3 Stainless Steel Forgings

6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 9327-5:1999	X6CrNi25-21	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-23.00	---	---
ASTM A 182/A 182M-02	F 310	---	S31000	0.25	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
	F310H	---	S31009	0.04-0.10	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A 473-01	310	---	S31000	0.25	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A 965/A 965M-02	F 310	---	S31000	0.25	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
	F310H	---	S31009	0.04-0.10	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	---	---
JIS G 3214:1991	SUS F 310	---	---	0.15	2.00	1.00	0.040	0.030	24.00-26.00	19.00-22.00	---	---
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
EN 10222-5:1999	X5CrNiMo17-12-2	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
	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
ISO 9327-5:1999	X5CrNiMo17-12	---	---	0.07	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.00-2.50	---
	X5CrNiMo17-13	---	---	0.07	2.00	1.00	0.045	0.030	16.50-18.50	11.00-14.00	2.50-3.00	---
ASTM A 182/A 182M-02	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	---
ASTM A 473-01	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 A 965/A 965M-02	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	---
JIS G 3214:1991	SUS 316	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 3214:1991	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	---
ASTM A 182/A 182M-02	F 316L	---	S31603	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-15.0	2.0-3.0	---
ASTM A 473-01	316L	---	S31603	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-15.0	2.0-3.0	---
ASTM A 965/A 965M-02	F 316L	---	S31603	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-15.0	2.0-3.0	---
EN 10222-5:1999	X2CrNiMo17-12-2	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
	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	N 0.11
ISO 9327-5:1999	X2CrNiMo17-12	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	11.00-14.00	2.00-2.50	---
	X2CrNiMo17-13	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	11.50-14.50	2.50-3.00	---
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
EN 10222-5:1999	X2CrNiMo18-14-3	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
ASTM A 182/A 182M-02	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 A 965/A 965M-02	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
JIS G 3214:1991	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

6.3 Stainless Steel Forgings

6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 182/A 182M-02	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 A 965/A 965M-02	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
JIS G 3214:1991	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
EN 10222-5:1999	X2CrNiMoN17-11-2	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
	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	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
	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
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
	X2CrNiMo17-13-3	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	X7CrNiMo17-12	---	---	0.04-0.10	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.00-2.50	---
ASTM A 182/A 182M-02	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 A 965/A 965M-02	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	---
JIS G 3214:1991	SUS 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	---
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 5 x C to 0.70
ISO 9327-5:1999	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 5 x C to 0.80
ASTM A 182/A 182M-02	F 317	---	S31700	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.00-4.00	---
ASTM A 473-01	317	---	S31700	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.00-4.00	---
JIS G 3214:1991	SUS 317	---	---	0.08	2.00	1.00	0.040	0.030	18.0-20.0	11.0-15.0	3.00-4.00	---
JIS G 3214:1991	SUS F 317L	---	---	0.030	2.00	1.00	0.040	0.030	18.0-20.0	11.0-15.0	3.00-4.00	---
ASTM A 182/A 182M-02	F 317L	---	S31703	0.030	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.00-4.00	---
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 5 x C to 0.70
EN 10222-5:1999	X6CrNiTi18-10	1.4541	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.70
ISO 9327-5:1999	X6CrNiTi18-10	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80
ASTM A 182/A 182M-02	F 321	---	S32100	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.70
ASTM A 473-01	321	---	S32100	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.70
ASTM A 965/A 965M-02	F 321	---	S32100	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.70
JIS G 3214:1991	SUS F 321	---	---	0.08	2.00	1.00	0.040	0.030	17.00 min	9.00-12.00	---	Ti 5 x C to 0.60
ISO 9327-5:1999	X7CrNiTi18-10	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80
ASTM A 182/A 182M-02	F 321H	---	S32109	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 4 x C to 0.70
ASTM A 965/A 965M-02	F 321H	---	S32109	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 4 x C to 0.70
JIS G 3214:1991	SUS F 321H	---	---	0.04-0.10	2.00	1.00	0.040	0.030	17.0 min	9.00-12.00	---	Ti 4 x C to 0.60

6.3 Stainless Steel Forgings

6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10222-5:1999	X6CrNiNb18-10	1.4550	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00
ISO 9327-5:1999	X6CrNiNb18-10	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00
ASTM A 182/A 182M-02	F 347	---	S34700	0.08	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Cb 10 x C to 1.10
ASTM A 473-01	347	---	S34700	0.08	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Cb 10 x C to 1.10
ASTM A 965/A 965M-02	F 347	---	S34700	0.08	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Cb 10 x C to 1.10
JIS G 3214:1991	SUS F 347	---	---	0.08	2.00	1.00	0.040	0.030	17.00-20.00	9.00-13.00	---	Nb 10 x C to 1.00
EN 10222-5:1999	X7CrNiNb18-10	1.4912	---	0.04-0.10	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.20
ISO 9327-5:1999	X7CrNiNb18-10	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.20
ASTM A 182/A 182M-02	F 347H	---	S34709	0.04-0.10	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Cb 8 x C to 1.10
JIS G 3214:1991	SUS F 347H	---	---	0.04-0.10	2.00	1.00	0.040	0.030	17.00-20.00	9.00-13.00	---	Nb 8 x C to 1.00
ISO 9327-5:1999	X2NiCrMoCu25-20-5	---	---	0.025	2.00	1.00	0.030	0.020	19.00-21.00	24.00-27.00	4.00-5.00	Cu 1.00-2.00; N 0.15
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

6.3 Stainless Steel Forgings

6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10222-5:1999	X5CrNi18-10	1.4301	---	ST	≤ 250	---	200	---	500-700	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at-196°C
EN 10250-4:1999	X5CrNi18-10	1.4301	---	SA	≤ 250	---	190	---	500-700	---	35	L: 100 J at RT T: 60 J at RT
ISO 9327-5:1999	X5CrNi18-9	---	---	Q	≤ 250	---	195	---	500-700	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-02	F 304	---	S30400	ST+Q	---	---	205	30	515	75	30	---
ASTM A 473-01	304	---	S30400	ST	≤ 127	≤ 5	205	30	515	75	40	---
				ST	> 127	> 5	205	30	485	70	40	---
ASTM A 965/A 965M-02	F 304	---	S30400	ST+Q	---	---	205	30	485	70	30	---
JIS G 3214:1991	SUS F 304	---	---	S	< 130	---	205	---	520	---	43	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
EN 10250-4:1999	X2CrNi18-9	1.4307	---	SA	≤ 250	---	175	---	450-680	---	35	L: 100 J at RT T: 60 J at RT
	X2CrNi19-11	1.4306	---	SA	≤ 250	---	180	---	460-680	---	35	L: 100 J at RT T: 60 J at RT
JIS G 3214:1991	SUS F 304L	---	---	S	< 130	---	175	---	480	---	29	187 HB max
					130 ≤ t ≤ 200	---	175	---	450	---	29	187 HB max
ISO 9327-5:1999	X2CrNi18-10	---	---	Q	≤ 250	---	180	---	480-680	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-02	F 304L	---	S30403	ST+Q	---	---	170	25	485	70	30	---
ASTM A 473-01	304L	---	S30403	ST	---	---	170	25	450	65	40	---
ASTM A 965/A 965M-02	F 304L	---	S30403	ST+Q	---	---	170	25	450	65	30	---
EN 10222-5:1999	X2CrNi18-9	1.4307	---	ST	≤ 250	---	200	---	500-700	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at -196°C
EN 10222-5:1999	X6CrNi18-10	1.4948	---	ST	≤ 250	---	195	---	490-690	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C
ISO 9327-5:1999	X7CrNi18-9	---	---	Q	≤ 250	---	195	---	490-690	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-02	F 304H	---	S30409	ST+Q	---	---	205	30	515	75	30	---
ASTM A 965/A 965M-02	F 304H	---	S30409	ST+Q	---	---	205	30	485	70	30	---
JIS G 3214:1991	SUS F 304H	---	---	S	< 130	---	205	---	520	---	43	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
ASTM A 182/A 182M-02	F 304N	---	S30451	ST+Q	---	---	240	35	550	80	30	---
ASTM A 965/A 965M-02	F 304N	---	S30451	ST+Q	---	---	240	35	550	80	25	---
JIS G 3214:1991	SUS F 304N	---	---	S	< 130	---	240	---	550	---	29	217 HB max
					130 ≤ t ≤ 200	---	240	---	550	---	24	217 HB max

6.3 Stainless Steel Forgings

6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 182/A 182M-02	F 304LN	---	S30453	ST+Q	---	---	205	30	515	75	30	---
ASTM A 965/A 965M-02	F 304LN	---	S30453	ST+Q	---	---	205	30	485	70	30	---
JIS G 3214:1991	SUS F 304LN	---	---	S	< 130	---	205	---	520	---	29	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
EN 10222-5:1999	X2CrNiN18-10	1.4311	---	ST	≤ 250	---	270	---	550-750	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at-196°C
ISO 9327-5:1999	X2CrNiN18-10	---	---	Q	≤ 250	---	270	---	550-750	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
EN 10250-4:1999	X2CrNiN18-10	1.4311	---	SA	≤ 250	---	270	---	550-760	---	30	L: 100 J at RT T: 60 J at RT
ISO 9327-5:1999	X6CrNi25-21	---	---	Q	≤ 160	---	210	---	500-700	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-02	F 310	---	S31000	ST+Q	---	---	205	30	515	75	30	---
	F310H	---	S31009	ST+Q	---	---	205	30	515	75	30	---
ASTM A 473-01	310	---	S31000	ST	---	---	205	30	515	75	40	---
ASTM A 965/A 965M-02	F 310	---	S31000	ST+Q	---	---	205	30	485	70	30	---
	F310H	---	S31009	ST+Q	---	---	205	30	485	70	30	---
JIS G 3214:1991	SUS F 310	---	---	S	< 130	---	205	---	520	---	34	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
EN 10250-4:1999	X5CrNiMo17-12-2	1.4401	---	SA	≤ 250	---	200	---	500-700	---	30	L: 100 J at RT T: 60 J at RT
	X3CrNiMo17-13-3	1.4436	---	SA	≤ 250	---	200	---	500-700	---	30	L: 100 J at RT T: 60 J at RT
EN 10222-5:1999	X5CrNiMo17-12-2	1.4401	---	ST	≤ 250	---	205	---	510-710	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at-196°C
	X3CrNiMo17-13-3	1.4436	---	ST	≤ 250	---	205	---	510-710	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at-196°C
ISO 9327-5:1999	X5CrNiMo17-12	---	---	Q	≤ 250	---	205	---	510-710	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
	X5CrNiMo17-13	---	---	Q	≤ 250	---	205	---	510-710	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-02	F 316	---	S31600	ST+Q	---	---	205	30	515	75	30	---
ASTM A 473-01	316	---	S31600	ST	≤ 250	≤ 5	205	30	515	75	40	---
				ST	> 250	> 5	205	30	485	70	40	---
ASTM A 965/A 965M-02	F 316	---	S31600	ST+Q	---	---	205	30	485	70	30	---
JIS G 3214:1991	SUS 316	---	---	S	< 130	---	205	---	520	---	43	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max

6.3 Stainless Steel Forgings

6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3214:1991	SUS F 316L	---	---	S	< 130	---	175	---	480	---	29	187 HB max
					130 ≤ t ≤ 200	---	175	---	450	----	29	187 HB max
ASTM A 182/A 182M-02	F 316L	---	S31603	ST+Q	---	---	170	25	485	70	30	---
ASTM A 473-01	316L	---	S31603	ST	---	---	170	25	450	65	40	---
ASTM A 965/A 965M-02	F 316L	---	S31603	ST+Q	---	---	170	25	450	65	30	---
EN 10222-5:1999	X2CrNiMo17-12-2	1.4404	---	ST	≤ 250	---	190	---	490-690	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at -196°C
	X2CrNiMo17-12-3	1.4432	---	ST	≤ 250	---	190	---	490-690	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at -196°C
ISO 9327-5:1999	X2CrNiMo17-12	---	---	Q	≤ 250	---	190	---	490-690	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
	X2CrNiMo17-13	---	---	Q	≤ 250	---	190	---	490-690	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
EN 10250-4:1999	X2CrNiMo17-12-2	1.4404	---	SA	≤ 250	---	200	---	500-700	---	30	L: 100 J at RT T: 60 J at RT
	X2CrNiMo18-14-3	1.4435	---	SA	≤ 250	---	200	---	500-700	---	30	L: 100 J at RT T: 60 J at RT
EN 10222-5:1999	X2CrNiMo18-14-3	1.4435	---	ST	≤ 75	---	200	---	520-670	---	45 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at -196°C
ASTM A 182/A 182M-02	F 316N	---	S31651	ST+Q	---	---	240	35	550	80	30	---
ASTM A 965/A 965M-02	F 316N	---	S31651	ST+Q	---	---	240	35	550	80	25	---
JIS G 3214:1991	SUS F 316N	---	---	S	< 130	---	240	---	550	---	29	217 HB max
					130 ≤ t ≤ 200	---	240	---	550	---	24	217 HB max

6.3 Stainless Steel Forgings

6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 182/A 182M-02	F 316LN	---	S31653	ST+Q	---	---	205	30	515	75	30	---
ASTM A 965/A 965M-02	F 316LN	---	S31653	ST+Q	---	---	205	30	485	70	30	---
JIS G 3214:1991	SUS F 316LN	---	---	S	< 130	---	205	---	520	---	29	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
EN 10222-5:1999	X2CrNiMoN17-11-2	1.4406	---	ST	≤ 160	---	280	---	580-780	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at -196°C
	X2CrNiMo17-13-3	1.4429	---	ST	≤ 160	---	280	---	580-780	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at -196°C
ISO 9327-5:1999	X2CrNiMoN17-12	---	---	Q	≤ 160	---	280	---	580-780	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
	X2CrNiMoN17-13	---	---	Q	≤ 160	---	280	---	580-780	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
EN 10250-4:1999	X2CrNiMoN17-12-2	1.4406	---	SA	≤ 250	---	280	---	580-800	---	30	L: 100 J at RT T: 60 J at RT
	X2CrNiMoN17-13-3	1.4429	---	SA	≤ 400	---	280	---	580-800	---	30	L: 100 J at RT T: 60 J at RT
ISO 9327-5:1999	X7CrNiMo17-12	---	---	Q	≤ 250	---	205	---	510-710	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-02	F 316H	---	S31609	ST+Q	---	---	205	30	515	75	30	---
ASTM A 965/A 965M-02	F 316H	---	S31609	ST+Q	---	---	205	30	485	70	30	---
JIS G 3214:1991	SUS 316H	---	---	S	< 130	---	205	---	520	---	43	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
EN 10250-4:1999	X6CrNiMoTi17-12-2	1.4571	---	SA	≤ 450	---	200	---	500-700	---	30	L: 100 J at RT T: 60 J at RT
ISO 9327-5:1999	X6CrNiMoTi17-12	---	---	Q	≤ 450	---	210	---	510-710	---	30	---
ASTM A 182/A 182M-02	F 317	---	S31700	ST+Q	---	---	205	30	515	75	30	---
ASTM A 473-01	317	---	S31700	ST	---	---	205	30	515	75	40	---
JIS G 3214:1991	SUS 317	---	---	S	< 130	---	205	---	520	---	29	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
JIS G 3214:1991	SUS F 317L	---	---	S	< 130	---	175	---	480	---	29	187 HB max
					130 ≤ t ≤ 200	---	175	---	450	---	29	187 HB max
ASTM A 182/A 182M-02	F 317L	---	S31703	ST+Q	---	---	170	25	485	70	30	---

6.3 Stainless Steel Forgings

6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10250-4:1999	X6CrNiTi18-10	1.4541	---	SA	≤ 450	---	190	---	500-700	---	30	L: 100 J at RT T: 60 J at RT
EN 10222-5:1999	X6CrNiTi18-10	1.4541	---	ST	≤ 450	---	200	---	510-710	---	40 L; 30 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at -196°C
ISO 9327-5:1999	X6CrNiTi18-10	---	---	Q	≤ 450	---	200	---	510-710	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-02	F 321	---	S32100	ST+Q	---	---	205	30	515	75	30	---
ASTM A 473-01	321	---	S32100	ST	---	---	205	30	515	75	40	---
ASTM A 965/A 965M-02	F 321	---	S32100	ST+Q	---	---	205	30	485	70	30	---
JIS G 3214:1991	SUS F 321	---	---	S	< 130	---	205	---	520	---	43	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
ISO 9327-5:1999	X7CrNiTi18-10	---	---	Q	≤ 450	---	175	---	490-690	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-02	F 321H	---	S32109	ST+Q	---	---	205	30	515	75	30	---
ASTM A 965/A 965M-02	F 321H	---	S32109	ST+Q	---	---	205	30	485	70	30	---
JIS G 3214:1991	SUS F 321H	---	---	S	< 130	---	205	---	520	---	43	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
EN 10222-5:1999	X6CrNiNb18-10	1.4550	---	ST	≤ 450	---	205	---	510-710	---	40 L; 30 T	L: 100 J at 20°C T: 60 J at 20°C T: 40 J at -196°C
ISO 9327-5:1999	X6CrNiNb18-10	---	---	Q	≤ 450	---	205	---	510-710	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-02	F 347	---	S34700	ST+Q	---	---	205	30	515	75	30	---
ASTM A 473-01	347	---	S34700	ST	---	---	205	30	515	75	40	---
ASTM A 965/A 965M-02	F 347	---	S34700	ST+Q	---	---	205	30	485	70	30	---
JIS G 3214:1991	SUS F 347	---	---	S	< 130	---	205	---	520	---	43	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
EN 10222-5:1999	X7CrNiNb18-10	1.4912	---	ST	≤ 450	---	205	---	510-710	---	40 L; 30 T	L: 100 J at 20°C T: 60 J at 20°C T: 40 J at -196°C
ISO 9327-5:1999	X7CrNiNb18-10	---	---	Q	≤ 450	---	205	---	510-710	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-02	F 347H	---	S34709	ST+Q	---	---	205	30	515	75	30	---
JIS G 3214:1991	SUS F 347H	---	---	S	< 130	---	205	---	520	---	43	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
ISO 9327-5:1999	X2NiCrMoCu25-20-5	---	---	Q	≤ 160	---	220	---	520-720	---	30	L: 85 J at RT T: 55 J at RT
EN 10250-4:1999	X1NiCrMoCu20-20-5	1.4539	---	SA	≤ 250	---	230	---	530-730	---	30	L: 100 J at RT T: 60 J at RT

6.3 Stainless Steel Forgings

6.3.4A Chemical Composition of Precipitation-Hardening Stainless Steel Forgings

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3214:1991	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
ASTM A 705/A 705M-95(2000)	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 5 x C to 0.45

6.3.4B Mechanical Properties of Precipitation-Hardening Stainless Steel Forgings

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3214:1991	SUS F 630	---	---	H1075	≤ 200	---	860	---	1000	---	12	311 min HBS or HBW 27 J at 23°C
				H1100	≤ 200	---	795	---	970	---	13	302 min HBS or HBW 34 J at 23°C
				H1150	≤ 200	---	725	---	930	---	15	277 min HBS or HBW 41 J at 23°C
ASTM A 705/A 705M-95(2000)	630	---	S17400	ST	---	---	---	---	---	---	---	38 HRC 363 HB
				H900	≤ 200	≤ 8	1170	170	1310	190	10	40 HRC 388 HB
				H925	≤ 200	≤ 8	1070	155	1170	170	10	38 HRC 375 HB 6.8 J at 23°C
				H1025	≤ 200	≤ 8	1000	145	1070	155	12	35 HRC 331 HB 20 J at 23°C
				H1075	≤ 200	≤ 8	860	125	1000	145	13	32 HRC 311 HB 27 J at 23°C
				H1100	≤ 200	≤ 8	795	115	965	140	14	31 HRC 302 HB 34 J at 23°C
				H1150	≤ 200	≤ 8	725	105	930	135	16	28 HRC 277 HB 41 J at 23°C
				H1150M	≤ 200	≤ 8	520	75	795	115	18	24 HRC 255 HB 75 J at 23°C
EN 10250-4:1999	X5CrNiCuNb16-4	1.4542	---	A	---	---	---	---	1200 max	---	---	360 HB max
				P 930	≤ 250	---	720	---	930	---	15 L; 12 T	L: 40 J at RT T: 30 J at RT
				P 1070	≤ 250	---	1000	---	1070	---	12 L; 10 T	L: 20 J at RT T: 15 J at RT
				P 1300	≤ 250	---	1150	---	1300	---	8 L; 6 T	---

6.3 Stainless Steel Forgings

6.3.5A Chemical Composition of Duplex (Ferritic-Austenitic) Stainless Steel Forgings

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
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
ASTM A 182/A 182M-02	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
ISO 9327-5:1999	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
ASTM A 182/A 182M-02	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
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
ASTM A 182/A 182M-02	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
EN 10222-5:1999	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
EN 10250-4:1999	X2CrNiMoN25-7-4	1.4410	---	0.030	2.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.00-4.50	N 0.20-0.35
ASTM A 182/A 182M-02	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
EN 10222-5:1999	X2CrNiMoN25-7-4	1.4410	---	0.030	2.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.00-4.50	N 0.20-0.35
EN 10250-4:1999	X2CrNiMoCuWN27-7-4	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; N 0.20-0.30; W 0.50-1.00
ASTM A 182/A 182M-02	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; N 0.20-0.30; W 0.50-1.00
ASTM A 473-01	---	---	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; N 0.20-0.30; W 0.50-1.00
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
ASTM A 473-01	---	---	S32550	0.040	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 A 182/A 182M-02	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
ISO 9327-5:1999	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
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

6.3 Stainless Steel Forgings

6.3.5B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steel Forgings

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10250-4:1999	X3CrNiMoN27-5-2	1.4460	---	ST	≤ 160	---	460	---	620-880	---	20 L; 15 T	L: 85 J at RT T: 50 J at RT
ASTM A 182/A 182M-02	F 50	---	S31200	ST+Q	---	---	450	65	690-900	100-130	25	---
ISO 9327-5:1999	X2CrNiMoN22-5-3	---	---	Q	≤ 250	---	450	---	600-860	---	25 L; 20 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-02	F 51	---	S31803	ST+Q	---	---	450	65	620	90	25	---
EN 10250-4:1999	X2CrNiMoN22-5-3	1.4462	---	ST	≤ 350	---	450	---	650-880	---	25 L; 20 T	L: 100 J at RT T: 60 J at RT
ASTM A 182/A 182M-02	F 60	---	S32205	ST+Q	---	---	485	70	655	95	25	---
EN 10222-5:1999	X2CrNiMoN22-5-3	1.4462	---	ST	≤ 350	---	450	---	680-880	---	30 L; 25 T	L: 200 J at 20°C T: 100 J at 20°C
EN 10250-4:1999	X2CrNiMoN25-7-4	1.4410	---	ST	≤ 160	---	530	---	730-930	---	25 L; 20 T	L: 100 J at RT T: 60 J at RT
ASTM A 182/A 182M-02	F 53	---	S32750	ST+Q	---	---	550	80	800	116	15	---
EN 10222-5:1999	X2CrNiMoN25-7-4	1.4410	---	ST	≤ 160	---	500	---	800-1000	---	30 L; 25 T	L: 200 J at 20°C T: 100 J at 20°C
EN 10250-4:1999	X2CrNiMoCuWN27-7-4	1.4501	---	ST	≤ 160	---	530	---	730-930	---	25 L; 20 T	L: 100 J at RT T: 60 J at RT
ASTM A 182/A 182M-02	F 55	---	S32760	ST+Q	---	---	550	80	750-895	109-130	25	---
ASTM A 473-01	---	---	S32760	ST	---	---	550	80	750	109	25	290 HB
EN 10250-4:1999	X2CrNiMoCuN25-6-3	1.4507	---	ST	≤ 160	---	500	---	700-900	---	25 L; 20 T	L: 100 J at RT T: 60 J at RT
ASTM A 473-01	---	---	S32550	ST	---	---	550	80	750	109	25	290 HB
ASTM A 182/A 182M-02	F 59	---	S32520	ST+Q	---	---	550	80	770	112	25	---
ISO 9327-5:1999	X2CrNiN23-4	---	---	Q	≤ 160	---	400	---	600-820	---	25 L; 20 T	L: 85 J at RT T: 55 J at RT
EN 10250-4:1999	X2CrNiN23-4	1.4362	---	ST	≤ 160	---	400	---	600-830	---	25 L; 20 T	L: 100 J at RT T: 60 J at RT

6.4 Non-Comparable Carbon Steel Forgings for General Use

EN 10250-2:1999 - Open Die Steel Forgings for General Engineering Purposes - Part 2: Non-Alloy Quality and Special Steels													
Steel Name	S355J2G3	C60	C60E	---	---	---	---	---	---	---	---	---	---
Steel Number	1.0570	1.0601	1.1221	---	---	---	---	---	---	---	---	---	---

6.5 Non-Comparable Carbon Steel Forgings for Piping, Pressure Vessel and Components

ASTM A 266/A 266M-03a - Carbon Steel Forgings for Pressure Vessel Components													
Grade, Class, Type	3	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K05001	---	---	---	---	---	---	---	---	---	---	---	---
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													
Steel Type	P 46	PH 46	PL 46	PLH 46	---	---	---	---	---	---	---	---	---

6.6 Non-Comparable Alloy Steel Forgings for General Use

ASTM A 668/A 668M-03 - Steel Forgings, Carbon and Alloy, for General Industrial Use													
Grade, Class, Type	G (GH)	H (HH)	J (JH)	K (KH)	L (LH)	M (MH)	N (NH)	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---	---
JIS G 3221:1988 - Chromium Molybdenum Steel Forgings for General Use													
Type Symbol	SFCM 590 S	SFCM 640 S	SFCM 830 S	SFCM 880 S	SFCM 930 S	SFCM 980 S	---	---	---	---	---	---	---
	SFCM 590 R	SFCM 640 R	SFCM 690 R	SFCM 740 R	SFCM 780 R	SFCM 830 R	SFCM 880 R	SFCM 930 R	SFCM 980 R	---	---	---	---
	SFCM 590 D	SFCM 640 D	SFCM 690 D	SFCM 740 D	SFCM 780 D	SFCM 830 D	SFCM 880 D	SFCM 930 D	SFCM 980 D	---	---	---	---
EN 10250-2:1999 - Open Die Steel Forgings for General Engineering Purposes - Part 2: Non-Alloy Quality and Special Steels													
Steel Name	28Mn6	20Mn5	---	---	---	---	---	---	---	---	---	---	---
Steel Number	1.1170	1.1133	---	---	---	---	---	---	---	---	---	---	---
EN 10250-3:1999 - Open Die Steel Forgings for General Engineering Purposes - Part 3: Alloy Special Steels													
Steel Name	38Cr2	46Cr2	34Cr4	37Cr4	41Cr4	36CrNiMo4	34CrNiMo6	30CrNiMo8	36NiCrMo16	51CrV4	33NiCrMoV14-5	40CrMoV13-9	
Steel Number	1.7003	1.7006	1.7033	1.7034	1.7035	1.6511	1.6582	1.6580	1.6773	1.8159	1.6956	1.8523	
Steel Name	18CrMo4	20MnMoNi4-5	30CrMoV9	32CrMo12	28NiCrMoV8-5	---	---	---	---	---	---	---	
Steel Number	1.7243	1.6311	1.7707	1.7361	1.6932	---	---	---	---	---	---	---	

6.7 Non-Comparable Alloy Steel Forgings for Piping, Pressure Vessel and Components

ASTM A 182/A 182M-02 - Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service												
Grade, Class, Type	F 91	F 92	F 911	F 11, Class 1	F 12, Class 1	F 3VCb	F 23	F 24	FR	---	---	---
UNS Number	K 90901	---	---	K11597	K11562	K31835	K41650	---	K22035	---	---	---
ASTM A 336/A 336M-03a - Alloy Steel Forgings for Pressure and High-Temperature Parts												
Grade, Class, Type	F11, Class 1	F6	F91	F911	F3VCb	---	---	---	---	---	---	---
UNS Number	---	S41000	---	---	---	---	---	---	---	---	---	---
ASTM A 350/A 350M-02b - Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components												
Grade, Class, Type	LF5	LF6	LF9	LF787	---	---	---	---	---	---	---	---
UNS Number	K13050	K12202	K22036	---	---	---	---	---	---	---	---	---
ASTM A 508/A 508M-03a - Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels												
Grade, Class, Type	4N, Class 1	4N, Class 2	5, Class 1	5, Class 2	3VCb	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 541/A 541M-95 (1999) - Quenched and Tempered Carbon and Alloy Steel Forgings for Pressure Vessel Components												
Grade, Class, Type	1C	11, Class 4	22, Class 4	22, Class 5	4N, Class 1	4N, Class 2	5, Class 1	5, Class 2	3VCb	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
EN 10222-2:1999 - Steel Forgings for Pressure Purposes - Part 2: Ferritic and Martensitic Steels with Specified Elevated Temperature Properties												
Steel Name	15MnMoV4-5	18MnMoNi5-5	14MoV6-3	15MnCrMoNiV5-3		---	---	---	---	---	---	---
Steel Number	1.5402	1.6308	1.7715	1.6920		---	---	---	---	---	---	---
ISO 9327-2:1999 - Steel Forgings and Rolled or Forged Bars for Pressure Purposes. Part 2: Non-Alloy and Alloy (Mo, Cr and CrMo) Steels with Specified Elevated Temperature Properties												
Steel Type	20MnMoNi5	---	---	---	---	---	---	---	---	---	---	---

6.8 Non-Comparable Stainless Steel Forgings

ASTM A 182/A 182M-02 - Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service												
Grade, Class, Type	F 122	F XM-27Cb	F 429	F 309H	F 310MoLN	F 348	F 348H	F XM-11	F XM-19	F 10	F 20	F 44
UNS Number	K92930	S44627	S42900	S30909	S31050	S34800	S34809	S21904	S20910	S33100	N08020	S31254
Grade, Class, Type	F 45	F 46	F 47	F 48	F 49	F 52	F 54	F 56	F 57	F 58	F 61	F 62
UNS Number	S30815	S30600	S31725	S31726	S34565	S32950	S39274	S33228	S39277	S31266	S32550	N08367
EN 10222-5:1999 - Steel Forgings for Pressure Purposes - Part 5: Martensitic, Austenitic and Austenitic-Ferritic Stainless Steels												
Steel Name	X6CrNiTiB18-10		X3CrNiMoN17-13-3		X2CrNiCu19-10		X3CrNiMo18-12-3		---	---	---	---
Steel Number	1.4941		1.4910		1.4650		1.4449		---	---	---	---
EN 10250-4:1999 - Open Die Steel Forgings for General Engineering Purposes - Part 4: Stainless Steels												
Steel Name	X6CrNiNb18-10		X1NiCrMoCu31-27-4		X1CrNiMoCuN20-18-7		X1NiMoCuN25-20-7	X6CrAl13	X20Cr13	X30Cr13	X17CrNi16-2	X4CrNiMo16-5-1
Steel Number	1.4550		1.4563		1.4547		1.4529	1.4002	1.4021	1.4028	1.4057	1.4418

Chapter 7

STEEL CASTINGS

AFNOR Standards

AFNOR NF A 32-053:1992	Cast Steels for Low Temperatures Purposes
AFNOR NF A 32-054:1994	Cast Steels for General Purpose in Mechanical Engineering
AFNOR NF A 32-058:1984	Cast Steels and White Cast Iron Resistant to Abrasion

ASTM Standards

ASTM A 27/A 27M-03	Steel Castings, Carbon, for General Application
ASTM A 128/A 128M-93 (2003)	Steel Castings, Austenitic Manganese
ASTM A 148/A 148 M-03	Steel Castings, High Strength, for Structural Purposes
ASTM A 216/A 216M-93 (2003)	Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A 217/A 217M-02	Steel Castings, Martensitic Stainless and Alloy, for Pressure- Containing Parts, Suitable for High-Temperature Service
ASTM A 297/A 297M-97 (2003)	Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for General Application
ASTM A 351/A 351M-03	Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
ASTM A 352/A 352M-03	Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service
ASTM A 389/A 389M-03	Steel Castings, Alloy, Specially Heat-Treated, for Pressure-Containing Parts, Suitable for High-Temperature Service
ASTM A 447/A 447M-93 (2003)	Steel Castings, Chromium-Nickel-Iron Alloy (25-12 Class), for High-Temperature Service
ASTM A 487/A 487M-93 (2003)	Steel Castings Suitable for Pressure Service
ASTM A 608-02	Centrifugally Cast Iron-Chromium-Nickel High-Alloy Tubing for Pressure Application at High Temperatures
ASTM A 743/A 743M-03	Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM A 744/A 744M-00	Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service
ASTM A 757/A 757M-00	Steel Castings, Ferritic and Martensitic, for Pressure-Containing and Other Applications, for Low-Temperature Service
ASTM A 958-00	Steel Castings, Carbon, and Alloy, with Tensile Requirements, Chemical Requirements Similar to Standard Wrought Grades

BSI Standards

BSI BS 3100:1991 AMD. 1:1992	Steel Castings for General Engineering Purposes

DIN Standards

DIN 1681:1985	Cast Steels for General Engineering Purposes
DIN 17205:1992	Quenched and Tempered Steel Castings for General Applications

CEN Standards

EN 10213-2:1995	Steel Castings for Pressure Purposes Part 2: Steel Grades for Use at Room Temperature and at Elevated Temperature
EN 10213-3:1995	Steel Castings for Pressure Purposes Part 3: Steel Grades for Use at Low Temperatures
EN 10213-4:1995	Steel Castings for Pressure Purposes Part 4: Austenitic and Austenitic-Ferritic Steel Grades
EN 10283:1998	Corrosion Resistant Steel Castings
EN 10295:2002	Heat Resistant Steel Castings

ISO Standards

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 3755:1991	Cast Carbon Steels for General Engineering Purposes
ISO 4991:1994	Steel Castings for Pressure Purposes

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	Stainless Steel Castings
JIS G 5122:2003	Heat Resisting Steel Castings
JIS G 5131:1991	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 32-053:1992	QT: quenched and tempered; Q (HY): hyperquenched
AFNOR NF A 32-054:1994	N: normalized; QT quenched and tempered; Q: quenched
AFNOR NF A 32-058:1984	Not specified
ASTM A 27/A 27M-03	AS: as cast; A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
ASTM A 128/A 128M-93 (2003)	See standard
ASTM A 148/A 148 M-03	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
ASTM A 216/A 216M-93 (2003)	A: annealed; N: normalized; NT: normalized and tempered
ASTM A 217/A 217M-02	NT: normalized and tempered
ASTM A 297/A 297M-97 (2003)	AS: as cast
ASTM A 351/A 351M-03	AS: as cast; S: solution treat and rapid cool
ASTM A 352/A 352M-03	NT: normalized and tempered; QT: quenched and tempered
ASTM A 389/A 389M-03	NT: normalized and tempered
ASTM A 447/A 447M-93 (2003)	AS: as cast
ASTM A 487/A 487M-93 (2003)	NT: normalized and tempered; QT: quenched and tempered
ASTM A 608-02	AS: as cast
ASTM A 743/A 743M-03	A: annealed; N: normalized; S: solution treat and rapid cool
ASTM A 744/A 744M-00	N: normalized; S: solution treat and rapid cool
ASTM A 757/A 757M-00	NT: normalized and tempered; QT: quenched and tempered
ASTM A 958-00	N: normalized; NT: normalized and tempered; QT: quenched and tempered
BSI BS 3100:1991 AMD. 1:1992	A: annealed; N: normalized; OQ: oil quenched; WQ: water quenched; AH: air hardened; T: tempered; ST: solution treated
DIN 1681:1985	---
DIN 17205:1992	NT: air hardened and tempered
EN 10213-2:1995	N: normalized; Q: quenched; T: tempered
EN 10213-3:1995	N: normalized; Q: quenched; T: tempered
EN 10213-4:1995	AT + QW: solution annealed + water quenched
EN 10283:1998	Q: quenched; T: tempered; AT: solution annealed
EN 10295:2002	A: annealed
ISO 3755:1991	---
ISO 4991:1994	A: annealed; N: normalized; Q: quenched; T: tempered; N_{ac}: heated, accelerated air cooling; S: solution treated; ( ): brackets indicate that the treatment is only applied in special cases
ISO 11972:1998	AT: austenitize and temper; ST/Q: solution treat and quench
ISO 11973:1999	AS: as cast; A: annealed
ISO 13521:1999	ST + WQ: solution treated + water quenched
JIS G 5101:1991	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
JIS G 5102:1991	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
JIS G 5111:1991	NT: normalized and tempered; QT: quenched and tempered
JIS G 5121:2003	T: quenched and tempered; T1 or T2: tempered at specified temperature; S: solution heat treated and rapid cooling; HXXX: solution treated + age hardened.
JIS G 5122:2003	AS: as cast; A: annealed
JIS G 5131:1991	WT: water toughening
JIS G 5151:1991	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
JIS G 5152:1991	A: annealed; N: normalized; NT: normalized and tempered; QT: 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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 5101:1991	SC 360	---	---	A, N, NT, or QT	---	---	175	---	360	---	23	---
DIN 1681:1985	GS-38	1.0420	---	---	---	---	200	---	380	---	25	---
AFNOR NF A 32-054:1994	GE230	---	---	N	28 ≤ t < 50	---	230	---	400	---	25	---
		---	---	N	50 ≤ t <100	---	210	---	400	---	23	---
ISO 3755:1991	200-400	---	---	---	---	---	200	---	400-550	---	25	---
	200-400W	---	---	---	---	---	200	---	400-550	---	25	---
JIS G 5101:1991	SC 410	---	---	A, N, NT, or QT	---	---	205	---	410	---	21	---
JIS G 5102:1991	SCW 410	---	---	A, N, NT, or QT	---	---	235	---	410	---	21	27 J at 0°C
ASTM A 27/A 27M-03	U-60-30	---	J02500	AC	---	---	205	30	415	60	22	---
	60-30	---	J03000	A, N, NT, or QT	---	---	205	30	415	60	24	---
BS 3100:1991 AMD.1:1992	A1	---	---	A, N, NT, OQT or WQT	---	---	230	---	430	---	22	27 J at 20°C
AFNOR NF A 32-054:1994	G16Mn5	---	---	N	28 ≤ t < 50	---	250	---	430	---	24	---
					50 ≤ t <100	---	230	---	430	---	24	---
ASTM A 27/A 27M-03	65-35	---	J03001	A, N, NT, or QT	---	---	240	35	450	65	24	---
ASTM A 958-00	SC 1020, Class 65/35	---	---	N	---	---	240	35	450	65	24	---
	SC 1025, Class 65/35											
	SC 1030, Class 65/35											
JIS G 5101:1991	SC 450	---	---	A, N, NT, or QT	---	---	225	---	450	---	19	---
JIS G 5102:1991	SCW 450	---	---	A, N, NT, or QT	---	---	255	---	450	---	20	27 J at 0°C
DIN 1681:1985	GS-45	1.0446	---	---	---	---	230	---	450	---	22	---
ISO 3755:1991	230-450	---	---	---	---	---	230	---	450-600	---	22	---
	230-450W											

7.1 Cast Carbon Steels

7.1.1A Mechanical Properties of Cast Carbon Steel for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
AFNOR NF A 32-054:1994	GE280	---	---	N	28 ≤ t < 50	---	280	---	480	---	20	30 J at RT
					50 ≤ t <100	---	260	---	480	---	18	25 J at RT
JIS G 5101:1991	SC 480	---	---	A, N, NT, or QT	---	---	245	---	480	---	17	---
JIS G 5102:1991	SCW 480	---	---	A, N, NT, or QT	---	---	275	---	480	---	20	27 J at 0°C
ISO 3755:1991	270-480	---	---	---	---	---	270	---	480-630	---	18	---
	270-480W											
ASTM A 27/A 27M-03	70-36	---	J03501	A, N, NT, or QT	---	---	250	36	485	70	22	---
	70-40	---	J02501	A, N, NT, or QT	---	---	275	40	485	70	22	---
ASTM A 958-00	SC 1020, Class 70/36	---	---	N	---	---	250	36	485	70	22	---
	SC 1025, Class 70/36											
	SC 1030, Class 70/36	---	---	NT								
	SC 1040, Class 70/36											
BS 3100:1991 AMD.1:1992	A2	---	---	A, N, NT, OQT or WQT	---	---	260	---	490	---	18	20 J at 20°C
AFNOR NF A 32-054:1994	G20Mn6	---	---	N	28 ≤ t < 50	---	300	---	500	---	22	40 J at RT
					50 ≤ t <100	---	280	---	500	---	22	30 J at RT
					100 ≤ t < 150	---	260	---	480	---	20	25 J at RT
					150 ≤ t < 250	---	240	---	450	---	---	---
				QT	28 ≤ t < 50	---	360	---	500	---	24	60 J at RT
					50 ≤ t <100	---	300	---	500	---	24	40 J at RT
					100 ≤ t < 150	---	280	---	500	---	22	30 J at RT
AFNOR NF A 32-053:1992	20 M5-M	---	---	QT	≤ 30	---	300	---	500	---	24	27 J at -30°C
DIN 1681:1985	GS-52	1.0552	---	---	---	---	260	---	520	---	18	---
DIN 17205:1992	GS-30 Mn 5	1.1165	---	QT	≤ 400	---	260	---	520-670	---	18	---
JIS G 5111:1991	SCC 3A	---	---	NT	---	---	265	---	520	---	13	143 HB
BS 3100:1991 AMD.1:1992	A3	---	---	A, N, NT, OQT or WQT	---	---	295	---	540	---	14	18 J at 20°C
JIS G 5111:1991	SCMn 1A	---	---	NT	---	---	275	---	540	---	17	143 HB
BS 3100:1991 AMD.1:1992	A4	---	---	N, NT, OQT or WQT	---	---	320	---	540-690	---	16	30 J at 20°C

7.1 Cast Carbon Steels

7.1.1A Mechanical Properties of Cast Carbon Steel for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 148/A 148M-03	80-40	---	---	A, N, NT, or QT	---	---	275	40	550	80	18	---
	80-50	---	---	A, N, NT, or QT	---	---	345	50	550	80	22	---
ASTM A 958-00	SC 1030, Class 80/40	---	---	QT	---	---	275	40	550	80	18	---
	SC 1040, Class 80/40	---	---	NT								
	SC 1045, Class 80/40	---	---	NT								
	SC 1030, Class 80/50	---	---	QT	---	---	345	50	550	80	22	---
	SC 1040, Class 80/50	---	---	NT								
	SC 1045, Class 80/50	---	---	NT								
JIS G 5102:1991	SCW 550	---	---	A, N, NT, or QT	---		355	---	550	---	18	27 J at 0°C
ISO 3755:1991	340-550	---	---	---	---	---	340	---	550-700	---	15	---
	340-550W											
AFNOR NF A 32-054:1994	GE320	---	---	N	28 ≤ t < 50	---	320	---	560	---	16	25 J at RT
					50 ≤ t <100	---	300	---	560	---	14	22 J at RT
	G30Mn6	---	---	N	28 ≤ t < 50	---	350	---	580	---	16	27 J at RT
					50 ≤ t <100	---	300	---	550	---	16	24 J at RT
					100 ≤ t < 150	---	280	---	550	---	14	24 J at RT
					150 ≤ t < 250	---	250	---	520	---	14	20 J at RT
JIS G 5111:1991	SCSiMn 2A	---	---	NT	---	---	295	---	590	---	13	163 HB
	SCMn 1B	---	---	QT	---	---	390	---	590	---	17	170 HB
	SCMn 2A	---	---	NT	---	---	345	---	590	---	16	163 HB
DIN 1681:1985	GS-60	1.0558	---	---	---	---	300	---	600	---	15	---
AFNOR NF A 32-054:1994	G30Mn6	---	---	QT2 (TR2)	28 ≤ t < 50	---	450	---	600	---	16	30 J at RT
					50 ≤ t <100	---	450	---	600	---	16	30 J at RT
					100 ≤ t < 150	---	400	---	550	---	14	35 J at RT
					150 ≤ t < 250	---	250	---	520	---	14	35 J at RT
JIS G 5111:1991	SCC 5A	---	---	NT	---	---	295	---	620	---	9	163 HB
	SCC 3B	---	---	QT	---	---	370	---	620	---	13	183 HB
BS 3100:1991 AMD.1:1992	A5	---	---	N, NT, OQT or WQT	---	---	370	---	620-770	---	13	25 J at 20°C
ASTM A 148/A 148M-03	90-60	---	---	A, N, NT, or QT	---	---	415	60	620	90	20	---
ASTM A 958-00	SC 1040 Class 90/60	---	---	NT	---	---	415	60	620	90	18	---
	SC 1045 Class 90/60	---	---	NT								
JIS G 5102:1991	SCW 620	---	---	A, N, NT, or QT	---	---	430	---	620	---	17	27 J at 0°C
JIS G 5111:1991	SCMn 3A	---	---	NT	---	---	370	---	640	---	13	170 HB
	SCMn 2B	---	---	QT	---	---	440	---	640	---	16	183 HB
	SCSiMn 2B	---	---	QT	---	---	440	---	640	---	17	183 HB

7.1 Cast Carbon Steels

7.1.1A Mechanical Properties of Cast Carbon Steel for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
AFNOR NF A 32-054:1994	GE370	---	---	N	28 ≤ t < 50	---	370	---	650	---	12	20 J at RT
					50 ≤ t <100	---	320	---	650	---	10	18 J at RT
JIS G 5111:1991	SCMn 5A	---	---	NT	---	---	390	---	690	---	9	183 HB
	SCC 5B	---	---	QT	---	---	440	---	690	---	9	201 HB
	SCMn 3B	---	---	QT	---	---	490	---	690	---	13	197 HB
BS 3100:1991 AMD.1:1992	A6	---	---	OQT or WQT	---	---	495	---	690-850	---	13	25 J at 20°C
AFNOR NF A 32-054:1994	G30Mn6	---	---	QT1 (TR1)	28 ≤ t < 50	---	550	---	700	---	10	30 J at RT
					50 ≤ t <100	---	550	---	700	---	10	30 J at RT
ASTM A 148/A 148M-03	105-85	---	J31575	A, N, NT, or QT	---	---	585	85	725	105	17	---
ASTM A 958-00	SC 1045 Class 105/85	---	---	NT	---	---	585	85	725	105	17	---
JIS G 5111:1991	SCMn 5B	---	---	QT	---	---	540	---	740	---	9	212 HB

7.1 Cast Carbon Steels

7.1.1B Chemical Composition of Cast Carbon Steel for General and Structural Applications

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 5101:1991	SC 360	---	---	0.20	---	---	0.040	0.040	---	---	---	---
DIN 1681:1985	GS-38	1.0420	---	---	---	---	---	---	---	---	---	---
AFNOR NF A 32-054:1994	GE 230	---	---	0.20	1.20	0.60	0.035	0.030	---	---	---	---
ISO 3755:1991	200-400	---	---	---	---	---	0.035	0.035	---	---	---	---
	200-400W	---	---	0.25	1.00	0.60	0.035	0.035	0.35	0.40	0.15	Cu 0.40; V 0.05; Ni+Cr+Mo+V 1.00
JIS G 5101:1991	SC 410	---	---	0.30	---	---	0.040	0.040	---	---	---	---
JIS G 5102:1991	SCW 410	---	---	0.22	1.50	0.80	0.040	0.040	---	---	---	---
ASTM A 27/A 27M-03	U-60-30	---	J02500	0.25	0.75	0.80	0.05	0.06	---	---	---	---
	60-30	---	J03000	0.30	0.60	0.80	0.05	0.06	---	---	---	---
BS 3100:1991 AMD.1:1992	A1	---	---	0.25	0.90	0.60	0.050	0.050	0.30	0.40	0.15	Cu 0.30; Cu+Ni+Cr+Mo 0.80
AFNOR NF A 32-054:1994	G16Mn5	---	---	0.13-0.20	1.60	0.60	0.030	0.025	---	---	---	---
ASTM A 27/A 27M-03	65-35	---	J03001	0.30	0.70	0.80	0.05	0.06	---	---	---	---
ASTM A 958-00	SC 1020 Class 65/35	---	---	0.18-0.23	0.40-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1025 Class 65/35	---	---	0.22-0.28	0.40-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1030 Class 65/35	---	---	0.28-0.34	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
JIS G 5101:1991	SC 450	---	---	0.35	---	---	0.040	0.040	---	---	---	---
JIS G 5102:1991	SCW 450	---	---	0.22	1.50	0.80	0.040	0.040	---	---	---	---
DIN 1681:1985	GS-45	1.0446	---	---	---	---	---	---	---	---	---	---
ISO 3755:1991	230-450	---	---	---	---	---	0.035	0.035	---	---	---	---
	230-450W	---	---	0.25	1.20	0.60	0.035	0.035	0.35	0.40	0.15	Cu 0.40; V 0.05; Ni+Cr+Mo+V 1.00
AFNOR NF A 32-054:1994	GE280	---	---	0.25	1.20	0.60	0.035	0.030	---	---	---	---
JIS G 5101:1991	SC 480	---	---	0.40	---	---	0.040	0.040	---	---	---	---
JIS G 5102:1991	SCW 480	---	---	0.22	1.50	0.80	0.040	0.040	0.50	0.50	---	---
ISO 3755:1991	270-480	---	---	---	---	---	0.035	0.035	---	---	---	---
	270-480W	---	---	0.25	1.20	0.60	0.035	0.035	0.35	0.40	0.15	Cu 0.40; V 0.05; Ni+Cr+Mo+V 1.00
ASTM A 27/A 27M-03	70-36	---	J03501	0.35	0.70	0.80	0.05	0.06	---	---	---	---
	70-40	---	J02501	0.25	1.20	0.80	0.05	0.06	---	---	---	---
ASTM A 958-00	SC 1020, Class 70/36	---	---	0.18-0.23	0.40-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1025, Class 70/36	---	---	0.22-0.28	0.40-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1030, Class 70/36	---	---	0.28-0.34	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1040, Class 70/36	---	---	0.37-0.44	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
BS 3100:1991 AMD.1:1992	A2	---	---	0.35	1.00	0.60	0.050	0.050	---	---	---	---

7.1 Cast Carbon Steels

7.1.1B Chemical Composition of Cast Carbon Steel for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 32-054:1994	G20Mn6	---	---	0.17-0.23	1.80	0.60	0.030	0.025	---	---	---	---
AFNOR NF A 32-053:1992	20 M5-M	---	---	0.17-0.23	1.10-1.50	0.60	0.025	0.020	---	---	---	---
DIN 1681:1985	GS-52	1.0552	---	---	---	---	---	---	---	---	---	---
DIN 17205:1992	GS-30 Mn 5	1.1165	---	0.27-0.34	1.20-1.50	0.60	0.020	0.015	---	---	---	---
JIS G 5111:1991	SCC 3	---	---	0.30-0.40	0.50-0.80	0.30-0.60	0.040	0.040	---	---	---	---
BS 3100:1991 AMD.1:1992	A3	---	---	0.45	1.0	0.60	0.050	0.050	---	---	---	---
JIS G 5111:1991	SCMn 1	---	---	0.20-0.30	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
BS 3100:1991 AMD.1:1992	A4	---	---	0.18-0.25	1.2-1.6	0.60	0.050	0.050	---	---	---	---
ASTM A 148/A 148M-03	80-40	---	---	---	---	---	0.05	0.06	---	---	---	---
	80-50											
ASTM A 958-00	SC 1030 Class 80/40 SC 1030 Class 80/50	---	---	0.28-0.34	0.40-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1040 Class 80/40 SC 1040 Class 80/50	---	---	0.37-0.44	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1045 Class 80/40 SC 1045 Class 80/50	---	---	0.43-0.50	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
JIS G 5102:1991	SCW 550	---	---	0.22	1.50	0.80	0.040	0.040	0.50	2.50	0.30	V 0.20
ISO 3755:1991	340-550	---	---	---	---	---	0.035	0.035	---	---	---	---
	340-550W	---	---	0.25	1.50	0.60	0.035	0.035	0.35	0.40	0.15	V 0.05; Cu+Ni+Cr+Mo+V 1.00
AFNOR NF A 32-054:1994	GE320	---	---	0.32	1.20	0.60	0.035	0.030	---	---	---	---
	G30Mn6	---	---	0.25-0.32	1.80	0.60	0.030	0.025	---	---	---	---
JIS G 5111:1991	SCSiMn 2	---	---	0.25-0.35	0.90-1.20	0.50-0.80	0.040	0.040	---	---	---	---
JIS G 5111:1991	SCMn 1	---	---	0.20-0.30	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
	SCMn 2	---	---	0.25-0.35	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
DIN 1681:1985	GS-60	1.0558	---	---	---	---	---	---	---	---	---	---
AFNOR NF A 32-054:1994	G30Mn6	---	---	0.25-0.32	1.80	0.60	0.030	0.025	---	---	---	---
JIS G 5111:1991	SCC 5	---	---	0.40-0.50	0.50-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	SCC 3	---	---	0.30-0.40	0.50-0.80	0.30-0.60	0.040	0.040	---	---	---	---
BS 3100:1991 AMD.1:1992	A5	---	---	0.25-0.33	1.2-1.6	0.60	0.05	0.05	---	---	---	---
ASTM A 148/A 148M-03	90-60	---	---	---	---	---	0.05	0.06	---	---	---	---
ASTM A 958-00	SC 1040 Class 90/60	---	---	0.37-0.44	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1045 Class 90/60	---	---	0.43-0.50	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
JIS G 5102:1991	SCW 620	---	---	0.22	1.50	0.80	0.040	0.040	0.50	2.50	0.30	V 0.20
JIS G 5111:1991	SCMn 3	---	---	0.30-0.40	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
	SCMn 2	---	---	0.25-0.35	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
	SCSiMn 2	---	---	0.25-0.35	0.90-1.20	0.50-0.80	0.040	0.040	---	---	---	---

7.1 Cast Carbon Steels

7.1.1B Chemical Composition of Cast Carbon Steel for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 32-054:1994	GE370	---	---	0.45	1.20	0.60	0.035	0.030	---	---	---	---
JIS G 5111:1991	SCMn 5	---	---	0.40-0.50	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
	SCC 5	---	---	0.40-0.50	0.50-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	SCMn 3	---	---	0.30-0.40	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
BS 3100:1991 AMD.1:1992	A6	---	---	0.25-0.33	1.2-1.6	0.60	0.050	0.050	---	---	---	---
ASTM A 148/A 148M-03	105-85	---	J31575	---	---	---	0.05	0.06	---	---	---	---
ASTM A 958-00	SC 1045 Class 105/85	---	---	0.43-0.50	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
JIS G 5111:1991	SCMn 5	---	---	0.40-0.50	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---

7.1 Cast Carbon Steels

7.1.2A Mechanical Properties of Cast Carbon Steel for Pressure Purposes at High Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 5151:1991	SCPH 1	---	---	A, N, NT, or QT	---	---	205	---	410	---	---	---
ASTM A 216/A 216M-93 (2003)	WCA	---	J02502	A, N, or NT	---	---	205	30	415-585	60-85	24	---
EN 10213-2:1995	GP240GR	1.0621	---	N	---	---	240	---	420-600	---	22	27 J at RT
	GP240GH	1.0619	---	N	---	---	240	---	420-600	---	22	27 J at RT
				QT								40 J at RT
ISO 4991:1994	C23-45A	---	---	A, N(T), or (QT)	---	---	240	---	450-600	---	22	---
	C23-45AH	---	---	N(T) or QT								
	C23-45B	---	---	A, N(T), or (QT)								
	C23-45BH	---	---	N(T) or QT								
JIS G 5151:1991	SCPH 2	---	---	A, N, NT, or QT	---	---	245		480	---	---	---
EN 10213-2:1995	GP280GH	1.0625	---	N	---	---	280	---	480-640	---	22	27 J at RT
				QT								35 J at RT
ASTM A 216/A 216M-93 (2003)	WCB	---	J03002	A, N, or NT	---	---	250	36	485-655	70-95	22	---
	WCC	---	J02503	A, N, or NT	---	---	275	40	485-655	70-95	22	---
ISO 4991:1994	C26-52	---	---	A, N(T), or (QT)	---	---	280	---	520-670	---	18	---
	C26-52H	---	---	NT or QT								

7.1.2B Chemical Composition of Cast Carbon Steel for Pressure Purposes at High Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 5151:1991	SCPH 1	---	---	0.25	0.70	0.60	0.040	0.040	0.25	0.50	0.25	Cu+Ni+Cr+Mo 1.00
ASTM A 216/A 216M-93 (2003)	WCA	---	J02502	0.25	0.70	0.60	0.04	0.045	0.50	0.50	0.20	Cu 0.30; V 0.03; Cu+Ni+Cr+Mo+V 1.00
EN 10213-2:1995	GP240GP	1.0621	---	0.18-0.25	1.20	0.60	0.030	0.020	---	---	---	---
	GP240GH	1.0619	---	0.18-0.23	0.50-1.20	0.60	0.030	0.020	---	---	---	---
ISO 4991:1995	C23-45A	---	---	0.025	1.20	0.60	0.035	0.035	---	---	---	---
	C23-45H											
	C23-45B	---	---	0.20	1.00-1.60	0.60	0.030	0.030	---	---	---	---
	C23-45BH											
JIS G 5151:1991	SCPH 2	---	---	0.30	1.00	0.60	0.040	0.040	0.25	0.50	0.25	Cu+Ni+Cr+Mo 1.00
EN 10213-2:1995	GP280GH	1.0625	---	0.18-0.25	0.80-1.20	0.60	0.030	0.020	---	---	---	---
ASTM A 216/A 216M-93 (2003)	WCB	---	J03002	0.30	1.00	0.60	0.04	0.045	0.50	0.50	0.20	Cu 0.30; V 0.03; Cu+Ni+Cr+Mo+V 1.00
	WCC	---	J02503	0.25	1.20	0.60	0.04	0.045	0.50	0.50	0.20	Cu 0.30; V 0.03; Cu+Ni+Cr+Mo+V 1.00
ISO 4991:1995	C26-52	---	---	0.25	1.20	0.60	0.030	0.030	---	---	---	---
	C26-52H											

7.1 Cast Carbon Steels

7.1.3A Mechanical Properties of Cast Carbon Steel for Pressure Purposes at Low Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 352/A 352M-03	LCA	---	J02504	NT or QT	---	---	205	30.0	415-585	60-85	24	18 J at -32°C
ASTM A 757/A 757M-00	A1Q	---	J03002	QT	---	---	240	35	450	65	24	17 J at -46°C
JIS G 5152:1991	SCPL 1	---	---	A, N, NT, or QT	---	---	245	---	450	---	21	18 J at -46°C
ISO 4991:1994	C23-45BL	---	---	(NT) or QT	---	---	240	---	450-600	---	22	27 J at -40°C
EN 10213-3:1995	G17Mn5	1.1131	---	QT	≤ 50	---	240	---	450-600	---	24	27 J at -40°C
ASTM A 352/A 352M-03	LCB	---	J03003	NT or QT	---	---	240	35	450-620	65.0-90.0	24	18 J at -46°C
EN 10213-3:1995	G20Mn5	1.6220	---	N	≤ 30	---	300	---	480-620	---	20	27 J at -30°C
ASTM A 757/A 757M-00	A2Q	---	J02503	QT	---	---	275	40	485	70	22	20 J at -46°C
ASTM A 352/A 352M-03	LCC	---	J02505	NT or QT	---	---	275	40.0	485-655	70.0-95.0	22	20 J at -46°C
EN 10213-3:1995	G20Mn5	1.6220	---	QT	≤ 100	---	300	---	500-650	---	22	27 J at -40°C
ISO 4991:1994	C26-52L	---	---	(NT) or QT	---	---	280	---	520-670	---	18	27 J at -35°C

7.1.3B Chemical Composition of Cast Carbon Steel for Pressure Purposes at Low Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 352/A 352M-03	LCA	---	J02504	0.25	0.70	0.60	0.04	0.045	0.50	0.50	0.20	Cu 0.30; V 0.03; P+S+Ni+Cr+Mo+Cu+V 1.00
ASTM A 757/A 757M-00	A1Q	---	J03002	0.30	1.00	0.60	0.025	0.025	0.40	0.50	0.25	Cu 0.50; V 0.03; Ni+Cr+Mo+Cu+V 1.00
JIS G 5152:1991	SCPL 1	---	---	0.30	1.00	0.60	0.040	0.040	0.25	0.50	---	Cu 0.50; Cu+Ni+Cr 1.00
ISO 4991:1994	C23-45BL	---	---	0.20	1.00-1.60	0.60	0.030	0.030	---	---	---	---
EN 10213-3:1995	G17Mn5	1.1131	---	0.15-0.20	1.00-1.60	0.60	0.020	0.020	---	---	---	---
ASTM A 352/A 352M-03	LCB	---	J03003	0.30	1.00	0.60	0.04	0.045	0.50	0.50	0.20	Cu 0.30; V 0.03; P+S+Ni+Cr+Mo+Cu+V 1.00
EN 10213-3:1995	G20Mn5	1.6220	---	0.17-0.23	1.00-1.60	0.60	0.020	0.020	---	0.80	---	---
ASTM A 757/A 757M-00	A2Q	---	J02503	0.25	1.20	0.60	0.025	0.025	0.40	0.50	0.25	Cu 0.50; V 0.03; Ni+Cr+Mo+Cu+V 1.00
ASTM A 352/A 352M-03	LCC	---	J02505	0.25	1.20	0.60	0.04	0.045	0.50	0.50	0.20	V 0.03; Ni+Cr+Mo+Cu+V 1.00
ISO 4991:1994	C26-52L	---	---	0.25	1.20	0.60	0.030	0.030	---	---	---	---

7.2 Cast Manganese Steels

7.2A Chemical Composition of Cast Manganese Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 5131:1991	SCMnH 1	---	---	0.90-1.30	11.00-14.00	---	0.100	0.050	---	---	---	---
	SCMnH 2	---	---	0.90-1.20	11.00-14.00	0.80	0.070	0.040	---	---	---	---
	SCMnH 3	---	---	0.90-1.20	11.00-14.00	0.30-0.80	0.050	0.035	---	---	---	---
ASTM A 128/A 128M-93 (2003)	A	---	J91109	1.05-1.35	11.0	1.00	0.07	---	---	---	---	---
	B-1	---	J91119	0.9-1.05	11.5-14.0	1.00	0.07	---	---	---	---	---
	B-2	---	J91129	1.05-1.2	11.5-14.0	1.00	0.07	---	---	---	---	---
	B-3	---	J91139	1.12-1.28	11.5-14.0	1.00	0.07	---	---	---	---	---
	B-4	---	J91149	1.2-1.35	11.5-14.0	1.00	0.07	---	---	---	---	---
BS 3100:1991 AMD.1:1992	BW10	---	---	1.00-1.35	11.0	1.0	0.050	0.050	---	---	---	---
AFNOR NF A 32-058:1984	Z120M12-M	---	---	1.1-1.4	11-14	1	0.08	0.030	---	---	---	---
ISO 13521:1999	GX100Mn13	---	---	0.90-1.05	11-14	0.3-0.9	0.060	0.045	---	---	---	---
	GX120Mn13	---	---	1.05-1.35	11-14	0.3-0.9	0.060	0.045	---	---	---	---
JIS G 5131:1991	SCMnH 11	---	---	0.90-1.30	11.00-14.00	0.80	0.070	0.040	1.50-2.50	---	---	---
ASTM A 128/A 128M-93 (2003)	C	---	J91309	1.05-1.35	11.5-14.0	1.00	0.07	---	1.5-2.5	---	---	---
AFNOR NF A 32-058:1984	Z120MC12-M	---	---	1.1-1.4	11-14	1	0.08	0.030	1-2.5	---	---	---
ISO 13521:1999	GX120MnCr13-2	---	---	1.05-1.35	11-14	0.3-0.9	0.060	0.045	1.5-2.5	---	---	---
ASTM A 128/A 128M-93 (2003)	D	---	J91459	0.7-1.3	11.5-14.0	1.00	0.07	---	---	3.0-4.0	---	---
AFNOR NF A 32-058:1984	Z100MN13 4-M	---	---	0.7-1.3	12-15	1	0.08	0.030	---	2-5	---	---
ISO 13521:1999	GX120MnNi13-3	---	---	1.05-1.35	11-14	0.3-0.9	0.060	0.045	---	3-4	---	---
ASTM A 128/A 128M-93 (2003)	E-1	---	J91249	0.7-1.3	11.5-14.0	1.00	0.07	---	---	---	0.9-1.2	---
AFNOR NF A 32-058:1984	Z110MD12 1-M	---	---	0.8-1.3	11-14	1	0.08	0.030	---	---	0.8-1.2	---
ISO 13521:1999	GX110MnMo13-1	---	---	0.75-1.35	11-14	0.3-0.9	0.060	0.045	---	---	0.9-1.2	---
ASTM A 128/A 128M-93 (2003)	E-2	---	J91339	1.05-1.45	11.5-14.0	1.00	0.07	---	---	---	1.8-2.1	---
ISO 13521:1999	GX90MnMo14	---	---	0.70-1.00	13-15	0.3-0.6	0.070	0.045	---	---	1.0-1.8	---
ASTM A 128/A 128M-93 (2003)	F	---	J91340	1.05-1.35	6.0-8.0	1.00	0.07	---	---	---	0.9-1.2	---
AFNOR NF A 32-058:1984	Z100MD8 1-M	---	---	0.8-1.2	5-7	1	0.08	0.030	---	---	0.8-1.2	---
ISO 13521:1999	GX120MnMo7-1	---	---	1.05-1.35	6-8	0.3-0.9	0.060	0.045	---	---	0.9-1.2	---
AFNOR NF A 32-058:1984	Z120MC17 2-M	---	---	1.1-1.4	16-18	1	0.08	0.030	1.8-2.3	---	---	---
ISO 13521:1999	GX120MnCr7-2	---	---	1.05-1.35	16-19	0.3-0.9	0.060	0.045	1.5-2.5	---	---	---

7.2 Cast Manganese Steels

7.2B Mechanical Properties of Cast Manganese Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 5131:1991	SCMnH 1	---	---	WT	---	---	---	---	---	---	---	---
	SCMnH 2	---	---	WT	---	---	---	---	740	---	---	---
	SCMnH 3	---	---	WT	---	---	---	---	740	---	---	---
ASTM A 128/A 128M-93 (2003)	A	---	J91109	see standard	---	---	---	---	---	---	---	---
	B-1	---	J91119	see standard	---	---	---	---	---	---	---	---
	B-2	---	J91129	see standard	---	---	---	---	---	---	---	---
	B-3	---	J91139	see standard	---	---	---	---	---	---	---	---
	B-4	---	J91149	see standard	---	---	---	---	---	---	---	---
BS 3100:1991 AMD.1:1992	BW10	---	---	ST	---	---	---	---	---	---	---	---
AFNOR NF A 32-058:1984	Z120M12-M	---	---	---	---	---	---	---	---	---	---	---
ISO 13521:1999	GX100Mn13	---	---	ST + WQ	---	---	---	---	---	---	---	---
	GX120Mn13	---	---	ST + WQ	---	---	---	---	---	---	---	---
JIS G 5131:1991	SCMnH 11	---	---	WT	---	---	390	---	740	---	---	---
ASTM A 128/A 128M-93 (2003)	C	---	J91309	see standard	---	---	---	---	---	---	---	---
AFNOR NF A 32-058:1984	Z120MC12-M	---	---	---	---	---	---	---	---	---	---	---
ISO 13521:1999	GX120MnCr13-2	---	---	ST + WQ	---	---	---	---	---	---	---	---
ASTM A 128/A 128M-93 (2003)	D	---	J91459	see standard	---	---	---	---	---	---	---	---
AFNOR NF A 32-058:1984	Z100MN13 4-M	---	---	---	---	---	---	---	---	---	---	---
ISO 13521:1999	GX120MnNi13-3	---	---	ST + WQ	---	---	---	---	---	---	---	---
ASTM A 128/A 128M-93 (2003)	E-1	---	J91249	see standard	---	---	---	---	---	---	---	---
AFNOR NF A 32-058:1984	Z110MD12 1M	---	---	---	---	---	---	---	---	---	---	---
ISO 13521:1999	GX110MnMo13-1	---	---	ST + WQ	---	---	---	---	---	---	---	---
ASTM A 128/A 128M-93 (2003)	E-2	---	J91339	see standard	---	---	---	---	---	---	---	---
ISO 13521:1999	GX90MnMo14	---	---	AC	< 45 mm and C < 0.8	---	---	---	---	---	---	---
				ST + WQ	≥ 45 mm	---						
ASTM A 128/A 128M-93 (2003)	F	---	J91340	see standard	---	---	---	---	---	---	---	---
AFNOR NF A 32-058:1984	Z100MD8 1-M	---	---	---	---	---	---	---	---	---	---	---
ISO 13521:1999	GX120MnMo7-1	---	---	ST + WQ	---	---	---	---	---	---	---	---
AFNOR NF A 32-058:1984	Z120MC17 2-M	---	---	---	---	---	---	---	---	---	---	---
ISO 13521:1999	GX120MnCr7-2	---	---	ST + WQ	---	---	---	---	---	---	---	---

7.3 Cast Alloy Steels

7.3.1A Chemical Composition of Cast Alloy Steels for General and Structural Purposes

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 32-053:1992	20 D5-M	---	---	0.23	1.20	0.60	0.025	0.020	---	---	0.45-0.65	---
BS 3100:1991 AMD.1:1992	B1	---	---	0.20	0.40-1.00	0.20-0.60	0.040	0.040	0.30	0.40	0.45-0.65	Cu 0.30; Cr+Ni+Cu+V 0.80
AFNOR NF A 32-054:1994	G25CrMo4	---	---	0.22-0.28	1.00	0.60	0.030	0.020	0.80-1.20	---	0.15-0.35	---
JIS G 5111:1991	SCCrM 1	---	---	0.20-0.30	0.50-0.80	0.30-0.60	0.040	0.040	0.80-1.20	---	0.15-0.35	---
DIN 17205:1992	GS-25 CrMo 4	1.7218	---	0.22-0.29	0.50-0.80	0.60	0.020	0.015	0.80-1.20	---	0.20-0.30	---
ASTM A 958-00	SC 4130	---	---	0.28-0.33	0.40-0.80	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
DIN 17205:1992	GS-34 CrMo 4	1.7220	---	0.30-0.37	0.50-0.80	0.60	0.020	0.015	0.80-1.20	---	0.20-0.30	---
JIS G 5111:1991	SCCrM 3	---	---	0.30-0.40	0.50-0.80	0.30-0.60	0.040	0.040	0.80-1.20	---	0.15-0.35	---
AFNOR NF A 32-054:1994	G35CrMo4	---	---	0.30-0.38	1.00	0.60	0.030	0.020	0.80-1.20	---	0.15-0.35	---
ASTM A 958-00	SC 4140	---	---	0.38-0.43	0.70-1.10	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
DIN 17205:1992	GS-42 CrMo 4	1.7225	---	0.38-0.45	0.60-1.00	0.60	0.020	0.015	0.80-1.20	---	0.20-0.30	---
AFNOR NF A 32-054:1994	G42CrMo4	---	---	0.39-0.45	1.00	0.60	0.030	0.020	0.80-1.20	---	0.15-0.35	---
ASTM A 958-00	SC 4330	---	---	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	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	---
DIN 17205:1992	GS-33 CrNiMo 7 4 4	1.6740	---	0.30-0.36	0.50-0.80	0.60	0.015	0.007	0.90-1.20	1.50-1.80	0.35-0.50	---
AFNOR NF A 32-054:1994	G30NiCrMo8	---	---	0.33	1.00	0.60	0.030	0.020	0.80-1.20	1.70-2.30	0.30-0.60	---

7.3 Cast Alloy Steels

7.3.1B Mechanical Properties of Cast Alloy Steels for General and Structural Purposes

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
AFNOR NF A 32-053:1992	20 D5-M	---	---	QT	≤ 100	---	245	---	440	---	22	27 J at -45°C
BS 3100:1991 AMD.1:1992	B1	---	---	NT or OQT or WQT	---	---	260	---	460	---	18	20 J at 20°C
AFNOR NF A 32-054:1994	G25CrMo4	---	---	N	28 ≤ t < 50	---	380	---	580	---	18	22 J at RT
					50 ≤ t <100	---	300	---	580	---	16	20 J at RT
					100 ≤ t < 150	---	250	---	550	---	14	20 J at RT
					150 ≤ t < 250	---	250	---	550	---	14	20 J at RT
				QT1 (TR1)	28 ≤ t < 50	---	550	---	750	---	12	35 J at RT
					50 ≤ t <100	---	550	---	700	---	10	18 J at RT
					100 ≤ t < 150	---	520	---	650	---	10	10 J at RT
					150 ≤ t < 250	---	500	---	650	---	10	10 J at RT
JIS G 5111:1991	SCCrM 1A	---	---	NT	---	---	390	---	590	---	13	170 HB min
	SCCrM 1B	---	---	QT	---	---	490	---	690	---	13	201 HB min
DIN 17205:1992	GS-25 CrMo 4	1.7218	---	NT	≤ 250	---	300	---	550-700	---	16	see standard for impact data
	GS-25 CrMo 4, Class I	1.7218	---	QT	≤ 50	---	450	---	600-750	---	18	
	GS-25 CrMo 4, Class II	1.7218	---	QT	≤ 50	---	600	---	750-900	---	10	
	GS-25 CrMo 4, Class I	1.7218	---	QT	50 < t ≤ 100	---	450	---	600-750	---	14	
	GS-25 CrMo 4, Class II	1.7218	---	QT	50 < t ≤ 100	---	550	---	700-850	---	10	
	GS-25 CrMo 4, Class I	1.7218	---	QT	100 < t ≤ 150	---	410	---	600-750	---	12	

7.3 Cast Alloy Steels

7.3.1B Mechanical Properties of Cast Alloy Steels for General and Structural Purposes (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 958-00	SC 4130 Class 65/35	---	---	NT	---	---	240	35	450	65	24	---
	SC 4130 Class 70/36	---	---	NT	---	---	250	36	485	70	22	---
	SC 4130 Class 80/40	---	---	NT	---	---	275	40	550	80	18	---
	SC 4130 Class 80/50	---	---	NT	---	---	345	50	550	80	22	---
	SC 4130 Class 90/60	---	---	NT or QT	---	---	415	60	620	90	18	---
	SC 4130 Class 105/85	---	---	QT	---	---	585	85	725	105	17	---
	SC 4130 Class 115/95	---	---	QT	---	---	655	95	795	115	14	---
	SC 4130 Class 130/115	---	---	QT	---	---	795	115	895	130	11	---
	SC 4130 Class 135/125	---	---	QT	---	---	860	125	930	135	9	---
	SC 4130 Class 150/135	---	---	QT	---	---	930	135	1035	150	7	---
DIN 17205:1992	GS-34 CrMo 4	1.7220	---	NT	≤ 150	---	380	---	650-800	---	10	see standard for impact data
					150 < t ≤ 250	---	330	---	620-770	---	10	
					250 < t ≤ 400	---	300	---	620-770	---	10	
	GS-34 CrMo 4, Class I	1.7220	---	QT	≤ 50	---	600	---	750-850	---	14	
	GS-34 CrMo 4, Class II	1.7220	---	QT	≤ 50	---	700	---	850-1000	---	10	
	GS-34 CrMo 4, Class I	1.7220	---	QT	50 < t ≤ 100	---	540	---	700-850	---	12	
	GS-34 CrMo 4, Class II	1.7220	---	QT	50 < t ≤ 100	---	650	---	830-980	---	10	
	GS-34 CrMo 4, Class I	1.7220	---	QT	100 < t ≤ 150	---	480	---	620-770	---	10	
JIS G 5111:1991	SCCrM 3A	---	---	NT	---	---	440	---	690	---	9	201 HB min
	SCCrM 3B	---	---	QT	---	---	540	---	740	---	9	217 HB min
AFNOR NF A 32-054:1994	G35CrMo4	---	---	N	28 ≤ t < 50	---	520	---	750	---	12	20 J at RT
					50 ≤ t <100	---	450	---	700	---	10	18 J at RT
					100 ≤ t < 150	---	380	---	650	---	10	15 J at RT
					150 ≤ t < 250	---	330	---	620	---	10	15 J at RT
				QT2 (TR2)	28 ≤ t < 50	---	600	---	750	---	14	35 J at RT
					50 ≤ t <100	---	540	---	700	---	12	30 J at RT
					100 ≤ t < 150	---	480	---	620	---	10	25 J at RT

7.3 Cast Alloy Steels

7.3.1B Mechanical Properties of Cast Alloy Steels for General and Structural Purposes (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 958-00	SC 4140 Class 65/35	---	---	NT	---	---	240	35	450	65	24	---
	SC 4140 Class 70/36	---	---	NT	---	---	250	36	485	70	22	---
	SC 4140 Class 80/40	---	---	NT	---	---	275	40	550	80	18	---
	SC 4140 Class 80/50	---	---	NT	---	---	345	50	550	80	22	---
	SC 4140 Class 90/60	---	---	NT	---	---	415	60	620	90	18	---
	SC 4140 Class 105/85	---	---	NT or QT	---	---	585	85	725	105	17	---
	SC 4140 Class 115/95	---	---	QT	---	---	655	95	795	115	14	---
	SC 4140 Class 130/115	---	---	QT	---	---	795	115	895	130	11	---
	SC 4140 Class 135/125	---	---	QT	---	---	860	125	930	135	9	---
	SC 4140 Class 150/135	---	---	QT	---	---	930	135	1035	150	7	---
	SC 4140 Class 160/145	---	---	QT	---	---	1000	145	1105	160	6	---
	SC 4140 Class 165/150	---	---	QT	---	---	1035	150	1140	165	5	---
DIN 17205:1992	GS-42 CrMo 4	1.7225	---	NT	≤ 150	---	400	---	700-850	---	10	see standard for impact data
					150 < t ≤ 250	---	350	---	650-800	---	10	
					250 < t ≤ 400	---	320	---	650-800	---	10	
	GS-42 CrMo 4, Class I	1.7225	---	QT	≤ 50	---	650	---	780-930	---	14	
	GS-42 CrMo 4, Class II	1.7225	---	QT	≤ 50	---	800	---	900-1100	---	10	
	GS-42 CrMo 4, Class I	1.7225	---	QT	50 < t ≤ 100	---	600	---	800-950	---	12	
	GS-42 CrMo 4, Class II	1.7225	---	QT	50 < t ≤ 100	---	700	---	850-1000	---	10	
	GS-42 CrMo 4, Class I	1.7225	---	QT	100 < t ≤ 150	---	550	---	700-850	---	10	
AFNOR NF A 32-054:1994	G42CrMo4	---	---	N	28 ≤ t < 50	---	580	---	780	---	10	12 J at RT
					50 ≤ t <100	---	460	---	740	---	10	12 J at RT
					100 ≤ t < 150	---	400	---	700	---	10	10 J at RT
					150 ≤ t < 250	---	350	---	650	---	10	10 J at RT
				QT2 (TR2)	28 ≤ t < 50	---	650	---	800	---	14	27 J at RT
					50 ≤ t <100	---	600	---	780	---	12	27 J at RT
					100 ≤ t < 150	---	550	---	700	---	10	20 J at RT

7.3 Cast Alloy Steels

7.3.1B Mechanical Properties of Cast Alloy Steels for General and Structural Purposes (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 958-00	SC 4330 Class 65/35	---	---	NT	---	---	240	35	450	65	24	---
	SC 4330 Class 70/36	---	---	NT	---	---	250	36	485	70	22	---
	SC 4330 Class 80/40	---	---	NT	---	---	275	40	550	80	18	---
	SC 4330 Class 80/50	---	---	NT	---	---	345	50	550	80	22	---
	SC 4330 Class 90/60	---	---	NT or QT	---	---	415	60	620	90	18	---
	SC 4330 Class 105/85	---	---	QT	---	---	585	85	725	105	17	---
	SC 4330 Class 115/95	---	---	QT	---	---	655	95	795	115	14	---
	SC 4330 Class 130/115	---	---	QT	---	---	795	115	895	130	11	---
	SC 4330 Class 135/125	---	---	QT	---	---	860	125	930	135	9	---
	SC 4330 Class 150/135	---	---	QT	---	---	930	135	1035	150	7	---
	SC 4330 Class 160/145	---	---	QT	---	---	1000	145	1105	160	6	---
	SC 4330 Class 165/150	---	---	QT	---	---	1035	150	1140	165	5	---
	SC 4330 Class 210/180	---	---	QT	---	---	1240	180	1450	210	4	---
JIS G 5111:1991	SCNCrM 2A	---	---	NT	---	---	590	---	780	---	9	223 HB min
	SCNCrM 2B	---	---	QT	---	---	685	---	880	---	9	269 HB min
DIN 17205:1992	GS-33 CrNiMo 7 4 4	1.6740	---	NT	≤ 150	---	600	---	800-950	---	12	see standard for impact data
					150 < t ≤ 400	---	550	---	750-900	---	12	
	GS-33 CrNiMo 7 4 4, Class I	1.6740	---	QT	≤ 100	---	700	---	850-1000	---	16	
	GS-33 CrNiMo 7 4 4, Class II	1.6740	---	QT	≤ 100	---	950	---	1050-1250	---	10	
	GS-33 CrNiMo 7 4 4, Class I	1.6740	---	QT	100 < t ≤ 250	---	700	---	850-1000	---	14	
	GS-33 CrNiMo 7 4 4, Class I	1.6740	---	QT	250 < t ≤ 400	---	650	---	800-950	---	10	
AFNOR NF A 32-054:1994	G30NiCrMo8	---	---	N	28 ≤ t < 50	---	550	---	750	---	15	32 J at RT
					50 ≤ t <100	---	550	---	750	---	12	32 J at RT
					100 ≤ t < 150	---	550	---	750	---	12	32 J at RT
					150 ≤ t < 250	---	500	---	700	---	12	32 J at RT
				QT2 (TR2)	28 ≤ t < 50	---	700	---	850	---	15	50 J at RT
					50 ≤ t <100	---	700	---	850	---	14	50 J at RT
					100 ≤ t < 150	---	650	---	850	---	12	35 J at RT
					150 ≤ t < 250	---	650	---	820	---	10	27 J at RT

7.3 Cast Alloy Steels

7.3.2A Chemical Composition of Cast Alloy Steels for Pressure Purposes at High Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10213-2:1995	G20Mo5	1.5419	---	0.15-0.23	0.50-1.00	0.60	0.025	0.020	---	0.40-0.60	---	---
JIS G 5151:1991	SCPH 11	---	---	0.25	0.50-0.80	0.60	0.040	0.040	0.35	0.45-0.65	0.50	W 0.1; Cu+Ni+Cr+W 1.00
ISO 4991:1994	C28H	---	---	0.15-0.23	0.50-1.00	0.30-0.60	0.035	0.030	0.30	0.40-0.60	---	---
ASTM A 217/A 217M-02	WC1	---	J12524	0.25	0.50-0.80	0.60	0.04	0.045	---	0.45-0.65	---	Cu 0.50; Ni 0.50; Cr 0.35; W 0.10; Cu+Ni+Cr+W 1.00
JIS G 5151:1991	SCPH 21	---	---	0.20	0.50-0.80	0.60	0.040	0.040	1.00-1.50	0.50	0.45-0.65	W 0.10; Cu+Ni+W 1.00
ASTM A 217/A 217M-02	WC6	---	J12072	0.05-0.20	0.50-0.80	0.60	0.04	0.045	1.00-1.50	---	0.45-0.65	Cu 0.50; Ni 0.50; W 0.10; Cu+Ni+W 1.00
ISO 4991:1994	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	---
EN 10213-2:1995	G17CrMo5-5	1.7357	---	0.15-0.20	0.50-1.00	0.60	0.020	0.020	1.00-1.50	---	0.45-0.65	---
JIS G 5151:1991	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
ASTM A 389/A 389M-03	C24	---	J12092	0.20	0.30-0.80	0.60	0.04	0.045	0.80-1.25	---	0.90-1.20	V 0.15-0.25
ISO 4991:1994	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
EN 10213-2:1995	G17CrMoV5-10	1.7706	---	0.15-0.20	0.50-0.90	0.60	0.020	0.015	1.20-1.50	---	0.90-1.10	V 0.20-0.30; Sn 0.025
JIS G 5151:1991	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
ASTM A 217/A 217M-02	WC9	---	J21890	0.05-0.18	0.40-0.70	0.60	0.04	0.045	2.00-2.75	---	0.90-1.20	Cu 0.50; Ni 0.50; W 0.10; Cu+Ni+W 1.00
ISO 4991:1994	C34AH	---	---	0.08-0.15	0.50-0.80	0.30-0.60	0.035	0.035	2.00-.250	---	0.90-1.20	---
ASTM A 487/A 487M-93 (2003)	Grade 8, Class A, B, 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
EN 10213-2:1995	G17CrMo9-10	1.7379	---	0.13-0.20	0.50-0.90	0.60	0.020	0.020	2.00-2.50	---	0.90-1.20	---
ISO 4991:1994	C34BH	---	---	0.13-0.20	0.50-0.80	0.30-0.60	0.035	0.035	2.00-.250	---	0.90-1.20	---
JIS G 5151:1991	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
ASTM A 217/A 217M-02	C5	---	J42045	0.20	0.40-0.70	0.75	0.04	0.045	4.00-6.50	---	0.45-0.65	Cu 0.50; Ni 0.50; W 0.10; Cu+Ni+W 1.00
EN 10213-2:1995	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	---
ISO 4991:1994	C37H	---	---	0.12-0.19	0.50-0.80	0.80	0.035	0.035	4.00-6.00	---	0.45-0.65	---
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	GX30CrSi7	---	---	0.20-0.35	0.5-1.0	1.0-2.5	0.04	0.04	6-8	0.5	0.5	---
ASTM A 217/A 217M-02	C12	---	J82090	0.20	0.35-0.65	1.00	0.04	0.045	8.00-10.00	---	0.90-1.20	Cu 0.50; Ni 0.50; W 0.10; Cu+Ni+W 1.00
ISO 4991:1994	C38H	---	---	0.10-0.17	0.50-0.80	0.80	0.035	0.035	8.00-10.00	---	1.00-1.30	---

7.3 Cast Alloy Steels

7.3.2B Mechanical Properties of Cast Alloy Steels for Pressure Purposes at High Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10213-2:1995	G20Mo5	1.5419	---	QT	≤ 100	---	245	---	440-590	---	22	27 J at RT
JIS G 5151:1991	SCPH 11	---	---	A, N, NT, or QT	---	---	245	---	450	---	22	---
ISO 4991:1994	C28H	---	---	NT or QT	---	---	250	---	450-600	---	21	25 J at RT
ASTM A 217/A 217M-02	WC1	---	J12524	NT	---	---	240	35	450-620	65-90	24	---
JIS G 5151:1991	SCPH 21	---	---	A, N, NT, or QT	---	---	275	---	480	---	17	---
ASTM A 217/A 217M-02	WC6	---	J12072	NT	---	---	275	40	485-655	70-95	20	---
ISO 4991:1994	C32H	---	---	NT or QT	---	---	290	---	490-640	---	18	27 J at RT
EN 10213-2:1995	G17CrMo5-5	1.7357	---	QT	≤ 100	---	315	---	490-690	---	20	27 J at RT
JIS G 5151:1991	SCPH 23	---	---	A, N, NT, or QT	---	---	345	---	550	---	13	---
ASTM A 389/A 389M-03	C24	---	J12092	NT	---	---	345	50	552	80	15.0	---
ISO 4991:1994	C35BH	---	---	N_{ac}T or QT	---	---	420	---	590-740	---	15	24 J at RT
EN 10213-2:1995	G17CrMoV5-10	1.7706	---	QT	≤ 150	---	440	---	590-780	---	15	27 J at RT
JIS G 5151:1991	SCPH 32	---	---	A, N, NT, or QT	---	---	275	---	480	---	17	---
ASTM A 217/A 217M-02	WC9	---	J21890	NT	---	---	275	40	485-655	70-95	20	---
ISO 4991:1994	C34AH	---	---	NT	---	---	280	---	510-660	---	18	25 J at RT
ASTM A 487/A 487M-93 (2003)	Grade 8, Class A	---	J22091	NT	---	---	380	55	585-760	85-110	20	---
EN 10213-2:1995	G17CrMo9-10	1.7379	---	QT	≤ 150	---	400	---	590-740	---	18	40 J at RT
ISO 4991:1994	C34BH	---	---	(NT), N_{ac}T or QT	---	---	390	---	600-750	---	18	40 J at RT
ASTM A 487/A 487M-93 (2003)	Grade 8, Class C	---	J22091	QT	---	---	515	75	690	100	17	22 HRC max 235 HB max
ASTM A 487/A 487M-93 (2003)	Grade 8, Class B	---	J22091	QT	---	---	585	85	725	105	17	---
JIS G 5151:1991	SCPH 61	---	---	A, N, NT, or QT	---	---	410	---	620	---	17	---
ASTM A 217/A 217M-02	C5	---	J42045	NT	---	---	415	60	620-795	90-115	18	---
EN 10213-2:1995	GX15CrMo5	1.7365	---	QT	≤ 150	---	420	---	630-760	---	16	27 J at RT
ISO 4991:1994	C37H	---	---	NT	---	---	420	---	630-780	---	16	25 J at RT
EN 10295:2002	GX30CrSi7	1.4710	---	A	---	---	---	---	---	---	---	300 HB
ISO 11973:1999	GX30CrSi7	---	---	AC or A	---	---	---	---	---	---	---	---
ASTM A 217/A 217M-02	C12	---	J82090	NT	---	---	415	60	620-795	90-115	18	---
ISO 4991:1994	C38H	---	---	NT	---	---	420	---	630-780	---	16	20 J at RT

7.3 Cast Alloy Steels

7.3.3A Chemical composition of Cast Alloy Steels for Pressure Purposes at Low Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10213-3:1995	G18Mo5	1.5422	---	0.15-0.20	0.80-1.20	0.60	0.020	0.020	---	---	0.45-0.65	---
JIS G 5152:1991	SCPL 11	---	---	0.25	0.50-0.80	0.60	0.040	0.040	0.35	---	0.45-0.65	Cu 0.50
ASTM A 352/A 352M-03	LC1	---	J12522	0.25	0.50-0.80	0.60	0.04	0.045	---	---	0.45-0.65	---
JIS G 5152:1991	SCPL 21	---	---	0.25	0.50-0.80	0.60	0.040	0.040	0.35	2.00-3.00	---	Cu 0.50
EN 10213-3:1995	G9Ni10	1.5636	---	0.06-0.12	0.50-0.80	0.60	0.020	0.015	---	2.00-3.00	---	---
ASTM A 757/A 757M-00	B2N, B2Q	---	J22501	0.25	0.50-0.80	0.60	0.025	0.025	0.40	2.0-3.0	0.25	Cu 0.50; V 0.03; P+S+Cu+V+Cr+Mo 1.00
ASTM A 352/A 352M-03	LC2	---	J22500	0.25	0.50-0.80	0.60	0.04	0.045	---	2.00-3.00	---	---
ISO 4991:1994	C43L	---	---	0.14	0.50-0.80	0.30-0.60	0.030	0.030	---	3.00-4.00	---	---
JIS G 5152:1991	SCPL 31	---	---	0.15	0.50-0.80	0.60	0.040	0.040	0.35	3.00-4.00	---	Cu 0.50
ASTM A 757/A 757M-00	B3N, B3Q	---	J31500	0.15	0.50-0.80	0.60	0.025	0.025	0.40	3.0-4.0	0.25	Cu 0.50; V 0.03; P+S+Cu+V+Cr+Mo 1.00
ASTM A 352/A 352M-03	LC3	---	J31550	0.15	0.50-0.80	0.60	0.04	0.045	---	3.00-4.00	---	---
EN 10213-3:1995	G9Ni14	1.5638	---	0.06-0.12	0.50-0.80	0.60	0.020	0.015	---	3.00-4.00	---	---
ISO 4991:1994	C43E2aL	---	---	0.22	0.40-0.80	0.30-0.60	0.030	0.030	1.35-2.00	2.50-3.50	0.35-0.60	---
ASTM A 352/A 352M-03	LC2-1	---	J42215	0.22	0.55-0.75	0.50	0.04	0.045	1.351.85	2.50-3.50	0.30-0.60	---
EN 10213-3:1995	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	0.45-0.60	---
ASTM A 757/A 757M-00	E2N1, E2Q1, E2N2, E2Q2, E2N3, E2Q3	---	---	0.20	0.40-0.70	0.60	0.020	0.020	1.50-2.00	2.75-3.90	0.40-0.60	Cu 0.50; V 0.03; W 0.10; P+S+V+Cu+W 0.70
ISO 4991:1994	C43E2bL	---	---	0.22	0.40-0.80	0.30-0.60	0.030	0.030	1.50-2.00	2.75-3.90	0.35-0.60	---

7.3 Cast Alloy Steels

7.3.3B Mechanical Properties of Cast Alloy Steels for Pressure Purposes at Low Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10213-3:1995	G18Mo5	1.5422	---	QT	≤ 100	---	240	---	440-790	---	23	27 J at -45°C
JIS G 5152:1991	SCPL 11	---	---	A, N, NT, or QT	---	---	245	---	450	---	21	18 J at -60°C
ASTM A 352/A 352M-03	LC1	---	J12522	NT or QT	---	---	240	35.0	450-620	65.0-90.0	24	18 J at -59°C
JIS G 5152:1991	SCPL 21	---	---	A, N, NT, or QT	---	---	275	---	480	---	21	21 J at -75°C
EN 10213-3:1995	G9Ni10	1.5636	---	QT	≤ 35	---	280	---	480-630	---	24	27 J at -70°C
ASTM A 757/A 757M-00	B2N, B2Q	---	J22501	NT or QT	≤ 125	5	275	40	485	70	24	20 J at -73°C
ASTM A 352/A 352M-03	LC2	---	J22500	NT or QT	---	---	275	40.0	485-655	70.0-95.0	24	20 J at -73°C
ISO 4991:1994	C43L	---	---	QT	---	---	300	---	460-610	---	20	27 at -70°C
JIS G 5152:1991	SCPL 31	---	---	A, N, NT, or QT	---	---	275	---	480	---	21	21 J at-100°C
ASTM A 757/A 757M-00	B3N, B3Q	---	J31500	NT or QT	≤ 32	1¼	275	40	485	70	24	20 J at -101°C
ASTM A 352/A 352M-03	LC3	---	J31550	NT or QT	---	---	275	40.0	485-655	70.0-95.0	24	20 J at -101°C
EN 10213-3:1995	G9Ni14	1.5638	---	QT	≤ 35	---	360	---	500-650	---	20	27 J -90°C
ISO 4991:1994	C43E2aL	---	---	(NT), N_{ac}T or QT	---	---	450	---	620-800	---	16	27 J at -80°C
ASTM A 352/A 352M-03	LC2-1	---	J42215	NT or QT	---	---	550	80.0	725-895	105.0-130.0	18	41 J at -73°C
EN 10213-3:1995	G17NiCrMo13-6	1.6781	---	QT	≤ 200	---	600	---	750-900	---	15	27 J at -80°C
ASTM A 757/A 757M-00	E2N1	---	---	NT, QT	---	---	485	70	90-120	18	620-825	41 J at -73°C
	E2Q1	---	---	NT, QT	---	---	485	70	90-120	18	620-825	41 J at -73°C
	E2N2	---	---	NT, QT	---	---	585	85	105-135	15	725-930	27 J at -73°C
	E2Q2	---	---	NT, QT	---	---	585	85	105-135	15	725-930	27 J at -73°C
	E2N3	---	---	NT, QT	---	---	690	100	115-145	13	795-1000	20 J at -73°C
	E2Q3	---	---	NT, QT	---	---	690	100	115-145	13	795-1000	20 J at -73°C
ISO 4991:1994	C43E2bL	---	---	(NT), N_{ac}T or QT	---	---	655	---	800-950	---	13	27 J at -60°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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 5121:2003	SCS 1	---	---	0.15	1.00	1.50	0.040	0.040	11.50-14.00	1.00	0.50	---
BS 3100:1991 AMD.1:1992	410C21	---	---	0.15	1.0	1.0	0.040	0.040	11.5-13.5	1.0	---	Cu 0.30
ASTM A 743/A 743M-03	CA15	---	J91150	0.15	1.00	1.50	0.04	0.04	11.5-14.0	1.00	0.50	---
BS 3100:1991 AMD.1:1992	420C28	---	---	0.20	1.0	1.0	0.040	0.040	11.5-13.5	1.0	---	Cu 0.30
EN 10283:1998	GX12Cr12	1.4011	---	0.15	1.00	1.00	0.035	0.025	11.50-13.50	1.0	0.50	---
ISO 11972:1998	GX 12 Cr 12	---	---	0.15	0.8	0.8	0.035	0.025	11.5-13.5	1.0	0.5	---
BS 3100:1991 AMD.1:1992	420C29	---	---	0.20	1.0	1.0	0.040	0.040	11.5-13.5	1.0	---	Cu 0.30
JIS G 5121:2003	SCS 3	---	---	0.15	1.00	1.00	0.040	0.040	11.50-14.00	0.50-1.50	0.15-1.00	---
EN 10283:1998	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	---
ISO 11972:1998	GX 8 CrNiMo 12 1	---	---	0.10	0.8	0.8	0.035	0.025	11.5-13.0	0.8-1.8	0.2-0.5	---
ASTM A 743/A 743M-03	CA15M	---	J91151	0.15	1.00	0.65	0.040	0.040	11.5-14.0	1.00	0.15-1.0	---
JIS G 5121:2003	SCS 2	---	---	0.16-0.24	1.00	1.50	0.040	0.040	11.50-14.00	1.00	0.50	---
	SCS 2A	---	---	0.25-0.40	1.00	1.50	0.040	0.040	11.50-14.00	1.00	0.50	---
ASTM A 743/A 743M-03	CA40	---	J91153	0.20-0.40	1.00	1.50	0.04	0.04	11.5-14.0	1.0	0.5	---
AFNOR NF A 32-053:1992	Z 3CN13.4-M	---	---	0.05	1.00	1.00	0.035	0.015	12.0-13.5	3.5-5.0	0.70	---
AFNOR NF A 32-054:1994	GX4CrNi13-4	---	---	0.06	1.00	0.80	0.035	0.020	12.00-13.50	3.50-4.50	---	---
EN 10283:1998	GX4CrNi13-4	1.4317	---	0.06	1.00	1.00	0.035	0.025	12.00-13.50	3.50-5.00	0.70	---
JIS G 5121:2003	SCS 5	---	---	0.06	1.00	1.00	0.040	0.040	11.50-14.00	3.50-4.50	---	---
ISO 11972:1998	GX 4CrNi 12 4	---	---	0.06	1.5	1.0	0.035	0.025	11.5-13.0	3.5-5.0	1.0	---
BS 3100:1991 AMD.1:1992	425C11	---	---	0.10	1.0	1.0	0.040	0.030	11.5-13.5	3.4-4.2	0.60	---
JIS G 5121:2003	SCS 6	---	---	0.06	1.00	1.00	0.040	0.030	11.50-14.00	3.50-4.50	0.40-1.00	---
BS 3100:1991 AMD.1:1992	425C12	---	---	0.06	1.0	1.0	0.040	0.030	11.5-14.0	3.5-4.5	0.40-1.0	---
ASTM A 743/A 743M-03	CA6NM	---	J91540	0.06	1.00	1.00	0.04	0.03	11.5-14.0	3.5-4.5	0.4-1.0	---
EN 10283:1998	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	---
ISO 11972:1998	GX 4 CrNiMo 16 5 1	---	---	0.06	0.8	0.8	0.035	0.025	15.0-17.0	4.0-6.0	0.7-1.5	---
AFNOR NF A 32-054:1994	GX4CrNi16-4	---	---	0.06	1.00	0.80	0.020	0.035	15.50-17.00	4.00-5.50	---	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 5121:2003	SCS 1	---	---	T1	---	---	345	---	540	---	18	163-229 HB
BS 3100:1991 AMD.1:1992	410C21	---	---	AHT or OQT	---	---	370	---	540	---	15	---
ASTM A 743/A 743M-03	CA15	---	J91150	A or NT	---	---	450	65	620	90	18	---
JIS G 5121:2003	SCS 1	---	---	T2	---	---	450	---	620	---	16	179-241 HB
BS 3100:1991 AMD.1:1992	420C28	---	---	AHT or OQT	---	---	450	---	620	---	13	---
EN 10283:1998	GX12Cr12	1.4011	---	QT	≤ 150	---	450	---	620	---	15	20 J at RT
ISO 11972:1998	GX 12 Cr 12	---	---	NT	≤ 150	---	450	---	620	---	14	20 J at RT
BS 3100:1991 AMD.1:1992	420C29	---	---	AHT or OQT	---	---	465	---	690	---	11	---
JIS G 5121:2003	SCS 3	---	---	T	---	---	440	---	590	---	16	170-235 HB
EN 10283:1998	GX7CrNiMo12-1	1.4008	---	QT	≤ 300	---	440	---	590	---	15	27 J at RT
ISO 11972:1998	GX 8 CrNiMo 12 1	---	---	NT	≤ 300	---	440	---	590	---	15	27 J at RT
ASTM A 743/A 743M-03	CA15M	---	J91151	A or NT	---	---	450	65	620	90	18	---
JIS G 5121:2003	SCS 2	---	---	T	---	---	390	---	590	---	16	170-235 HB
	SCS 2A	---	---	T	---	---	485	---	690	---	15	269 HB max
ASTM A 743/A 743M-03	CA40	---	J91153	A or NT	---	---	485	70	690	100	15	---
AFNOR NF A 32-053:1992	Z 3CN13.4-M	---	---	Q+T1+T2	≤ 300	---	500	---	700	---	20	27 J at -120°C
AFNOR NF A 32-054:1994	GX4CrNi13-4	---	---	QT3	28 ≤ t < 100	---	500	---	700	---	18	60 J at RT
					100 ≤ t < 200	---	500	---	700	---	16	60 J at RT
EN 10283:1998	GX4CrNi13-4	1.4317	---	QT3	≤ 300	---	500	---	700	---	16	50 J at RT
JIS G 5121:2003	SCS 5	---	---	QT	---	---	540	---	740	---	13	217-277 HB
AFNOR NF A 32-054:1994	GX4CrNi13-4	---	---	QT2	28 ≤ t < 200	---	550	---	750	---	15	50 J at RT
ISO 11972:1998	GX 4CrNi 12 4	---	---	QT1	≤ 300	---	550	---	750	---	15	45 J at RT
EN 10283:1998	GX4CrNi13-4	1.4317	---	QT1	≤ 300	---	550	---	760	---	15	50 J at RT
BS 3100:1991 AMD.1:1992	425C11	---	---	AHT or OQT	---	---	620	---	770	---	12	30 J at 20°C
AFNOR NF A 32-054:1994	GX4CrNi13-4	---	---	QT1	28 ≤ t < 200	---	800	---	900	---	12	35 J at RT
EN 10283:1998	GX4CrNi13-4	1.4317	---	QT2	≤ 300	---	830	---	900	---	12	35 J at RT
ISO 11972:1998	GX 4CrNi 12 4	---	---	QT2	≤ 300	---	830	---	900	---	12	35 J at RT
JIS G 5121:2003	SCS 6	---	---	T	---	---	550	---	750	---	15	285 HB max
BS 3100:1991 AMD.1:1992	425C12	---	---	AHT or OQT	---	---	550	---	755	---	15	---
ASTM A 743/A 743M-03	CA6NM	---	J91540	NT	---	---	550	80	755	110	15	---
EN 10283:1998	GX4CrNiMo16-5-1	1.4405	---	QT	≤ 300	---	540	---	760	---	15	60 J at RT
ISO 11972:1998	GX 4 CrNiMo 16 5 1	---	---	NT	≤ 300	---	540	---	760	---	15	60 J at RT
AFNOR NF A 32-054:1994	GX4CrNi16-4	---	---	QT2 (TR2)	28 ≤ t < 250	---	540	---	780	---	15	60 J at RT
				QT1 (TR1)	28 ≤ t < 250	---	830	---	1000	---	10	30 J at RT

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 5121:2003	SCS 12	---	---	0.20	2.00	2.00	0.040	0.040	18.00-21.00	8.00-11.00	---	---
ASTM A 743/A 743M-03	CF20	---	J92602	0.20	1.50	2.00	0.04	0.04	18.0-21.0	8.0-11.0	---	---
AFNOR NF A 32-053:1992	Z 5CN19.10-M	---	---	0.07	2.00	2.00	0.035	0.025	18.0-21.0	8.0-12.0	0.50	---
EN 10283:1998	GX5CrNi19-10	1.4308	---	0.07	1.50	1.50	0.040	0.030	18.00-20.00	8.00-11.00	---	---
ISO 11972:1998	GX 5 CrNi 19 9	---	---	0.07	1.5	1.5	0.040	0.030	18.0-21.0	8.0-11.0	---	---
JIS G 5121:2003	SCS 13	---	---	0.08	2.00	2.00	0.040	0.040	18.00-21.00	8.00-11.00	---	---
	SCS 13A	---	---	0.08	1.50	2.00	0.040	0.040	18.00-21.00	8.00-11.00	---	---
BS 3100:1991 AMD.1:1992	304C15	---	---	0.08	2.0	1.5	0.040	0.040	18.0-21.0	8.0-11.0	---	---
	304C15LT196	---	---	0.08	2.0	1.5	0.040	0.040	18.0-21.0	8.0-11.0	---	---
ASTM A 743/A 743M-03	CF8	---	J92600	0.08	1.50	2.00	0.04	0.04	18.0-21.0	8.0-11.0	---	---
ASTM A 744/A 744M-00	CF8	---	J92600	0.08	1.50	2.0	0.04	0.04	18.0-21.0	8.0-11.0	---	---
JIS G 5121:2003	SCS 19	---	---	0.03	2.00	2.00	0.040	0.040	17.00-21.00	8.00-12.00	---	---
BS 3100:1991 AMD.1:1992	304C12	---	---	0.03	2.0	1.5	0.040	0.040	17.0-21.0	8.0-12.0	---	---
	304C12LT196	---	---	0.03	2.0	1.5	0.040	0.040	17.0-21.0	8.0-12.0	---	---
EN 10283:1998	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
ISO 11972:1998	GX 2 CrNi 18 10	---	---	0.03	1.5	1.5	0.040	0.030	17.0-19.0	9.0-12.0	---	---
JIS G 5121:2003	SCS 19A	---	---	0.03	1.50	2.00	0.040	0.040	17.00-21.00	8.00-12.00	---	---
ASTM A 743/A 743M-03	CF3	---	J92500	0.03	1.50	2.00	0.04	0.04	17.0-21.0	8.0-12.0	---	---
ASTM A 744/A 744M-00	CF3	---	J92500	0.03	1.50	2.0	0.04	0.04	17.0-21.0	8.0-12.0	---	---
EN 10283:1998	GX5CrNiNb19-11	1.4552	---	0.07	1.50	1.50	0.040	0.030	18.00-20.00	9.00-12.00	---	Nb 8 x C to 1.00
ISO 11972:1998	GX 6 CrNiNb 19 10	---	---	0.08	1.5	1.5	0.040	0.030	18.0-21.0	9.0-12.0	---	Nb 8 x C to 1.00
JIS G 5121:2003	SCS 21	---	---	0.08	2.00	2.00	0.040	0.040	18.00-21.00	9.00-12.00	---	Nb 10 x C to 1.35
BS 3100:1991 AMD.1:1992	347C17	---	---	0.08	2.0	1.5	0.040	0.040	18.0-21.0	9.0-12.0	---	Nb 8 x C to 1.0
ASTM A 743/A 743M-03	CF8C	---	J92710	0.08	1.50	2.00	0.04	0.04	18.0-21.0	9.0-12.0	---	Cb 8 x C to 1.0
ASTM A 744/A 744M-00	CF8C	---	J92710	0.08	1.50	2.0	0.04	0.04	18.0-21.0	9.0-12.0	---	Cb 8 x C to 1.0
EN 10283:1998	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	---
ISO 11972:1998	GX 5 CrNiMo 19 11 2	---	---	0.07	1.5	1.5	0.040	0.030	17.0-20.0	9.0-12.0	2.0-2.5	---
	GX 5 CrNiMo 19 11 3	---	---	0.07	1.5	1.5	0.040	0.030	17.0-20.0	9.0-12.0	3.0-3.5	---
JIS G 5121:2003	SCS 14	---	---	0.08	2.00	2.00	0.040	0.040	17.00-20.00	10.00-14.00	2.00-3.00	---
	SCS 14A	---	---	0.08	1.50	1.50	0.040	0.040	18.00-21.00	9.00-12.00	2.00-3.00	---
BS 3100:1991 AMD.1:1992	316C16	---	---	0.08	2.0	1.5	0.040	0.040	17.0-21.0	9.0 min	2.0-3.0	---
	316C16LT196	---	---	0.08	2.0	1.5	0.040	0.040	17.0-21.0	9.0 min	2.0-3.0	---
ASTM A 743/A 743M-03	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 A 744/A 744M-00	CF8M	---	J92900	0.08	1.50	2.0	0.04	0.04	18.0-21.0	9.0-12.0	2.0-3.0	---

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 5121:2003	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 10 x C to 1.35
EN 10283:1998	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 8 x C to 1.00
ISO 11972:1998	GX 6 CrNiMoNb 19 11 2	---	---	0.08	1.5	1.5	0.040	0.030	17.0-20.0	9.0-12.0	2.0-2.5	Nb 8 x C to 1.00
BS 3100:1991 AMD.1:1992	318C17	---	---	0.08	2.0	1.5	0.040	0.040	17.0-21.0	9.0 min	2.0-3.0	Nb 8 x C to 1.0
BS 3100:1991 AMD.1:1992	316C12	---	---	0.03	2.0	1.5	0.040	0.040	17.0-21.0	9.0 min	2.0-3.0	---
BS 3100:1991 AMD.1:1992	316C12LT196	---	---	0.03	2.0	1.5	0.040	0.040	17.0-21.0	9.0 min	2.0-3.0	---
EN 10283:1998	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
ISO 11972:1998	GX 2 CrNiMo 19 11 2	---	---	0.03	1.5	1.5	0.040	0.030	17.0-20.0	9.0-12.0	2.0-2.5	---
JIS G 5121:2003	SCS 16 A	---	---	0.03	1.50	1.50	0.040	0.040	17.00-21.00	9.00-13.00	2.00-3.00	---
ASTM A 743/A 743M-03	CF3M	---	---	0.03	1.50	1.50	0.04	0.04	17.0-21.0	9.0-13.0	2.0-3.0	---
ASTM A 744/A 744M-00	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 10283:1998	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
ISO 11972:1998	GX 2 CrNiMoN 19 11 2	---	---	0.03	1.5	1.5	0.040	0.030	17.0-20.0	9.0-12.0	2.0-2.5	N 0.10-0.20
	GX 2 CrNiMoN 19 11 3	---	---	0.03	1.5	1.5	0.040	0.030	17.0-20.0	9.0-12.0	3.0-3.5	N 0.10-0.20
ASTM A 743/A 743M-03	CF3MN	---	---	0.03	1.50	1.50	0.040	0.040	17.0-22.0	9.0-13.0	2.0-3.0	N 0.10-0.20
EN 10283:1998	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	---
BS 3100:1991 AMD.1:1992	317C16	---	---	0.08	2.0	1.5	0.040	0.040	17.0-21.0	9.0 min	3.0-4.0	---
ASTM A 743/A 743M-03	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 A 744/A 744M-00	CG8M	---	J93000	0.08	1.50	1.50	0.04	0.04	18.0-21.0	9.0-13.0	3.0-4.0	---
ISO 11972:1998	GX 2 CrNiMo 19 11 3	---	---	0.03	1.5	1.5	0.040	0.030	17.0-20.0	9.0-12.0	3.0-3.5	---
ASTM A 743/A 743M-03	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 A 744/A 744M-00	CG3M	---	J92999	0.03	1.50	1.50	0.04	0.04	18.0-21.0	9.0-13.0	3.0-4.0	---
JIS G 5121:2003	SCS 17	---	---	0.20	2.00	2.00	0.040	0.040	22.00-26.00	12.00-15.00	---	---
ASTM A 743/A 743M-03	CH20	---	J93402	0.20	1.50	2.00	0.04	0.04	22.0-26.0	12.0-15.0	---	---
JIS G 5121:2003	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 A 743/A 743M-03	CN7M	---	---	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 A 744/A 744M-00	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
BS 3100:1991 AMD.1:1992	332C11	---	---	0.07	1.5	1.5	0.040	0.040	19.0-22.0	27.5-30.5	2.0-3.0	Cu 3.0-4.0
EN 10283:1998	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
EN 10283:1998	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
ASTM A 743/A 743M-03	CN3M	---	J94652	0.03	1.0	2.0	0.03	0.03	20.0-22.0	23.00-27.00	4.5-5.5	---

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10283:1998	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 A 743/A 743M-03	CN3MN	---	---	0.03	2.00	1.00	0.040	0.010	20.0-22.0	23.50-25.50	6.00-7.00	Cu 0.75; N 0.18-0.26
ASTM A 744/A 744M-00	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 10283:1998	GX2CrNiMoCuN20-18-6	1.4593	---	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
ASTM A 743/A 743M-03	CK3MCuN	---	---	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 A 744/A 744M-00	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
ISO 11972:1998	GX 2 CrNiCuMoN 26 5 3 3	---	---	0.03	1.5	1.0	0.035	0.025	25.0-27.0	4.5-6.5	2.5-3.5	Cu 2.5-3.5; N 0.12-0.25
BS 3100:1991 AMD.1:1992	332C13	---	---	0.04	1.0	1.0	0.040	0.040	24.5-26.5	4.75-6.0	1.75-2.25	Cu 2.75-3.25
BS 3100:1991 AMD.1:1992	332C15	---	---	0.08	1.5	1.5	0.040	0.040	21.0-27.0	4.0-7.0	1.75-3.0	N 0.10-0.25
ISO 11972:1998	GX 2 CrNiMoN 26 5 3	---	---	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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 5121:2003	SCS 12	---	---	S	---	---	205	---	480	---	28	183 HB max
ASTM A 743/A 743M-03	CF20	---	J92602	S	---	---	205	30	485	70	30	---
AFNOR NF A 32-053:1992	Z 5CN19.10-M	---	---	Q (HY)	≤ 300	---	200	---	440	---	30	60 J at -196°C
EN 10283:1998	GX5CrNi19-10	1.4308	---	AT	≤ 150	---	175	---	440	---	30	60 J at RT
ISO 11972:1998	GX 5 CrNi 19 9	---	---	ST/Q	≤ 150	---	180	---	440	---	30	60 J at RT
JIS G 5121:2003	SCS 13	---	---	S	---	---	185	---	440	---	30	183 HB max
	SCS 13A	---	---	S	---	---	205	---	480	---	33	183 HB max
BS 3100:1991 AMD.1:1992	304C15	---	---	ST	---	---	215	---	480	---	26	---
	304C15LT196	---	---	ST	---	---	215	---	480	---	26	41 J at -196°C
ASTM A 743/A 743M-03	CF8	---	J92600	S	---	---	205	30	485	70	35	---
ASTM A 744/A 744M-00	CF8	---	J92600	S	---	---	205	30	485	70	35	---
JIS G 5121:2003	SCS 19	---	---	S	---	---	185	---	390	---	33	183 HB max
BS 3100:1991 AMD.1:1992	304C12	---	---	ST	---	---	215	---	430	---	26	---
	304C12LT196	---	---	ST	---	---	215	---	430	---	26	41 J at -196°C
EN 10283:1998	GX2CrNi19-11	1.4309	---	AT	≤ 150	---	185	---	440	---	30	80 J at RT
ISO 11972:1998	GX 2 CrNi 18 10	---	---	ST/Q	≤ 150	---	180	---	440	---	30	80 J at RT
JIS G 5121:2003	SCS 19A	---	---	S	---	---	205	---	480	---	33	183 HB max
ASTM A 743/A 743M-03	CF3	---	J92500	S	---	---	205	30	485	70	35	---
ASTM A 744/A 744M-00	CF3	---	J92500	S	---	---	205	30	485	70	35	---
EN 10283:1998	GX5CrNiNb19-11	1.4552	---	AT	≤ 150	---	175	---	440	---	25	40 J at RT
ISO 11972:1998	GX 6 CrNiNb 19 10	---	---	ST/Q	≤ 150	---	180	---	440	---	25	40 J at RT
JIS G 5121:2003	SCS 21	---	---	S	---	---	205	---	480	---	28	183 HB max
BS 3100:1991 AMD.1:1992	347C17	---	---	ST	---	---	215	---	480	---	22	---
ASTM A 743/A 743M-03	CF8C	---	J92710	S	---	---	205	30	485	70	30	---
ASTM A 744/A 744M-00	CF8C	---	J92710	S	---	---	205	30	485	70	30	---

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10283:1998	GX5CrNiMo19-11-2	1.4408	---	AT	≤ 150	---	185	---	440	---	30	60 J ar RT
ISO 11972:1998	GX 5 CrNiMo 19 11 2	---	---	ST/Q	≤ 150	---	180	---	440	---	30	60 J at RT
	GX 5 CrNiMo 19 11 3	---	---	ST/Q	≤ 150	---	180	---	440	---	30	60 J at RT
JIS G 5121:2003	SCS 14	---	---	S	---	---	185	---	440	---	28	183 HB max
	SCS 14A	---	---	S	---	---	205	---	480	---	33	183 HB max
BS 3100:1991 AMD.1:1992	316C16	---	---	ST	---	---	240	---	480	---	26	---
	316C16LT196	---	---	ST	---	---	240	---	480	---	26	41 J at -196°C
ASTM A 743/A 743M-03	CF8M	---	J92900	S	---	---	205	30	485	70	30	---
ASTM A 744/A 744M-00	CF8M	---	J92900	S	---	---	205	30	485	70	30	---
JIS G 5121:2003	SCS 22	---	---	S	---	---	205	---	440	---	28	183 HB max
EN 10283:1998	GX5CrNiMoNb19-11-2	1.4581	---	AT	≤ 150	---	185	---	440	---	25	40 J ar RT
ISO 11972:1998	GX 6 CrNiMoNb 19 11 2	---	---	ST/Q	≤ 150	---	180	---	440	---	25	40 J at RT
BS 3100:1991 AMD.1:1992	318C17	---	---	ST	---	---	240	---	480	---	18	---
BS 3100:1991 AMD.1:1992	316C12	---	---	ST	---	---	215	---	430	---	26	---
BS 3100:1991 AMD.1:1992	316C12LT196	---	---	ST	---	---	---	240	480	26	---	41 J at -196°C
EN 10283:1998	GX2CrNiMo19-11-2	1.4409	---	AT	≤ 150	---	195	---	440	---	30	80 J at RT
ISO 11972:1998	GX 2 CrNiMo 19 11 2	---	---	ST/Q	≤ 150	---	180	---	440	---	30	80 J at RT
JIS G 5121:2003	SCS 16 A	---	---	S	---	---	205	---	480	---	33	183 HB max
ASTM A 743/A 743M-03	CF3M	---	---	S	---	---	205	30	485	70	30	---
ASTM A 744/A 744M-00	CF3M	---	J92800	S	---	---	205	30	485	70	30	---
EN 10283:1998	GX2CrNiMoN17-13-4	1.4446	---	AT	≤ 150	---	210	---	440	---	20	50 J at RT
ISO 11972:1998	GX 2 CrNiMoN 19 11 2	---	---	ST/Q	≤ 150	---	230	---	510	---	30	80 J at RT
	GX 2 CrNiMoN 19 11 3	---	---	ST/Q	≤ 150	---	230	---	510	---	30	80 J at RT
ASTM A 743/A 743M-03	CF3MN	---	---	S	---	---	255	37	515	75	35	---
EN 10283:1998	GX5CrNiMo19-11-3	1.4412	---	AT	≤ 150	---	205	---	440	---	30	60 J at RT
BS 3100:1991 AMD.1:1992	317C16	---	---	ST	---	---	240	---	480	---	22	---
ASTM A 743/A 743M-03	CG8M	---	J93000	S	---	---	240	35	520	75	25	---
ASTM A 744/A 744M-00	CG8M	---	J93000	S	---	---	240	35	520	75	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 (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ISO 11972:1998	GX 2 CrNiMo 19 11 3	---	---	ST/Q	≤ 150	---	180	---	440	---	30	80 J at RT
ASTM A 743/A 743M-03	CG3M	---	J92999	S	---	---	240	35	515	75	25	---
ASTM A 744/A 744M-00	CG3M	---	J92999	S	---	---	240	35	515	75	25	---
JIS G 5121:2003	SCS 17	---	---	S	---	---	205	---	480	---	28	183 HB max
ASTM A 743/A 743M-03	CH20	---	J93402	S	---	---	205	30	485	70	30	---
JIS G 5121:2003	SCS 23	---	---	S	---	---	165	---	390	---	30	183 HB max
ASTM A 743/A 743M-03	CN7M	---	---	S	---	---	170	25	425	62	35	---
ASTM A 744/A 744M-00	CN7M	---	N08007	S	---	---	170	25	425	62	35	---
BS 3100:1991 AMD.1:1992	332C11	---	---	ST	---	---	170	---	425	---	34	---
EN 10283:1998	GX2NiCrMo28-20-2	1.4458	---	AT	≤ 150	---	165	---	430	---	30	60 J at RT
	GX4NiCrCuMo30-20-4	1.4572	---	---	---	---	170	---	430	---	35	60 J at RT
EN 10283:1998	GX2NiCrMoN25-20-5	1.4416	---	AT	≤ 150	---	185	---	450	---	30	60 J at RT
ASTM A 743/A 743M-03	CN3M	---	J94652	S	---	---	260	38	550	80	35	---
EN 10283:1998	GX2NiCrMoCuN25-20-6	1.4588	---	AT	≤ 50	---	210	---	480	---	30	60 J at RT
ASTM A 743/A 743M-03	CN3MN	---	---	S	---	---	260	38	550	80	35	---
ASTM A 744/A 744M-00	CN3MN	---	J94651	S	---	---	260	38	550	80	35	---
EN 10283:1998	GX2CrNiMoCuN20-18-6	1.4593	---	AT	≤ 50	---	260	---	500	---	35	50 J at RT
ASTM A 743/A 743M-03	CK3MCuN	---	---	S	---	---	260	38	550	80	35	---
ASTM A 744/A 744M-00	CK3MCuN	---	J93254	S	---	---	260	38	550	80	35	---
ISO 11972:1998	GX 2 CrNiCuMoN 26 5 3 3	---	---	ST/Q	≤ 150	---	450	---	650	---	18	50 J at RT
BS 3100:1991 AMD.1:1992	332C13	---	---	ST	---	---	485	---	690	---	16	25 J at 20°C
BS 3100:1991 AMD.1:1992	332C15	---	---	ST	---	---	430	---	640	---	30	25 J at 20°C
ISO 11972:1998	GX 2 CrNiMoN 26 5 3	---	---	ST/Q	≤ 150	---	450	---	650	---	18	50 J at RT

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 217/A 217M-02	CA15	---	J91150	0.15	1.00	1.50	0.040	0.040	11.5-14.0	1.00	0.50	---
ASTM A 487/A 487M-93 (2003)	CA15	---	J91171	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
EN 10213-2:1995	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	---
ISO 4991:1994	C39CH	---	---	0.10-0.17	1.00	0.8	0.035	0.035	11.5-13.5	1.0	0.5	---
	C39CNiH	---	---	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	
EN 10213-2:1995	GX4CrNi13-4	1.4317	---	0.06	1.00	1.00	0.035	0.025	12.00-13.50	3.50-5.00	0.70	---
EN 10213-3:1995	GX3CrNi13-4	1.6982	---	0.05	1.00	1.00	0.035	0.015	12.00-13.50	3.50-5.00	0.70	---
ISO 4991:1994	C39NiH	---	---	0.08	1.50	1.00	0.035	0.035	11.5-13.5	3.50-5.00	1.00	---
	C39NiL	---	---	0.08	1.50	1.00	0.030	0.030	11.5-13.5	3.50-5.00	1.00	---
ASTM A 352/A 352M-03	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 A 487/A 487M-93 (2003)	CA6NM	---	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 A 757/A 757M-00	E3N	---	J91550	0.06	1.00	1.00	0.030	0.030	11.5-14.0	3.5-4.5	0.4-1.0	Cu 0.50; W 0.10; P+S+Cu+W 0.50
EN 10213-2:1995	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; W 0.50
ISO 4991:1994	C40H	---	---	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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 217/A 217M-02	CA15	---	J91150	NT	---	---	450	65	620-795	90-115	18	---
ASTM A 487/A 487M-93 (2003)	CA15, Class A	---	J91171	NT or QT	---	---	760-895	110-130	965-1170	140-170	10	---
	CA15, Class B	---	J91171	NT or QT	---	---	450	65	620-795	90-115	18	---
	CA15, Class C	---	J91171	NT or QT	---	---	415	60	620	90	18	22 HRC max 235 HB max
	CA15, Class D	---	J91171	NT or QT	---	---	515	75	690	100	17	22 HRC max 235 HB max
EN 10213-2:1995	GX8CrNi12	1.4107	---	QT1	≤ 300	---	355	---	540-690	---	18	45 J at RT
				QT2	≤ 300	---	500	---	600-800	---	16	40 J at RT
ISO 4991:1994	C39CH	---	---	NT	---	---	450	---	620-770	---	14	20 J at RT
	C39CNiH	---	---	NT	---	---	360	---	540-690	---	18	35 J at RT
EN 10213-2:1995	GX4CrNi13-4	1.4317	---	QT	≤ 300	---	550	---	760-960	---	15	50 J at RT
EN 10213-3:1995	GX3CrNi13-4	1.6982	---	QT	≤ 300	---	500	---	700-900	---	15	27 J at -120°C
ISO 4991:1994	C39NiH	---	---	NT	---	---	550	---	750-900	---	15	45 J at RT
	C39NiL	---	---	N_{ac}T or (NT)	---	---	550	---	750-900	---	15	27 J at -80°C
ASTM A 352/A 352M-03	CA6NM	---	J91540	NT	---	---	550	80	760-930	110.0-135.0	15	27 J at -73°C
ASTM A 487/A 487M-93 (2003)	CA6NM, Class A	---	J91540	NT or QT	---	---	550	80	760-930	110-135	15	---
	CA6NM, Class B	---	J91540	NT or QT	---	---	515	75	690	100	17	23 HRC max 255 HB max
ASTM A 757/A 757M-00	E3N	---	J91550	NT	≤ 32	1¼	550	80	760	110	15	27 J at -73°C
EN 10213-2:1995	GX23CrMoV12-1	1.4931	---	QT	≤ 150	---	540	---	740-880	---	15	27 J at RT
ISO 4991:1994	C40H	---	---	NT	---	---	540	---	740-880	---	15	21 J at 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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10213-4:1995	GX5CrNi19-10	1.4308	---	0.07	1.50	1.50	0.040	0.030	18.00-20.00	8.00-11.00	---	---
ISO 4991:1994	C47	---	---	0.07	2.00	2.00	0.045	0.035	18.0-21.0	8.0-11.0	---	---
	C47L	---	---	0.07	2.00	2.00	0.045	0.035	17.0-20.0	9.0-12.0	---	---
ASTM A 351/A 351M-03	CF-8, CF-8A	---	J92600	0.08	1.50	2.00	0.040	0.040	18.0-21.0	8.0-11.0	0.50	---
EN 10213-4:1995	GX2CrNi19-11	1.4309	---	0.03	2.00	1.50	0.035	0.025	18.00-20.00	9.00-12.00	---	N 0.20
ISO 4991:1994	C46	---	---	0.03	2.00	2.00	0.045	0.035	17.0-19.0	9.0-12.0	---	---
ASTM A 351/A 351M-03	CF-3, CF-3A	---	J92700	0.03	1.50	2.00	0.040	0.040	17.0-21.0	8.0-12.0	0.50	---
EN 10213-4:1995	GX5CrNiNb19-11	1.4552	---	0.07	1.50	1.50	0.040	0.030	18.00-20.00	9.00-12.00	---	Nb 8 x C to 1.0
ISO 4991:1994	C50	---	---	0.08	2.00	2.00	0.045	0.035	18.0-21.0	9.0-12.0	---	Nb 8 x C to 1.0
ASTM A 351/A 351M-03	CF-8C	---	J92710	0.08	1.50	2.00	0.040	0.040	18.0-21.0	9.0-12.0	0.50	Cb 8 x C to 1.00
EN 10213-4:1995	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	---
ISO 4991:1994	C60	---	---	0.07	2.00	2.00	0.045	0.035	17.0-21.0	9.0-13.0	2.0-2.5	---
	C61	---	---	0.07	2.00	2.00	0.045	0.035	17.0-21.0	9.0-13.0	2.5-3.0	---
ASTM A 351/A 351M-03	CF-8M	---	J92900	0.08	1.50	1.50	0.040	0.040	18.0-21.0	9.0-12.0	2.0-3.0	---
EN 10213-4:1995	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 8 x C to 1.0
ISO 4991:1994	C60Nb	---	---	0.08	2.00	2.00	0.045	0.035	17.0-21.0	9.0-13.0	2.0-2.5	Nb 8 x C to 1.0
ISO 4991:1994	C57	---	---	0.03	2.00	2.00	0.045	0.035	17.0-21.0	9.0-13.0	2.0-2.5	---
	C61LC	---	---	0.03	2.00	2.00	0.045	0.035	17.0-21.0	9.0-13.0	2.5-3.0	---
EN 10213-4:1995	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
ASTM A 351/A 351M-03	CF-3M, CF-3MA	---	J92800	0.03	1.50	1.50	0.040	0.040	17.0-21.0	9.0-13.0	2.0-3.0	---
ASTM A 351/A 351M-03	CN-7M	---	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 10213-4:1995	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
EN 10213-4:1995	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
ASTM A 351/A 351M-03	CD-4MCu	---	J93370	0.04	1.00	1.00	0.04	0.04	24.5-26.5	4.75-6.00	1.75-2.25	Cu 2.75-3.25

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
EN 10213-4:1995	GX5CrNi19-10	1.4308	---	AT + QW	≤ 150	---	200	---	440-640	---	30	60 J at RT
ISO 4991:1994	C47	---	---	S	---	---	210	---	440-640	---	30	---
	C47L	---	---	S	---	---	210	---	440-640	---	30	45 J at -195°C
ASTM A 351/A 351M-03	CF-8	---	J92600	S	---	---	205	30	485	70	35.0	---
	CF-8A	---	J92600	S	---	---	240	35	530	77	35.0	---
EN 10213-4:1995	GX2CrNi19-11	1.4309	---	AT + QW	≤ 150	---	210	---	440-640	---	30	80 J at RT
ISO 4991:1994	C46	---	---	S	---	---	210	---	440-640	---	30	---
ASTM A 351/A 351M-03	CF-3	---	J92800	S	---	---	205	30	485	70	35.0	---
	CF-3A	---	J92800	S	---	---	240	35	530	77	35.0	---
EN 10213-4:1995	GX5CrNiNb19-11	1.4552	---	AT + QW	≤ 150	---	200	---	440-640	---	25	40 J at RT
ISO 4991:1994	C50	---	---	S	---	---	210	---	440-640	---	25	---
ASTM A 351/A 351M-03	CF-8C	---	J92710	S	---	---	205	30	485	70	30.0	---
EN 10213-4:1995	GX5CrNiMo19-11-2	1.4408	---	AT + QW	≤ 150	---	210	---	440-640	---	30	60 J at RT
ISO 4991:1994	C60	---	---	S	---	---	210	---	440-640	---	30	---
	C61	---	---	S	---	---	210	---	440-640	---	30	---
ASTM A 351/A 351M-03	CF-8M	---	J92900	S	---	---	205	30	485	70	30.0	---
EN 10213-4:1995	GX5CrNiMoNb19-11-2	1.4581	---	AT + QW	≤ 150	---	210	---	440-640	---	25	40 J at RT
ISO 4991:1994	C60Nb	---	---	S	---	---	210	---	440-640	---	25	---
ISO 4991:1994	C57	---	---	S	---	---	210	---	440-620	---	30	---
	C61LC	---	---	S	---	---	210	---	440-640	---	30	---
EN 10213-4:1995	GX2CrNiMo19-11-2	1.4409	---	AT + QW	≤ 150	---	220	---	440-640	---	30	80 J at RT
ASTM A 351/A 351M-03	CF-3M	---	J92800	S	---	---	205	30	485	70	30.0	---
	CF-3MA	---	J92800	S	---	---	255	37	550	80	30.0	---
ASTM A 351/A 351M-03	CN-7M	---	N08007	S	---	---	170	25	425	62	35.0	---
EN 10213-4:1995	GX2NiCrMo28-20-2	1.4458	---	AT + QW	≤ 150	---	190	---	430-630	---	30	60 J at RT
EN 10213-4:1995	GX2CrNiMoCuN25-6-3-3	1.4517	---	AT + QW	≤ 150	---	480	---	650-850	---	22	50 J at RT
ASTM A 351/A 351M-03	CD-4MCu	---	J93370	S	---	---	485	70	690	100	16.0	---

7.5 Cast Heat Resistant Steels

7.5A Chemical Composition of Cast Heat Resistant Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 5122:2003	SCH 1	---	---	0.20-0.40	1.00	1.50-3.00	0.040	0.040	12.00-15.00	1.00	0.50	---
	SCH 3	---	---	0.40	1.00	2.00	0.040	0.040	12.00-15.00	1.00	0.50	---
BS 3100:1991 AMD.1:1992	420C24	---	---	0.25	1.0	2.0	0.050	0.050	12.0-16.0	---	---	---
EN 10295:2002	GX40CrSi13	1.4729	---	---	1.00	1.00-2.50	0.040	0.030	12.00-14.00	1.00	0.50	---
ISO 11973:1999	GX40CrSi13	---	---	0.3-0. 5	0.5-1.0	1.0-2.5	0.04	0.03	12-14	1	0.5	---
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	GX40CrSi17	---	---	0.3-0.5	0.5-1.0	1.0-2.5	0.04	0.03	16-19	1	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	GX40CrSi24	---	---	0.3-0.5	0.5-1.0	1.0-2.5	0.04	0.03	23-26	1	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	GX40CrSi28	---	---	0.3-0.5	0.5-1.0	1.0-2.5	0.04	0.03	27-30	1	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	GX130CrSi29	---	---	1.2-1.4	0.5-1.0	1.0-2.5	0.04	0.03	27-30	1	0.5	---
JIS G 5122:2003	SCH 2	---	---	0.40	1.00	2.00	0.040	0.040	25.00-28.00	1.00	0.50	---
ASTM A 297/A 297M-97 (2003)	HC	---	J92605	0.50	1.00	2.00	0.04	0.04	26.0-30.0	4.00	0.50	---
ASTM A 608/A 608M-02	HC30	---	J92613	0.25-0.35	0.5-1.0	0.50-2.00	0.04	0.04	26-30	4.0	0.50	---
BS 3100:1991 AMD.1:1992	452C11	---	---	1.0	1.0	2.0	0.050	0.050	25.0-30.0	4.0	1.5	---
	452C12	---	---	1.0-2.0	1.0	2.0	0.050	0.050	25.0-30.0	4.0	1.5	---
ISO 11973:1999	GX40CrNiSi27-4	---	---	0.3-0.5	1.5	1.0-2.5	0.04	0.03	25-28	3-6	0.5	---
ASTM A 297/A 297M-97 (2003)	HD	---	J93005	0.50	1.50	2.00	0.04	0.04	26.0-30.0	4.0-7.0	0.50	---
JIS G 5122:2003	SCH 11	---	---	0.40	1.00	2.00	0.040	0.040	24.00-28.00	4.00-6.00	0.50	---
ASTM A 608/A 608M-02	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	---
JIS G 5122:2003	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 A 297/A 297M-97 (2003)	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 A 608/A 608M-02	HE35	---	J93413	0.30-0.40	1.50	0.50-2.00	0.04	0.04	26-30	8-11	0.50	---
BS 3100:1991 AMD.1:1992	309C40	---	---	0.5	2.0	2.0	0.050	0.050	25.0-30.0	8.0-12.0	1.5	---
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	GX25CrNiSi18-9	---	---	0.15-0.35	2	1.0-2.5	0.04	0.03	17-19	8-10	0.5	---
	GX40CrNiSi22-10	---	---	0.3-0.5	2	1.0-2.5	0.04	0.03	21-23	9-11	0.5	---
ASTM A 297/A 297M-97 (2003)	HF	---	J93603	0.20-0.40	2.00	2.00	0.04	0.04	18.0-23.0	8.0-12.0	0.50	---
JIS G 5122:2003	SCH 12	---	---	0.20-0.40	2.00	2.00	0.040	0.040	18.00-23.00	8.00-12.00	0.50	---
ASTM A 608/A 608M-02	HF30	---	J92803	0.25-0.35	1.50	0.50-2.00	0.04	0.04	19-23	9-12	0.50	---
BS 3100:1991 AMD.1:1992	302C35	---	---	0.2-0.4	2.0	2.0	0.050	0.050	17.0-22.0	6.0-10.0	1.5	---

7.5 Cast Heat Resistant Steels

7.5A Chemical Composition of Cast Heat Resistant Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
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	GX25CrNiSi20-14	---	---	0.15-0.35	2	1.0-2.5	0.04	0.03	19-21	13-15	0.5	---
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	GX40CrNiSi25-12	---	---	0.3-0.5	2	1.0-2.5	0.04	0.03	24-27	11-14	0.5	---
JIS G 5122:2003	SCH 13	---	---	0.20-0.50	2.00	2.00	0.040	0.040	24.00-28.00	11.00-14.00	0.50	---
	SCH 13A	---	---	0.25-0.50	2.50	1.75	0.040	0.040	23.00-26.00	12.00-14.00	0.50	---
BS 3100:1991 AMD.1:1992	309C35	---	---	0.20-0.50	2.0	1.5	0.040	0.040	24.0-28.0	11.0-14.0	1.5	---
ASTM A 297/A 297M-97 (2003)	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 A 447/A 447M-93 (2003)	Type I	---	J93303	0.20-0.45	2.50	1.75	0.05	0.05	23.00-28.00	10.00-14.00	---	N 0.20
	Type II	---	J93303	0.20-0.45	2.50	1.75	0.05	0.05	23.00-28.00	10.00-14.00	---	N 0.20
BS 3100:1991 AMD.1:1992	309C32	---	---	0.20-0.45	2.5	1.5	0.040	0.040	24.0-28.0	11.0-14.0	1.5	N 0.2
ASTM A 608/A 608M-02	HH30	---	J93513	0.25-0.35	1.50	0.50-2.00	0.04	0.04	24-28	11-14	0.50	---
	HH33	---	J93633	0.28-0.38	1.50	0.50-2.00	0.04	0.04	24-26	12-14	0.50	---
BS 3100:1991 AMD.1:1992	309C30	---	---	0.5	2.0	2.5	0.050	0.050	22.0-27.0	10.0-14.0	1.5	---
ASTM A 297/A 297M-97 (2003)	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 A 608/A 608M-02	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	SCH 18	---	---	0.20-0.50	2.00	2.00	0.040	0.040	26.00-30.00	14.00-18.00	0.50	---
JIS G 5122:12003	SCH 21	---	---	0.25-0.35	1.50	1.75	0.040	0.040	23.00-27.00	19.00-22.00	0.50	---
ASTM A 297/A 297M-97 (2003)	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 A 351/A 351M-03	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 A 608/A 608M-02	HK30	---	J94203	0.25-0.35	1.50	0.50-2.00	0.04	0.04	23-27	19-22	0.50	---
ASTM A 351/A 351M-03	HK40	---	J94204	0.35-0.45	1.50	1.75	0.040	0.040	23.0-27.0	19.0-22.0	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	---
JIS G 5122:2003	SCH 22	---	---	0.35-0.45	1.50	1.75	0.040	0.040	23.00-27.00	19.00-22.00	0.50	---
BS 3100:1991 AMD.1:1992	310C40	---	---	0.30-0.5	2.0	1.5	0.040	0.040	24.0-27.0	19.0-22.0	1.5	---
ISO 11973:1999	GX40CrNiSi25-20	---	---	0.3-0.5	2	1.0-2.5	0.04	0.03	24-27	19-22	0.5	---
ASTM A 608/A 608M-02	HK40	---	J94204	0.35-0.45	1.50	0.50-2.00	0.04	0.04	23-27	19-22	0.50	---
BS 3100:1991 AMD.1:1992	310C45	---	---	0.5	2.0	3.0	0.050	0.050	22.0-27.0	17.0-22.0	1.5	---
ASTM A 297/A 297M-97 (2003)	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 A 608/A 608M-02	HL30	---	N08613	0.25-0.35	1.50	0.50-2.00	0.04	0.04	28-32	18-22	0.50	---
	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	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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 5122:2003	SCH 19	---	---	0.20-0.50	2.00	2.00	0.040	0.040	19.00-23.00	23.00-27.00	0.50	---
ASTM A 297/A 297M-97 (2003)	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 A 608/A 608M-02	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	---
BS 3100:1991 AMD.1:1992	311C11	---	---	0.5	2.0	3.0	0.050	0.050	17.0-23.0	23.0-28.0	1.5	---
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	GX40CrNiSiNb24-24	---	---	0.25-0.50	2	1.0-2.5	0.04	0.03	23-25	23-25	0.5	Nb 1.2-1.8
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
ASTM A 297/A 297M-97 (2003)	HP	---	N08705	0.35-0.75	2.00	2.50	0.04	0.04	24-28	33-37	0.50	---
JIS G 5122:2003	SCH 24	---	---	0.35-0.75	2.00	2.00	0.040	0.040	24.00-28.00	33.00-37.00	0.50	---
EN 10295:2002	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	GX40NiCrSi35-26	---	---	0.3-0.5	2	1.0-2.5	0.04	0.03	24-27	33-36	0.5	---
	GX40NiCrSiNb35-26	---	---	0.3-0.5	2	1.0-2.5	0.04	0.03	24-27	33-36	0.5	Nb 0.8-1.8
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	GX40NiCrSi35-17	---	---	0.3-0.5	2	1.0-2.5	0.04	0.03	16-18	34-36	0.5	---
JIS G 5122:2003	SCH 15	---	---	0.35-0.70	2.00	2.50	0.040	0.040	15.00-19.00	33.00-37.00	0.50	---
ASTM A 297/A 297M-97 (2003)	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 A 608/A 608M-02	HT50	---	N08050	0.40-0.60	1.50	0.50-2.00	0.04	0.04	15-19	33-37	0.50	---
BS 3100:1991 AMD.1:1992	330C12	---	---	0.75	2.0	3.0	0.050	0.050	13.0-20.0	30.0-40.0	1.5	---
JIS G 5122:2003	SCH 16	---	---	0.20-0.35	2.00	2.50	0.040	0.040	13.00-17.00	33.00-37.00	0.50	---
BS 3100:1991 AMD.1:1992	330C11	---	---	0.35-0.55	2.0	1.5	0.040	0.040	13.0-17.0	33.0-37.0	1.5	---
ASTM A 351/A 351M-03	HT30	---	N08603	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	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	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	GX40NiCrSi38-19	---	---	0.3-0.5	2	1.0-2.5	0.04	0.03	18-21	36	0.5	---
	GX40NiCrSiNb38-19	---	---	0.3-0.5	2	1.0-2.5	0.04	0.03	18-21	36	0.5	Nb 1.2-1.8
ASTM A 297/A 297M-97 (2003)	HU	---	N08004	0.35-0.75	2.00	2.50	0.04	0.04	17.0-21.0	37.0-41.0	0.50	---
BS 3100:1991 AMD.1:1992	331C40	---	---	0.35-0.55	2.0	1.5	0.040	0.040	17.0-21.0	33.0-37.0	1.5	---
ASTM A 608/A 608M-02	HU50	---	N08005	0.40-0.60	1.50	0.50-2.00	0.04	0.04	17-21	37-41	0.50	---
BS 3100:1991 AMD.1:1992	331C60	---	---	0.75	2.0	3.0	0.050	0.050	15.0-25.0	36.0-46.0	1.5	---
EN 10295:2002	G-NiCr50Nb	2.4680	---	0.10	0.50	1.00	0.020	0.020	48.00-52.00	bal	0.50	N 0.16; Nb 1.00-1.80; Fe 1.00
ISO 11973:1999	GX10NiCrNb50-50	---	---	0.1	0.5	0.5	0.02	0.02	47-52	bal	0.5	N 0.16; Nb 1.4-1.7; N+C 0.2

7.5 Cast Heat Resistant Steels

7.5A Chemical Composition of Cast Heat Resistant Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 297/ A297M-97 (2003)	HW	---	---	0.35-0.75	2.00	2.50	0.04	0.04	10.0-14.0	58.0-62.0	0.50	---
ASTM A 608/A 608M-02	HW50	---	---	0.40-0.60	1.50	0.50-2.00	0.04	0.04	10-14	58-62	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	Fe bal
ISO 11973:1999	GX50NiCr65-15	---	---	0.35-0.65	1.3	2	0.04	0.03	13-19	64-69	---	---
ASTM A 297/A 297M-97 (2003)	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 A 608/A 608M-02	HX50	---	N08006	0.40-0.60	1.50	0.50-2.00	0.04	0.04	15.0-19.0	64-68	0.50	---
BS 3100:1991 AMD.1:1992	334C11	---	---	0.75	2.0	3.0	0.050	0.050	10.0-20.0	55.0-65.0	1.5	---
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	Nb 0.50; Co 48.0-52.0; Fe bal
ISO 11973:1999	GX30CoCr50-28	---	---	0.5	1	1	0.04	0.03	25-30	1	0.5	Co 48-52; Fe 20
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; Fe bal
ISO 11973:1999	GX45NiCrWSi48-28-5	---	---	0.35-0.55	1.5	1.0-2.5	0.04	0.03	27-30	47-50	---	W 4-6
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	Nb 0.75-1.25; Co 18.50-22.00; W 2.00-3.00
ISO 11973:1999	GX40NiCrCo20-20-20	---	---	0.35-0.60	2	1	0.04	0.03	19-22	18-22	2.5-3.0	Co 18-22; W 2-3

7.5 Cast Heat Resistant Steels

7.5B Mechanical Properties of Cast Heat Resistant Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 5122:2003	SCH 1	---	---	A	---	---	---	---	490	---	---	---
	SCH 3	---	---	A	---	---	----	---	490	---	---	---
BS 3100:1991 AMD.1:1992	420C24	---	---	AC	---	---	---	---	---	---	---	---
EN 10295:2002	GX40CrSi13	1.4729	---	A	---	---	---	---	---	---	---	300 HB
ISO 11973:1999	GX40CrSi13	---	---	A	---	---	---	---	---	---	---	300 HB max
EN 10295:2002	GX40CrSi17	1.4740	---	A	---	---	---	---	---	---	---	300 HB
ISO 11973:1999	GX40CrSi17	---	---	A	---	---	---	---	---	---	---	300 HB max
EN 10295:2002	GX40CrSi24	1.4745	---	---	---	---	---	---	---	---	---	---
ISO 11973:1999	GX40CrSi24	---	---	A	---	---	---	---	---	---	---	300 HB max
EN 10295:2002	GX40CrSi28	1.4776	---	---	---	---	---	---	---	---	---	---
ISO 11973:1999	GX40CrSi28	---	---	A	---	---	---	---	---	---	---	320 HB max
EN 10295:2002	GX130CrSi29	1.4777	---	---	---	---	---	---	---	---	---	---
ISO 11973:1999	GX130CrSi29	---	---	A	---	---	---	---	---	---	---	400 HB max
JIS G 5122:2003	SCH 2	---	---	A	---	---	---	---	340	---	---	---
ASTM A 297/A 297M-97 (2003)	HC	---	J92605	AC	---	---	---	---	380	55	---	---
ASTM A 608/A 608M-02	HC30	---	J92613	AC	---	---	---	---	---	---	---	---
BS 3100:1991 AMD.1:1992	452C11	---	---	AC	---	---	---	---	---	---	---	---
	452C12	---	---	AC	---	---	---	---	---	---	---	---
ISO 11973:1999	GX40CrNiSi27-4	---	---	AC	---	---	250	---	400	---	3	400 HB max
ASTM A 297/A 297M-97 (2003)	HD	---	J93005	AC	---	---	240	35	515	75	8	---
JIS G 5122:2003	SCH 11	---	---	AC	---	---	---	---	590	---	---	---
ASTM A 608/A 608M-02	HD50	---	J93015	AC	---	---	---	---	---	---	---	---
EN 10295:2002	GX40CrNiSi27-4	1.4823	---	---	---	---	250	---	550	---	3	---

7.5 Cast Heat Resistant Steels

7.5B Mechanical Properties of Cast Heat Resistant Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 5122:2003	SCH 17	---	---	AC	---	---	275	---	540	---	5	---
ASTM A 297/A 297M-97 (2003)	HE	---	J93403	AC	---	---	275	40	585	85	9	---
ASTM A 608/A 608M-02	HE35	---	J93413	AC	---	---	---	---	---	---	---	---
BS 3100:1991 AMD.1:1992	309C40	---	---	AC	---	---	---	---	---	---	---	---
EN 10295:2002	GX25CrNiSi18-9	1.4825	---	---	---	---	230	---	450	---	15	---
	GX40CrNiSi22-10	1.4826	---	---	---	---	230	---	450	---	8	---
ISO 11973:1999	GX25CrNiSi18-9	---	---	AC	---	---	230	---	450	---	15	---
	GX40CrNiSi22-10	---	---	AC	---	---	230	---	450	---	8	---
ASTM A 297/A 297M-97 (2003)	HF	---	J93603	AC	---	---	240	35	485	70	25	---
JIS G 5122:2003	SCH 12	---	---	AC	---	---	235	---	490	---	23	---
ASTM A 608/A 608M-02	HF30	---	J92803	AC	---	---	---	---	---	---	---	---
BS 3100:1991 AMD.1:1992	302C35	---	---	AC	---	---	---	---	---	---	---	---
EN 10295:2002	GX25CrNiSi20-14	1.4832	---	---	---	---	230	---	450	---	10	---
ISO 11973:1999	GX25CrNiSi20-14	---	---	AC	---	---	230	---	450	---	10	---
EN 10295:2002	GX40CrNiSi25-12	1.4837	---	---	---	---	220	---	450	---	6	---
ISO 11973:1999	GX40CrNiSi25-12	---	---	AC	---	---	220	---	450	---	6	---
JIS G 5122:2003	SCH 13	---	---	AC	---	---	235	---	490	---	8	---
	SCH 13A	---	---	AC	---	---	235	---	490	---	8	---
BS 3100:1991 AMD.1:1992	309C35	---	---	AC	---	---	---	---	510	---	7	---
ASTM A 297/A 297M-97 (2003)	HH	---	J93503	AC	---	---	240	35	515	75	10	---
ASTM A 447/A 447M-93 (2003)	Type I	---	J93303	AC	---	---	---	---	550	80	9	---
	Type II	---	J93303	AC	---	---	---	---	550	80	4	---
BS 3100:1991 AMD.1:1992	309C32	---	---	HTC	---	---	---	---	550	---	3	---
ASTM A 608/A 608M-02	HH30	---	J93513	AC	---	---	---	---	---	---	---	---
	HH33	---	J93633	AC	---	---	---	---	---	---	---	---
BS 3100:1991 AMD.1:1992	309C30	---	---	AC	---	---	---	---	---	---	---	---
ASTM A 297/A 297M-97 (2003)	HI	---	J94003	AC	---	---	240	35	485	70	10	---
ASTM A 608/A 608M-02	HI35	---	J94013	AC	---	---	---	---	---	---	---	---
JIS G 5122:2003	SCH 18	---	---	AC	---	---	235	---	490	---	8	---
JIS G 5122:2003	SCH 21	---	---	AC	---	---	235	---	440	---	8	---
ASTM A 297/A 297M-97 (2003)	HK	---	J94224	AC	---	---	240	35	450	65	10	---
ASTM A 351/A 351M-03	HK30	---	J94203	AC	---	---	240	35	450	65	10.0	---
ASTM A 608/A 608M-02	HK30	---	J94203	AC	---	---	---	---	---	---	---	---

7.5 Cast Heat Resistant Steels

7.5B Mechanical Properties of Cast Heat Resistant Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 351/A 351M-03	HK40	---	J94204	AC	---	---	240	35	425	62	10.0	---
EN 10295:2002	GX40CrNiSi25-20	1.4848	---	---	---	---	220	---	450	---	8	---
JIS G 5122:2003	SCH 22	---	---	AC	---	---	235	---	440	---	8	---
BS 3100:1991 AMD.1:1992	310C40	---	---	AC	---	---	---	---	450	---	7	---
ISO 11973:1999	GX40CrNiSi25-20	---	---	AC	---	---	220	---	450	---	6	---
ASTM A 608/A 608M-02	HK40	---	J94204	AC	---	---	---	---	---	---	---	---
BS 3100:1991 AMD.1:1992	310C45	---	---	AC	---	---	---	---	---	---	---	---
ASTM A 297/A 297M-97 (2003)	HL	---	N08604	AC	---	---	240	35	450	65	10	---
ASTM A 608/A 608M-02	HL30	---	N08613	AC	---	---	---	---	---	---	---	---
	HL40	---	N08614	AC	---	---	---	---	---	---	---	---
JIS G 5122:2003	SCH 23	---	---	AC	---	---	245	---	450	---	8	---
JIS G 5122:2003	SCH 19	---	---	AC	---	----	---	---	390	---	5	---
ASTM A 297/A 297M-97 (2003)	HN	---	J94213	AC	---	---	---	---	435	63	8	---
ASTM A 608/A 608M-02	HN40	---	J94214	AC	---	---	---	---	---	---	---	---
EN 10295:2002	GX35NiCrSi25-21	1.4805	---	---	---	---	220	---	430	---	8	---
BS 3100:1991 AMD.1:1992	311C11	---	---	AC	---	---	---	---	---	---	---	---
EN 10295:2002	GX40CrNiSiNb24-24	1.4855	---	---	---	---	220	---	450	---	4	---
ISO 11973:1999	GX40CrNiSiNb24-24	---	---	AC	---	---	220	---	400	---	4	---
EN 10295:2002	GX40NiCrSiNb35-26	1.4852	---	---	---	---	220	---	440	---	4	---
ASTM A 297/A 297M-97 (2003)	HP	---	N08705	AC	---	---	235	34	430	62.5	4.5	---
JIS G 5122:2003	SCH 24	---	---	AC	---	---	235	---	440	---	5	---
EN 10295:2002	GX40NiCrSi35-26	1.4857	---	---	---	---	220	---	440	---	6	---
ISO 11973:1999	GX40NiCrSi35-26	---	---	AC	---	---	220	---	440	---	6	---
	GX40NiCrSiNb35-26	---	---	AC	---	---	220	---	440	---	4	---
ISO 11973:1999	GX40NiCrSi35-17	---	---	AC	---	---	220	---	420	---	6	---
EN 10295:2002	GX40NiCrSi35-17	1.4806	---	---	---	---	220	---	420	---	6	---
JIS G 5122:2003	SCH 15	---	---	AC	---	---	---	---	440	---	4	---
ASTM A 297/A 297M-97 (2003)	HT	---	N08605	AC	---	---	---	---	450	65	4	---
ASTM A 608/A 608M-02	HT50	---	N08050	AC	---	---	---	---	---	---	---	---
BS 3100:1991 AMD.1:1992	330C12	---	---	AC	---	---	---	---	---	---	---	---
JIS G 5122:2003	SCH 16	---	---	AC	---	---	195	---	440	---	13	---
BS 3100:1991 AMD.1:1992	330C11	---	---	AC	---	---	---	---	450	---	3	---
ASTM A 351/A 351M-03	HT30	---	N08603	AC	---	---	195	28	450	65	15.0	---

7.5 Cast Heat Resistant Steels

7.5B Mechanical Properties of Cast Heat Resistant Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 5122:2003	SCH 20	---	---	AC	---	---	---	---	390	---	4	---
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	GX40NiCrSi38-19	---	---	AC	---	---	220	---	420	---	6	---
	GX40NiCrSiNb38-19	---	---	AC	---	---	220	---	420	---	4	---
ASTM A 297/A 297M-97 (2003)	HU	---	N08004	AC	---	---	---	---	450	65	4	---
BS 3100:1991 AMD.1:1992	331C40	---	---	AC	---	---	---	---	450	---	3	---
ASTM A 608/A 608M-02	HU50	---	N08005	AC	---	---	---	---	---	---	---	---
BS 3100:1991 AMD.1:1992	331C60	---	---	AC	---	---	---	---	---	---	---	---
EN 10295:2002	G-NiCr50Nb	2.4680	---	---	---	---	230	---	540	---	8	---
ISO 11973:1999	GX10NiCrNb50-50	---	---	AC	---	---	230	---	540	---	8	---
ASTM A 297/ A297M-97 (2003)	HW	---	---	AC	---	---	---	---	60	---	415	---
ASTM A 608/A 608M-02	HW50	---	---	AC	---	---	---	---	---	---	---	---
EN 10295:2002	G-NiCr15	2.4815	---	---	---	---	200	---	400	---	3	---
ISO 11973:1999	GX50NiCr65-15	---	---	AC	---	---	200	---	400	---	3	---
ASTM A 297/A 297M-97 (2003)	HX	---	N06006	AC	---	---	---	---	415	60	---	---
ASTM A 608/A 608M-02	HX50	---	N08006	AC	---	---	---	---	---	---	---	---
BS 3100:1991 AMD.1:1992	334C11	---	---	AC	---	---	---	---	---	---	---	---
EN 10295:2002	G-CoCr28	2.4778	---	---	---	---	235	---	490	---	6	---
ISO 11973:1999	GX30CoCr50-28	---	---	AC	---	---	---	---	---	---	---	---
EN 10295:2002	G-NiCr28W	2.4879	---	---	---	---	240	---	440	---	3	---
ISO 11973:1999	GX45NiCrWSi48-28-5	---	---	AC	---	---	220	---	400	---	3	---
EN 10295:2002	GX50NiCrCo20-20-20	1.4874	---	---	---	---	320	---	420	---	6	---
ISO 11973:1999	GX40NiCrCo20-20-20	---	---	AC	---	---	320	---	400	---	6	---

7.6 Non-Comparable Cast Carbon Steels

ASTM A 27/A 27M-03 - Steel Casting, Carbon, for General Application												
Grade, Class, Type	N-1	N-2	---	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 148/A 148M-03 - Steel Castings, High Strength, for Structural Purposes												
Grade, Class, Type	115-95	130-115	135-125	150-135	160-145	165-150	165-150L	210-180	210-180L	260-210	260-210L	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 352/A 352M-03 - Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service												
Grade, Class, Type	LC4	LC9	---	---	---	---	---	---	---	---	---	---
UNS Number	J41500	J31300	---	---	---	---	---	---	---	---	---	---
ASTM A 757/A 757M-00 - Steel Castings, Ferritic and Martensitic, for Pressure-Containing and Other Applications, for Low-Temperature Service												
Grade, Class, Type	B4N	B4Q	C1Q	D1N1	D1N2	D1N3	D1Q1	D1Q2	D1Q3	E1Q	E3N	---
UNS Number	J41501	J41501	J12582	J22092	J22092	J22092	J22092	J22092	J22092	J42220	J42065	---
ASTM A 958-00 - Steel Castings, Carbon, and Alloy, with Tensile Requirements, Chemical Requirements Similar to Standard Wrought Grades												
Grade, Class, Type	SC 4340	SC 8620	SC 8625	SC 8630	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
JIS G 5111:1991 - High Tensile Strength Carbon Steel Castings and Low Alloy Steel Castings for Structural Purposes												
Symbol of Grade	SCMnCr 2	SCMnCr 3	SCMnCr 4	SCMnCrM 2	SCMnCrM 3	SCMnM 3	---	---	---	---	---	---
JIS G 5151:1991 - Steel Castings for High Temperature and High Pressure Service												
Class	SCPH 22	---	---	---	---	---	---	---	---	---	---	---
BS 3100:1991 AMD.1:1992 - Steel Castings for General Engineering Purposes												
Steel	AL1	AL2	AL3	BL2	AM1	AM2	AW1	AW2	AW3	B3	B4	B5
	B6	B7	BT1	BT2	BT3	BW2	BW3	BW4	302C25	B2	---	---
AFNOR NF A 32-053:1992 - Cast Steels for Low Temperatures Purposes												
Designation	16 M5-M	10 N6-M	18 NCD12.6-M	10 N14-M	10 N19-M	20 NCD4-M	---	---	---	---	---	---
AFNOR NF A 32-054:1994 - Cast Steels for General Purpose in Mechanical Engineering												
Designation	G10MnMoV6	G15CrMoV6	G35NiCrMo6	G20NiCrMo12	G30NiCrMo14	---	---	---	---	---	---	---
DIN 17205:1992 - Quenched and Tempered Steel Castings for General Applications												
Steel Name	GS-30 CrMoV 6 4		GS-35 CrMoV 10 4		GS-25 CrNiMo 4		GS-34 CrNiMo 6		GS-30 CrNiMo 8 5		---	
Steel Number	1.7725		1.7755		1.6515		1.6582		1.6570		---	
EN 10213-2:1995 - Steel Castings for Pressure Purposes Part 2: Steel Grades for Use at Room Temperature and at Elevated Temperature												
Steel Name	G12MoCrV5-2		GX4CrNiMo16-5-1		---		---		---		---	
Steel Number	1.7720		1.4405		---		---		---		---	
ISO 4991:1994 - Steel Castings for Pressure Purposes												
Steel Type	C31L	C33H	C34BL	C43C1L	C47H	C60H	---	---	---	---	---	---

7.7 Non-Comparable Cast Manganese Steels

JIS G 5131:1991 - High Manganese Steel Castings												
Class	SCMnH 21	---	---	---	---	---	---	---	---	---	---	---
AFNOR NF A 32-058:1984 - Cast Steels for General Purpose in Mechanical Engineering												
Designation	45 S7-M		18 CDBB2-M		35 CD 4-M		42 CD 4-M		50 CD 4-M		16 MCDV 6-M	
Designation	25 MCDV 6-M		30 MSCB 6.4-M		35 CDV 10 4-M		45 CSD 6-M		30 NSCDV 86-M		20 NCD 8-M	
Designation	32 NCD 8-M		42 NCD 16-M		50 NSCDV 5-M		85 CDV 12-M		Z 100 CD 6 1-M		Z 160 CDV 12-M	
Designation	Z 200 C 12-M		Z 320 CD 16 3-M		Z 280CD 16 3-M		Z 270 C 27-M		---		---	
ISO 13521:1999 - Austenitic Manganese Steel Castings												
Steel Type	GX120Mn17	---	---	---	---	---	---	---	---	---	---	---

7.8 Non-Comparable Cast Alloy Steels

ASTM A 217/A 217M-02 - Steel Castings, Martensitic Stainless and Alloy, for Pressure- Containing Parts, Suitable for High-Temperature Service												
Grade, Class, Type	WC4	WC5	WC11	C12A	---	---	---	---	---	---	---	---
UNS Number	J12082	J22000	J11872	J84090	---	---	---	---	---	---	---	---
ASTM A 389/A 389M-03 - Steel Castings, Alloy, Specially Heat-Treated, for Pressure-Containing Parts, Suitable for High-Temperature Service												
Grade, Class, Type	C23	---	---	---	---	---	---	---	---	---	---	---
UNS Number	J12080	---	---	---	---	---	---	---	---	---	---	---
ASTM A 487/A 487M-93 (2003) - Steel Castings Suitable for Pressure Service												
Grade, Class, Type	1	2	4	6	7	9	10	11	12	13	14	16
UNS Number	J13002	J13005	J13047	J13855	J12084	J13345	J23015	J12082	J22000	J13080	J15580	J31200
Grade, Class, Type	CA15M	---	---	---	---	---	---	---	---	---	---	---
UNS Number	J91151	---	---	---	---	---	---	---	---	---	---	---

7.9 Non-Comparable Cast Stainless Steels for General and Corrosion Resistant Applications

ASTM A 743/A 743M-03 - Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application												
Grade, Class, Type	CG-12	CF16F	CF16Fa	CH-10	CE-30	CB-30	CC-50	CA-40F	CF10SMnN	CG6MMN	CN-7MS	CA6N
UNS Number	J93001	J92701	---	---	J93423	J91803	J92615	J91154	J92972	---	---	---
Grade, Class, Type	CA-28MWV	CK-35MN	CB-6	CK20	---	---	---	---	---	---	---	
UNS Number	J91422	---	J91804	J94202	---	---	---	---	---	---	---	---
ASTM A 744/A 744M-00 - Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service												
Grade, Class, Type	CN7MS	---	---	---	---	---	---	---	---	---	---	---
UNS Number	J94650	---	---	---	---	---	---	---	---	---	---	---
JIS G 5121:2003 - Stainless Steel Castings												
Class	SCS 4	SCS 10	SCS 11	SCS 15	SCS 16	SCS 18	SCS 20	SCS 24	---	---	---	---
EN 10283:1998 - Corrosion Resistant Steel Castings												
Steel Name	GX4CrNiMo16-5-2		GX5CrNiCu16-4		GX2NiCrMoCu25-20-5		GX2CrNiMoCuN29-25-5		GX6CrNiN26-7		GX2CrNiMoN22-5-3	
Steel Number	1.4411		1.4525		1.4584		1.4587		1.4347		1.4470	
Steel Name	GX2CrNiMoN25-6-3		GX2CrNiMoCuN25-6-3-3		GX2CrNiMoN25-7-3		GX2CrNiMoN26-7-4		---		---	
Steel Number	1.4468		1.4517		1.4417		1.4469		---		---	
ISO 11972:1998 - Corrosion-Resistant Cast Steels for General Applications												
Steel Type	GX 2 CrNiN 18 10		---	---	---	---	---	---	---	---	---	---

7.10 Non-Comparable Cast Stainless Steels for Pressure Purposes

ASTM A 351/A 351M-03 - Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts												
Grade, Class, Type	CF10	CF10M	CH8	CH10	CF10MC	CN3MN	CE8MN	CG6MMN	CF10SMnN	CT15C	CK3MnCuN	CE20N
UNS Number	J92590	J92901	J93400	J93401	J92971	J94651	---	---	---	N08151	J93254	---
Grade, Class, Type	CD3MWCuN	CF3-MN	CG-8M	CG-3M	CH-20	CK-20	---	---	---	---	---	---
UNS Number	---	---	J93000	J92999	J93402	J94202	---	---	---	---	---	---
EN 10213-4:1995 - Steel Castings for Pressure Purposes Part 4: Austenitic and Austenitic-Ferritic Steel Grades												
Steel Name	GX2CrNiMoN26-7-4		GX2CrNiMoN22-5-3		---		---		---		---	
Steel Number	1.4469		1.4470		---		---		---		---	

7.11 Non-Comparable Cast Heat Resistant Steels

EN 10295:2002 - Heat Resistant Steel Castings									
Steel Name	GX160CrSi18	GX10NiCrSiNb32-20	GX50NiCrCoW35-25-15-5	GX40NiCrNb45-35		---		---	
Steel Number	1.4743	1.4859	1.4869	1.4889		---		---	
ISO 11973:1999 - Heat-Resistant Cast Steels and Alloys for General Applications									
Steel Type	GX10NiCrNb31-20	GX50NiCr52-19	GX45NiCrCoW35-25-15-5	---	---	---	---	---	---

Chapter 8

WROUGHT STAINLESS STEELS

Plate, Sheet, Strip

ASTM Standards

ASTM A 167-99	Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 176-99	Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 666-00	Annealed or Cold-Worked Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar
ASTM A 693–03	Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM B 625-99	UNS N08904, UNS N08925, UNS N08031, UNS N08932, UNS N08926, and UNS R20033 Plate, Sheet, and Strip
ASTM B 688-96	Chromium-Nickel-Molybdenum-Iron (UNS N08366 and UNS N08367) Plate, Sheet, and Strip

JIS Standards

JIS G 4304:1999	Hot Rolled Stainless Steel Plates, Sheets and Strip
JIS G 4305:1999	Cold Rolled Stainless Steel Plates, Sheets and Strip
JIS G 4312:1991	Heat-Resisting Steel Plates and Sheets

CEN Standards

EN 10088-2:1995	Stainless Steels – Part 2: Technical Delivery Conditions for Sheet/Plate and Strip for General Purpose
EN 10095:1999	Heat Resisting Steels and Nickel Alloys

Bars

ASTM Standards

ASTM A 276-03	Stainless Steel Bars and Shapes
ASTM A 564/A 564M-02a	Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A 565-03b	Martensitic Stainless Steel Bars for High-Temperature Service
ASTM A 582/A 582M-95b (2000)	Free-Machining Stainless Steel Bars
ASTM B 649-02	Ni-Fe-Cr-Mo-Cu Low-Carbon Alloy (UNS N08904), Ni-Fe-Cr-Mo-Cu-N Low-Carbon Alloys (UNS N08925, UNS N08031, and UNS N08926), and Cr-Ni-Fe-N Low-Carbon Alloy (UNS R20033) Bar and Wire
ASTM B 691-02	Iron-Nickel-Chromium-Molybdenum Alloys (UNS N08366 and UNS N08367) Rod, Bar, and Wire

JIS Standards

JIS G 4303:1998	Stainless Steel Bars
JIS G 4311:1991	Heat-Resisting Steel Bars
JIS G 4318:1998	Cold Finished Stainless Steel Bars

CEN Standards

EN 10088-3:1995	Stainless Steels – Part 3: Technical Delivery Conditions for Semi-Finished Products, Bars, Rod and Sections for General Purposes
EN 10095:1999	Heat Resisting Steels and Nickel Alloys

ISO Standard

ISO 4955:1994	Heat-Resisting Steels and Alloys

Heat Treatment Terms Applicable to this Chapter

Standard	Heat Treatment Terms
ASTM A 167-99	---
ASTM A 176-99	---
ASTM A 276-03	HF or CF: hot-finished or cold-finished A: annealed; H: hardened and tempered at a relatively low temp.; T: hardened and tempered at a relatively high temperature; S: strain hardened – relatively light cold work; B: relatively severe cold work; as hot-rolled
ASTM A 564/A 564M-02a	HR & CF: hot-rolled and cold-finished A: solution treated; HXXX: age hardening at specified temperature
ASTM A 582/A 582M-95b (2000)	HF or CF: hot-finished or cold-finished A: annealed; T: intermediate temper; H: hard temper
ASTM A 666-00	A: annealed; CW: cold-worked, 1⁄16 hard, 1⁄8 hard, ¼ hard, ½ hard, ¾ hard, full hard
ASTM A 693–03	S: solution treated condition; PHT: precipitation hardening treatment at specified temperature
ASTM B 625-99	HR or CR: hot rolled or cold-rolled. A: annealed
ASTM B 649-02	CF & HF: cold finished and hot finished S: solution-treated
ASTM B 688-96	HR or CR: hot-rolled or cold-rolled
ASTM B 691-02	HF & CF: hot-finished and cold-finished A: annealed
EN 10088-2:1995	HR or CR: hot rolled or cold rolled C: cold rolled strip; H: hot rolled strip; P: hot rolled plate and sheet A: annealed; QT: quenched and tempered; AT: solution annealed; P: precipitation hardened (with specified temperature); SR: strength relieved
EN 10088-3:1995	HF or CF: hot- or cold-formed A: annealed; QT: quenched and tempered; AT: solution annealed; PXXX: precipitation hardened at specified temperature
EN 10095:1999	Pl, Sh, St/HR or CR: hot rolled or cold rolled; Bars/HF or CF: hot formed or cold formed A: annealed; AT: solution annealed
ISO 4955:1994	TA: annealed; TQ: quenched
JIS G 4303:1998	HF: hot-finished S: solution-treated; A: annealed; Q: quenched and tempered; HXXX: precipitation hardened at specified temperature
JIS G 4304:1999	HR: hot rolled; S: solution treated; A: annealed; QT: quenched and tempered; HXXX: precipitation hardening treatment at specified temperature
JIS G 4305:1999	CR: cold rolled same as JIS G 4304, except SUS 301 and SUS 301L (TRR: thermal refining rolled)/ ¼ H, ½ H, ¾ H, H
JIS G 4311:1991	S: solution treatment; H: aging treatment after solution treatment
JIS G 4312:1991	S: solution treatment; H: aging treatment after solution treatment
JIS G 4318:1998	CF: cold finished

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.1A Chemical Composition of Martensitic Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 176-99	403	---	S40300	0.15	1.00	0.50	0.040	0.030	11.50-13.00	0.60	---	---
JIS G 4304:1999	SUS403	---	---	0.15	1.00	0.05	0.040	0.030	11.50-13.00	0.60	---	---
JIS G 4305:1999	SUS403	---	---	0.15	1.00	0.05	0.040	0.030	11.50-13.00	0.60	---	---
JIS G 4312:1991	SUS403	---	---	0.15	1.00	0.05	0.040	0.030	11.50-13.00	0.60	---	---
ASTM A 240/A 240M-03c	410	---	S41000	0.08-0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.75	---	---
JIS G 4304:1999	SUS410	---	---	0.15	1.00	1.00	0.040	0.030	11.5-13.0	---	---	---
JIS G 4305:1999	SUS410	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	---	---	---
EN 10088-2:1995	X12Cr13	1.4006	---	0.08-0.15	1.50	1.00	0.040	0.015	11.50-13.50	0.75	---	---
ASTM A 240/A 240M-03c	---	---	S41003	0.030	1.5	1.00	0.040	0.030	10.5-12.5	1.5	---	---
JIS G 4304:1999	SUS410L	---	---	0.030	1.00	1.00	0.040	0.030	11.00-13.50	---	---	---
JIS G 4305:1999	SUS410L	---	---	0.030	1.00	1.00	0.040	0.030	11.00-13.50	---	---	---
ASTM A 240/A 240M-03c	410S	---	S41008	0.08	1.00	1.00	0.040	0.030	11.5-13.5	0.60	---	---
JIS G 4304:1999	SUS410S	---	---	0.08	1.00	1.00	0.040	0.030	11.50-13.50	0.60	---	---
JIS G 4305:1999	SUS410S	---	---	0.08	1.00	1.00	0.040	0.030	11.50-13.50	0.60	---	---
EN 10088-2:1995	X6Cr13	1.4000	---	0.08	1.00	1.00	0.040	0.015	12.00-14.00	---	---	---
ISO 4955:1994	X6Cr13	---	---	0.08	1.0	1.0	0.040	0.030	12.0-14.0	1.0	---	---
ASTM A 176-99	420	---	S42000	0.15 min	1.00	1.00	0.040	0.030	12.0-14.0	0.75	0.50	---
JIS G 4304:1999	SUS420J1	---	---	0.16-0.25	1.00	1.00	0.040	0.030	12.00-14.00	0.60	---	---
JIS G 4305:1999	SUS420J1	---	---	0.16-0.25	1.00	1.00	0.040	0.030	12.00-14.00	0.60	---	---
EN 10088-2:1995	X20Cr13	1.4021	---	0.16-0.25	1.50	1.00	0.040	0.030	12.00-14.00	---	---	---
JIS G 4304:1999	SUS420J2	---	---	0.26-0.40	1.00	1.00	0.040	0.030	12.00-14.00	0.60	---	---
JIS G 4305:1999	SUS420J2	---	---	0.26-0.40	1.00	1.00	0.040	0.030	12.00-14.00	0.60	---	---
EN 10088-2:1995	X30Cr13	1.4028	---	0.26-0.35	1.50	1.00	0.040	0.030	12.0-14.00	---	---	---

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.1B Mechanical Properties of Martensitic Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 176-99	403	---	S40300	Pl, Sh, St/---	---	---	205	30	485	70	25.0	217/96/---
JIS G 4304:1999	SUS403	---	---	Pl, Sh, St/HR, A	---	---	205	---	440	---	20	201/93/210
JIS G 4305:1999	SUS403	---	---	Pl, Sh, St/CR, A	---	---	205	---	440	---	20	201/93/210
JIS G 4312:1991	SUS403	---	---	Pl, Sh, St/HR or CR, A	---	---	205	---	440	---	20	201/93/210
ASTM A 240/A 240M-03c	410	---	S41000	Pl, Sh, St	---	---	205	30	450	65	20	217/96/---
JIS G 4304:1999	SUS410	---	---	Pl, Sh, St/HR, A	---	---	205	---	440	---	20	201/93/210
JIS G 4305:1999	SUS410	---	---	Pl, Sh, St/CR, A	---	---	205	---	440	---	20	201/93/210
EN 10088-2:1995	X12Cr13	1.4006	---	St/CR, A	≤ 6	---	---	---	600	---	20	200/90/200
				St/HR, A	≤ 12	---						
				Pl/HR, QT550	≤ 75	---	400	---	550-750	---	15	---/---/---
				Pl/HR, QT650		---	450	---	650-850	---	12	---/---/---
ASTM A 240/A 240M-03c	---	---	S41003	Pl, Sh, St	---	---	275	40	455	66	18	183/89/---
JIS G 4304:1999	SUS410L	---	---	Pl, Sh, St/HR, A	---	---	195	---	360	---	22	183/88/200
JIS G 4305:1999	SUS410L	---	---	Pl, Sh, St/CR, A	---	---	195	---	360	---	22	183/88/200
ASTM A 240/A 240M-03c	410S	---	S41008	Pl, Sh, St	---	---	205	30	415	60	22	183/89/---
JIS G 4304:1999	SUS410S	---	---	Pl, Sh, St/HR, A	---	---	205	---	410	---	20	183/88/200
JIS G 4305:1999	SUS410S	---	---	Pl, Sh, St/CR, A	---	---	205	---	410	---	20	183/88/200
EN 10088-2:1995	X6Cr13	1.4000	---	St/CR	≤ 6	---	240	---	400-600	---	19	---
				St/HR	≤ 12	---	220	---				
				Pl/HR	≤ 25	---	220	---				
ISO 4955:1994	X6Cr13	---	---	Pl, Sh, St/TA	---	---	230	---	400-630	---	see standard	197/---/---
ASTM A 176-99	420	---	S42000	Pl, Sh, St/---	---	---	---	---	485	70	15.0	217/96/---
JIS G 4304:1999	SUS420J1	---	---	Pl, Sh, St/HR, A	---	---	225	---	520	---	18	223/97/234
JIS G 4305:1999	SUS420J1	---	---	Pl, Sh, St/CR, A	---	---	225	---	520	---	18	223/97/234
EN 10088-2:1995	X20Cr13	1.4021	---	St/CR, QT	≤ 3	---	---	---	---	---	---	---/---/440-530
				St/CR, A	≤ 6	---	---	---	---	---	15	225/95/225
				HR St/A	≤ 12	---						
				HR Pl/QT65	≤ 75	---	450	---	650-850	---	12	---/---/---
				HR Pl/QT750			550	---	750-950	---	10	---/---/---
JIS G 4304:1999	SUS420J2	---	---	Pl, Sh, St/HR, A	---	---	225	---	540	---	18	235/99/247
JIS G 4305:1999	SUS420J2	---	---	Pl, Sh, St/CR, A	---	---	225	---	540	---	18	235/99/247
EN 10088-2:1995	X30Cr13	1.4028	---	St/CR, QT	≤ 3	---	---	---	---	---	---	---/---/450-550
				St/CR, A	≤ 6	---	---	---	740 max	---	15	235/97/235
				St/HR, A	≤ 12	---						
				Pl/HR, QT800	≤ 75	---	600	---	800-1000	---	10	---/---/---

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.2A Chemical Composition of Ferritic Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 240/A 240M-03c	405	---	S40500	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.60	---	Al 0.10-0.30
JIS G 4304:1999	SUS405	---	---	0.08	1.00	1.00	0.040	0.030	11.50-14.50	---	---	Al 0.10-0.30
JIS G 4305:1999	SUS405	---	---	0.08	1.00	1.00	0.040	0.030	11.50-14.50	---	---	Al 0.10-0.30
JIS G 4312:1991	SUS405	---	---	0.08	1.00	1.00	0.040	0.030	11.50-14.50	---	---	Al 0.10-0.30
EN 10088-2:1995	X6CrAl13	1.4002	---	0.08	1.00	1.00	0.040	0.015	12.00-14.00	---	---	Al 0.10-0.30
ASTM A 240/A 240M-03c	---	---	S40977	0.030	1.5	1.00	0.040	0.015	10.5-12.5	0.30-1.00	---	N 0.030
	---	---	S41050	0.030	1.00	1.00	0.040	0.030	12.0-13.0	0.50	---	N 0.030; Cb 9 x (C+N) to 0.60
EN 10088-2:1995	X2CrNi12	1.4003	---	0.030	1.50	1.00	0.040	0.015	10.50-12.50	0.30-1.00	---	N 0.030
JIS G 4312:1991	SUH409L	---	---	0.030	1.00	1.00	0.040	0.030	10.50-11.75	---	---	Ti 6 x C to 0.75
EN 10088-2:1995	X2CrTi12	1.4512	---	0.030	1.00	1.00	0.040	0.015	10.50-12.50	---	---	Ti 6 x (C+N) to 0.65
ASTM A 240/A 240M-03c	430	---	S43000	0.12	1.00	1.00	0.040	0.030	16.0-18.0	0.75	---	---
JIS G 4304:1999	SUS430	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	---	---	---
JIS G 4305:1999	SUS430	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	---	---	---
JIS G 4312:1991	SUS430	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	---	---	---
EN 10088-2:1995	X6Cr17	1.4016	---	0.08	1.00	1.00	0.040	0.015	16.00-18.00	---	---	---
JIS G 4304:1999	SUS430LX	---	---	0.030	1.00	0.75	0.040	0.030	16.00-19.00	---	---	Ti or Nb 0.10-1.00
JIS G 4305:1999	SUS430LX	---	---	0.030	1.00	0.75	0.040	0.030	16.00-19.00	---	---	Ti or Nb 0.10-1.00
EN 10088-2:1995	X2CrTi17	1.4520	---	0.025	0.50	0.50	0.040	0.015	16.00-18.00	---	---	N 0.015; Ti 0.30-0.60
	X3CrTi17	1.4510	---	0.05	1.00	1.00	0.040	0.015	16.00-18.00	---	---	Ti 4 x (C+N) + 0.15 to 0.80
	X3CrNb17	1.4511	---	0.05	1.00	1.00	0.040	0.015	16.00-18.00	---	---	Nb 12 x C to 1.00
ASTM A 240/A 240M-03c	434	---	S43400	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	0.75-1.25	---
JIS G 4304:1999	SUS434	---	---	0.12	1.00	1.00	0.040	0.030	16.00-18.00	---	0.75-1.25	---
JIS G 4305:1999	SUS434	---	---	0.12	1.00	1.00	0.040	0.030	16.00-18.00	---	0.75-1.25	---
EN 10088-2:1995	X6CrMo17-1	1.4113	---	0.08	1.00	1.00	0.040	0.015	16.00-18.00	---	0.90-1.40	---
ASTM A 240/A 240M-03c	439	---	S43035	0.030	1.00	1.00	0.040	0.030	17.0-19.0	0.50	---	Ti [0.20 + 4 x (C+N)] to 1.10; N 0.030; Al 0.15
	---	---	S43932	0.030	1.00	1.00	0.040	0.030	17.0-19.0	0.50	---	(Ti+Cb) [0.20 + 4 x (C+N)] to 0.75; N 0.030; Al 0.15
	---	---	S43940	0.030	1.00	1.00	0.040	0.015	17.5-18.5	---	---	Ti 0.10-0.60; Cb [0.30 + (3 x C)] min
EN 10088-2:1995	X2CrTiNb18	1.4509	---	0.030	1.00	1.00	0.040	0.015	17.50-18.50	---	---	Ti 0.10-0.60; Nb 3 x C+ 0.30 to 1.00

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.2A Chemical Composition of Ferritic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 240/A 240M-03c	444	---	S44400	0.025	1.00	1.000	0.040	0.030	17.5-19.5	1.00	1.75-2.50	(Ti+Cb) [0.20 + 4 x (C+N)] to 0.80; N 0.035
JIS G 4304:1999	SUS444	---	---	0.025	1.00	1.00	0.040	0.030	17.00-20.00	---	1.75-2.50	N 0.025; Ti, Nb, Zr or their combination 8 x (C+N) to 0.80
JIS G 4305:1999	SUS444	---	---	0.025	1.00	1.00	0.040	0.030	17.00-20.00	---	1.75-2.50	N 0.025; Ti+Nb or their combination 8 x (C+N) to 0.80
EN 10088-2:1995	X2CrMoTi18-2	1.4521	---	0.025	1.00	1.00	0.040	0.015	17.00-20.00	---	1.80-2.50	N 0.030; Ti 4 (C+N) + 0.15 to 0.80
ASTM A 176-99	446	---	S44600	0.20	1.50	1.00	0.040	0.030	23.00-27.00	0.75	---	N 0.25
JIS G 4312:1991	SUH446	---	---	0.20	1.50	1.00	0.040	0.030	23.00-27.00	---	---	N 0.25
ISO 4955:1994	X15CrN26	---	---	0.20	1.0	1.0	0.040	0.030	24.0-28.0	1.0	---	N 0.15-0.25
ASTM A 240/A 240M-03c	---	---	S44735	0.030	1.00	1.00	0.040	0.030	28.0-30.0	1.00	3.6-4.2	(Ti+Cb) 0.20-1.00; (Ti+Cb) 6 x (C+N) min; N 0.045
EN 10088-2:1995	X2CrMoTi29-4	1.4592	---	0.025	1.00	1.00	0.030	0.010	28.00-30.00	---	3.50-4.50	N 0.045; Ti 4X(C+N)+0.15-0.80

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.2B Mechanical Properties of Ferritic Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 240/A 240M-03c	405	---	S40500	Pl, Sh, St	---	---	170	25	415	60	20.0	179/88/---
JIS G 4304:1999	SUS405	---	---	Pl, Sh, St/HR, A	---	---	175	---	410	---	20	183/88/200
JIS G 4305:1999	SUS405	---	---	Pl, Sh, St/CR, A	---	---	175	---	410	---	20	183/88/200
JIS G 4312:1991	SUS405	---	---	Pl, Sh/HR or CR, A	---	---	175	---	410	---	20	183/88/200
EN 10088-2:1995	X6CrAl13	1.4002	---	St/CR, A	≤ 6	---	230	---	400-600	---	17	---/---/---
				St/HR, A	≤ 12	---	210	---				
				Pl/HR, A	≤ 25	---	210	---				
ASTM A 240/A 240M-03c	---	---	S40977	Pl, Sh, St	---	---	280	41	450	65	18	180/88/---
	---	---	S41050	Pl, Sh, St	---	---	205	30	415	60	22	183/89/---
EN 10088-2:1995	X2CrNi12	1.4003	---	St/CR, A	≤ 6	---	280	---	450-650	---	20	---/---/---
				St/HR, A	≤ 12	---	280	---		---	20	
				Pl/HR, A	≤ 25	---	250	---		---	18	
JIS G 4312:1991	SUH409L	---	---	Pl, Sh/HR or CR, A	---	---	175	---	360	---	25	162/80/175
EN 10088-2:1995	X2CrTi12	1.4512	---	St/CR, A	≤ 6	---	210	---	380-560	---	25	---/---/---
				St/HR, A	≤ 12	---						
ASTM A 240/A 240M-03c	430	---	S43000	Pl, Sh, St	---	---	205	30	450	65	22	183/89/---
JIS G 4304:1999	SUS430	---	---	Pl, Sh, St/HR, A	---	---	205	---	450	---	22	183/88/200
JIS G 4305:1999	SUS430	---	---	Pl, Sh, St/CR, A	---	---	205	---	450	---	22	183/88/200
JIS G 4312:1991	SUS430	---	---	Pl, Sh/HR or CR, A	---	---	205	---	450	---	22	183/88/200
EN 10088-2:1995	X6Cr17	1.4016	---	St/CR, A	≤ 6	---	260	---	450-600	---	20	---/---/---
				St/HR, A	≤ 12	---	240	---			18	
				Pl/HR, A	≤ 25	---	240	---	430-630	---	20	
JIS G 4304:1999	SUS430LX	---	---	Pl, Sh, St/HR, A	---	---	175	---	360	---	22	183/88/200
JIS G 4305:1999	SUS430LX	---	---	Pl, Sh, St/CR, A	---	---	175	---	360	---	22	183/88/200
EN 10088-2:1995	X2CrTi17	1.4520	---	St/CR, A	≤ 6	---	180	---	380-530	---	24	---/---/---
	X3CrTi17	1.4510	---	St/CR, A	≤ 6	---	230	---	420-600	---	23	---/---/---
				St/HR, A	≤ 12	---						
	X3CrNb17	1.4511	---	St/CR, A	≤ 6	---	230	---	420-600	---	23	---/---/---
ASTM A 240/A 240M-03c	434	---	S43400	Pl, Sh, St	---	---	240	35	450	65	22	---/89/---
JIS G 4304:1999	SUS434	---	---	Pl, Sh, St/HR, A	---	---	205	---	450	---	22	183/88/200
JIS G 4305:1999	SUS434	---	---	Pl, Sh, St/CR, A	---	---	205	---	450	---	22	183/88/200
EN 10088-2:1995	X6CrMo17-1	1.4113	---	St/CR, A	≤ 6	---	260	---	450-630	---	18	---/---/---
				St/HR, A	≤ 12	---						

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.2B Mechanical Properties of Ferritic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 240/A 240M-03c	439	---	S43035	Pl, Sh, St	---	---	205	30	415	60	22.0	183/89/---
	---	---	S43932	Pl, Sh, St	---	---	205	30	415	60	22.0	183/89/---
	---	---	S43940	Pl, Sh, St	---	---	250	36	430	62	18	180/88/---
EN 10088-2:1995	X2CrTiNb18	1.4509	---	St/CR, A	≤ 6	---	230	---	430-630	---	18	---/---/---
ASTM A 240/A 240M-03c	444	---	S44400	Pl, Sh, St	---	---	275	40	415	60	20.0	217/96/---
JIS G 4304:1999	SUS444	---	---	Pl, Sh, St/HR, A	---	---	245	---	410	---	20	217/96/230
JIS G 4305:1999	SUS444	---	---	Pl, Sh, St/CR, A	---	---	245	---	410	---	20	217/96/230
EN 10088-2:1995	X2CrMoTi18-2	1.4521	---	St/CR, A	≤ 6	---	300	---	420-640	---	20	---/---/---
				St/HR, A	≤ 12	---	280	---	400-600	---		
				Pl/HR, A	≤ 12	---	280	---	420-620	---		
ASTM A 176-99	446	---	S44600	Pl, Sh, St/A	---	---	275	40	515	65	20.0	217/96/---
JIS G 4312:1991	SUH446	---	---	Pl, Sh/HR or CR, A	---	---	275	---	510	---	20	201/95/210
ISO 4955:1994	X15CrN26	---	---	Pl, Sh, St/TA	---	---	280	---	500-700	---	see standard	212/---/---
ASTM A 240/A 240M-03c	---	---	S44735	Pl, Sh, St	---	---	415	60	550	80	18	255/25/---
EN 10088-2:1995	X2CrMoTi29-4	1.4592	---	St/CR, A	≤ 6	---	430	---	550-700	---	20	---/---/---

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 666-03	201	---	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 A 240/A 240M-03c	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 10088-2:1995	X12CrMnNiN17-7-5	1.4372	---	0.15	5.50-7.50	1.00	0.045	0.015	16.00-18.00	3.50-5.50	---	N 0.05-0.25
ASTM A 666-03	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
	201LN	---	S20153	0.03	6.4-7.5	0.75	0.045	0.015	16.0-17.5	4.0-5.0	---	N 0.10-0.25; Cu 1.00
ASTM A 240/A 240M-03c	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
	201LN	---	S20153	0.03	6.4-7.5	0.75	0.045	0.015	16.0-17.5	4.0-5.0	---	N 0.10-0.25; Cu 1.00
EN 10088-2:1995	X2CrMnNiN17-7-5	1.4371	---	0.030	6.00-8.00	1.00	0.045	0.015	16.00-17.00	3.50-5.50	---	N 0.15-0.20
ASTM A 666-03	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 A 240/A 240M-03c	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
EN 10088-2:1995	X12CrMnNiN18-9-5	1.4373	---	0.15	7.50-10.50	1.00	0.045	0.015	17.00-19.00	4.00-6.00	---	N 0.05-0.25
ASTM A 666-03	301	---	S30100	0.15	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.10
ASTM A 240/A 240M-03c	301	---	S30100	0.15	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.10
JIS G 4304:1999	SUS301	---	---	0.15	2.00	1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	---
	SUS301J1	---	---	0.08-0.12	2.00	1.00	0.045	0.030	16.00-18.00	7.00-9.00	---	---
JIS G 4305:1999	SUS301	---	---	0.15	2.00	1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	---
	SUS301J1	---	---	0.08-0.12	2.00	1.00	0.045	0.030	16.00-18.00	7.00-9.00	---	---
EN 10088-2:1995	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	N 0.11
ASTM A 240/A 240M-03c	301L	---	S30103	0.03	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.20
ASTM A 666-03	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 4304:1999	SUS301L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	N 0.20
JIS G 4305:1999	SUS301L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	N 0.20
ASTM A 240/A 240M-03c	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 A 666-03	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 10088-2:1995	X2CrNiN18-7	1.4318	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	6.00-8.00	---	N 0.10-0.20
ASTM A 240/A 240M-03c	302	---	S30200	0.15	2.00	0.75	0.045	0.030	17.0-19.0	8.0-10.0	---	N 0.10
ASTM A 666-03	302	---	S30200	0.15	2.00	0.75	0.045	0.030	17.0-19.0	8.0-10.0	---	---
JIS G 4304:1999	SUS302	---	---	0.15	2.00	1.00	0.045	0.030	17.00-19.00	8.00-10.00	---	---
JIS G 4305:1999	SUS302	---	---	0.15	2.00	0.75	0.045	0.030	17.00-19.00	8.00-10.00	---	---
ASTM A 167-99	302B	---	S30215	0.15	2.00	2.00-3.00	0.045	0.030	17.0-19.0	8.0-10.0	---	N 0.10
JIS G 4304:1999	SUS302B	---	---	0.15	2.00	2.00-3.00	0.045	0.030	17.00-19.00	8.00-10.00	---	---
JIS G 4305:1999	SUS302B	---	---	0.15	2.00	2.00-3.00	0.045	0.030	17.00-19.00	8.00-10.00	---	---
JIS G 4312:1991	SUS302B	---	---	0.15	2.00	2.00-3.00	0.045	0.030	17.00-19.00	8.00-10.00	---	---

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 240/A 240M-03c	304	---	S30400	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10
ASTM A 666-03	304	---	S30400	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10
JIS G 4304:1999	SUS304	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
JIS G 4305:1999	SUS304	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
JIS G 4312:1991	SUS304	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
EN 10088-2:1995	X5CrNi18-10	1.4301	---	0.07	2.00	1.00	0.045	0.015	17.00-19.50	8.00-10.50	---	N 0.11
ISO 4955:1994	X7CrNi18-9	---	---	0.10	2.0	1.0	0.045	0.030	17.0-19.0	8.0-11.0	---	---
ASTM A 240/A 240M-03c	304L	---	S30403	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10
ASTM A 666-03	304L	---	S30403	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10
JIS G 4304:1999	SUS304L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	9.00-13.00	---	---
JIS G 4305:1999	SUS304L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	9.00-13.00	---	---
EN 10088-2:1995	X2CrNi19-11	1.4306	---	0.030	2.00	1.00	0.045	0.015	18.00-20.00	10.00-12.00	---	N 0.11
	X2CrNi18-9	1.4307	---	0.030	2.00	1.00	0.045	0.015	17.50-19.50	8.00-10.00	---	N 0.11
ASTM A 240/A 240M-03c	305	---	S30500	0.12	2.00	0.75	0.045	0.030	17.0-19.0	10.5-13.0	---	---
JIS G 4304:1999	SUS305	---	---	0.12	2.00	1.00	0.045	0.030	17.00-19.00	10.50-13.00	---	---
JIS G 4305:1999	SUS305	---	---	0.12	2.00	1.00	0.045	0.030	17.00-19.00	10.50-13.00	---	---
EN 10088-2:1995	X4CrNi18-12	1.4303	---	0.06	2.00	1.00	0.045	0.015	17.00-19.00	11.00-13.00	---	N 0.11
ASTM A 240/A 240M-03c	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 A 666-03	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
JIS G 4304:1999	SUS304N1	---	---	0.08	2.50	1.00	0.045	0.030	18.00-20.00	7.00-10.50	---	N 0.15-0.25
JIS G 4305:1999	SUS304N1	---	---	0.08	2.50	1.00	0.045	0.030	18.00-20.00	7.00-10.50	---	N 0.10-0.25
ASTM A 240/A 240M-03c	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 A 666-03	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
JIS G 4304:1999	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 4305:1999	SUS304LN	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
EN 10088-2:1995	X2CrNiN18-10	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
ASTM A 240/A 240M-03c	---	---	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 10088-2:1995	X1CrNiSi18-15-4	1.4361	---	0.015	2.00	3.70-4.50	0.025	0.010	16.50-18.50	14.00-16.00	0.20	N 0.11
ASTM A 167-99	309	---	S30900	0.20	2.00	0.75	0.045	0.030	22.0-24.0	12.0-15.0	---	---
JIS G 4312:1991	SUH309	---	---	0.20	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 240/A 240M-03c	309S	---	S30908	0.08	2.00	0.75	0.045	0.030	22.0-24.0	12.0-15.0	---	---
JIS G 4304:1999	SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 4305:1999	SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 4312:1991	SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
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
ISO 4955:1994	X6CrNi23-14	---	---	0.08	2.0	1.0	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASTM A 167-99	310	---	S31000	0.25	2.00	1.50	0.045	0.030	24.0-26.0	19.0-22.0	---	---
JIS G 4312:1991	SUH310	---	---	0.25	2.00	1.50	0.040	0.030	24.00-26.00	19.00-22.00	---	---
ASTM A 240/A 240M-03c	310S	---	S31008	0.08	2.00	1.50	0.045	0.030	24.0-26.0	19.0-22.0	---	---
JIS G 4304:1999	SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 4305:1999	SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 4312:1991	SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
ISO 4955:1994	X6CrNi25-21	---	---	0.08	2.0	1.5	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A 240/A 240M-03c	310MoLN	---	S31050	0.20	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 10088-2:1995	X1CrNiMoN25-22-2	1.4466	---	0.20	2.00	0.70	0.025	0.010	24.00-26.00	21.0-23.0	2.00-2.50	N 0.10-0.16
ASTM A 240/A 240M-03c	---	---	S31254	0.20	1.00	0.80	0.030	0.010	19.5-20.5	17.5-18.5	6.0-6.5	N 0.18-0.22; Cu 0.50-1.00
EN 10088-2:1995	X1CrNiMoCuN20-18-7	1.4547	---	0.20	1.00	0.70	0.030	0.010	19.50-20.50	17.50-18.50	6.00-7.00	N 0.18-0.25; Cu 0.50-1.00
ASTM A 240/A 240M-03c	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 A 666-03	316	---	S31600	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
JIS G 4304:1999	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 4305:1999	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 4312:1991	SUS316	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
EN 10088-2:1995	X5CrNiMo17-12-2	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
	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
ASTM A 240/A 240M-03c	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 A 666-03	316L	---	S31603	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
JIS G 4304:1999	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 4305:1999	SUS316L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
EN 10088-2:1995	X2CrNiMo17-12-2	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
	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	N 0.11
	X2CrNiMo18-14-3	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
ASTM A 240/A 240M-03c	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 A 666-03	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
JIS G 4304:1999	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 4305:1999	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

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 240/A 240M-03c	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
JIS G 4304:1999	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 4305:1999	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
EN 10088-2:1995	X2CrNiMoN17-11-2	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
	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
ASTM A 240/A 240M-03c	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 min, 1.10 max; N 0.10
EN 10088-2:1995	X6CrNiMoNb17-12-2	1.4580	---	0.08	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.50	2.00-2.50	Nb 10xC to 1.00
ASTM A 240/A 240M-03c	316Ti	---	S31635	0.08	2.00	0.75	0.045	0.030	16.00-18.0	10.0-14.0	2.0-3.0	Ti 5 x (C+N) min, 0.70 max
JIS G 4304:1999	SUS316Ti	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti ≥ 5 x C
JIS G 4305:1999	SUS316Ti	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti ≥ 5 x C
JIS G 4312:1991	SUS316Ti	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti ≥ 5 x C
EN 10088-2:1995	X6CrNiMoTi17-12-2	1.4571	---	0.08	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.50	2.00-2.50	Ti 5 x C to 0.70
ASTM A 240/A 240M-03c	317L	---	S31700	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
JIS G 4304:1999	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 4305:1999	SUS317L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
EN 10088-2:1995	X2NiCrMo18-15-4	1.4438	---	0.030	2.00	1.00	0.045	0.015	17.50-19.50	13.00-16.00	3.00-4.00	N 0.11
ASTM A 240/A 240M-03c	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
JIS G 4304:1999	SUS317LN	---	---	0.03	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 4305:1999	SUS317LN	---	---	0.03	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
EN 10088-2:1995	X2CrNiMoN18-12-4	1.4434	---	0.030	2.00	1.00	0.045	0.015	16.50-19.50	10.50-14.00	3.00-4.00	N 0.10-0.20
ASTM A 240/A 240M-03c	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
JIS G 4304:1999	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 4305:1999	SUS317J1	---	---	0.040	2.50	1.00	0.045	0.030	16.00-19.00	15.00-17.00	4.00-6.00	---
EN 10088-2:1995	X2CrNiMoN17-13-5	1.4439	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	12.50-14.50	4.00-5.00	N 0.12-0.22
ASTM A 240/A 240M-03c	---	---	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
ASTM B 688-96	---	---	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	N 0.18-0.25; Cu 0.75
JIS G 4304:1999	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 4305:1999	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 10088-2:1995	X1NiCrMoCuN25-20-7	1.4529	---	0.020	1.00	0.50	0.030	0.010	19.00-21.00	24.00-26.00	6.00-7.00	N 0.15-0.25; Cu 0.50-1.50
ASTM A 240/A 240M-03c	904L	---	N08904	0.020	2.00	1.00	0.045	0.035	19.0-23.0	23.0-28.0	4.0-5.0	N 0.10; Cu 1.0-2.0
ASTM B 625-99	---	---	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; Fe bal
JIS G 4304:1999	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 4305:1999	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 10088-2:1995	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	N 0.15; Cu 1.20-2.00

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 240/A 240M-03c	321	---	S32100	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x (C+N) min, 0.70 max
JIS G 4304:1999	SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti ≥ 5 x C
JIS G 4305:1999	SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti ≥ 5 x C
JIS G 4312:1991	SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti ≥ 5 x C
EN 10088-2:1995	X6CrNiTi18-10	1.4541	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.70
ISO 4955:1994	X7CrNiTi18-10	---	---	0.040-0.10	2.0	1.0	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.80
ASTM A 240/A 240M-03c	347	---	S34700	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 10 x C min, 1.00 max
JIS G 4304:1999	SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb ≥ 10 x C
JIS G 4305:1999	SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb ≥ 10 x C
JIS G 4312:1991	SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb ≥ 10 x C
EN 10088-2:1995	X6CrNiNb18-10	1.4550	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00
ISO 4955:1994	X7CrNiNb18-10	---	---	0.040-0.10	2.0	1.0	0.045	0.030	17.0-19.0	9.0-12.0	---	Nb 10 x C to 1.2

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 666-03	201, Class 1	---	S20100	Pl, Sh, St/A	---	---	260	38	515	75	40	217/95/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	310	45	655	95	40	---/---/---
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	45	---/---/---
				Pl, Sh, St/CW, 1/4 Hard	---	---	515	75	860	125	25	---/---/---
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	760	110	1035	150	15	---/---/---
					---	≥ 0.015					18	
				Pl, Sh, St/CW, 3/4 Hard	---	< 0.015	930	135	1205	175	10	---/---/---
					---	≥ 0.015					12	
				Pl, Sh, St/CW, Full Hard	---	< 0.015	965	140	1275	185	8	---/---/---
					---	≥ 0.015					9	
	201, Class 2	---	S20100	Pl, Sh, St/A	---	---	310	45	655	95	40	241/100/---
ASTM A 240/A 240M-03c	201-1	---	S20100	Pl, Sh, St	---	---	260	38	515	75	40	241/100/---
	201-2	---	S20100	Pl, Sh, St	---	---	310	45	655	95	40	241/100/---
EN 10088-2:1995	X12CrMnNiN17-7-5	1.4372	---	St/CR, AT	≤ 6	---	350	---	750-950	---	45	---/---/---
				St/HR, AT	≤ 12	---	330	---				
				Pl/HR, AT	≤ 75	---	330	---			40	
ASTM A 666-03	201L	---	S20103	Pl, Sh, St/A	---	---	260	38	655	95	40	217/95/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	345	50	690	100	40	---/---/---
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	725	105	35	
				Pl, Sh, St/CW, 1/4 Hard	---	---	515	75	825	120	25	
				Pl, Sh, St/CW, 1/2 Hard	---	≤ 0.030	690	100	930	135	22	
					---	> 0.030					20	
	201LN	---	S20153	Pl, Sh, St/A	---	---	310	45	655	95	45	241/100/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	345	50	690	100	40	---/---/---
				Pl, Sh, St/CW, 1/8 Hard	---	---	415	60	760	110	35	
				Pl, Sh, St/CW, 1/4 Hard	---	---	515	75	825	120	25	
				Pl, Sh, St/CW, 1/2 Hard	---	≤ 0.030	690	100	930	135	22	
					---	> 0.030					20	
ASTM A 240/A 240M-03c	201L	---	S20103	Pl, Sh, St	---	---	260	38	655	95	40	217/95/---
	201LN	---	S20153	Pl, Sh, St	---	---	310	45	655	95	45	241/100/---
EN 10088-2:1995	X2CrMnNiN17-7-5	1.4371	---	St/CR, AT	≤ 6	---	300	---	650-850	---	45	---/---/---
				St/HR, AT	≤ 12	---	280	---				
				Pl/HR, AT	≤ 75	---	280	---	630-830	---	35	
ASTM A 666-03	202	---	S20200	Pl, Sh, St/A	---	---	260	38	620	90	40	241/---/---
				Pl, Sh, St/CW, 1/4 Hard	---	≤ 0.030	515	75	860	125	12	---/---/---
ASTM A 240/A 240M-03c	202	---	S20200	Pl, Sh, St	---	---	260	38	620	90	40	241/---/---
EN 10088-2:1995	X12CrMnNiN18-9-5	1.4373	---	St/CR, AT	≤ 6	---	340	---	680-880	---	45	---/---/---
				St/HR, AT	≤ 12	---	320	---				
				Pl/HR, AT	≤ 75	---	320	---	600-800	---	35	

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 666-03	301	---	S30100	Pl, Sh, St/A	---	---	205	30	515	75	40	217/95/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	310	45	620	90	40	---/---/---
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	40	
				Pl, Sh, St/CW, 1/4 Hard	---	---	515	75	860	125	25	
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	760	110	1035	150	15	
					---	≥ 0.015					18	
				Pl, Sh, St/CW, 3/4 Hard	---	< 0.015	930	135	1205	175	10	
					---	≥ 0.015					12	
				Pl, Sh, St/CW, Full Hard	---	< 0.015	965	140	1275	185	8	
					---	≥ 0.015					9	
ASTM A 240/A 240M-03c	301	---	S30100	Pl, Sh, St	---	---	205	30	515	75	40	217/95/---
JIS G 4304:1999	SUS301	---	---	Pl, Sh, St/HR, S	---	---	205	---	520	---	40	207/95/218
	SUS301J1	---	---	Pl, Sh, St/HR, S	---	---	205	---	570	---	45	187/90/200
JIS G 4305:1999	SUS301	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	207/95/218
				Pl, Sh, St/TRR, 1/4 H	< 0.4	---	510	---	860	---	25	---/---/---
					0.4 ≤ t < 0.8	---					25	
					≥ 0.8	---					25	
				Pl, Sh, St/TRR, 1/2 H	< 0.4	---	755	---	1030	---	9	---/---/---
					0.4 ≤ t < 0.8	---					10	
					≥ 0.8	---					10	
				Pl, Sh, St/TRR, 3/4 H	< 0.4	---	930	---	1210	---	3	---/---/---
					0.4 ≤ t < 0.8	---					5	
					≥ 0.8	---					7	
				Pl, Sh, St/TRR, H	< 0.4	---	960	---	1270	---	3	---/---/---
					0.4 ≤ t < 0.8	---					4	
					≥ 0.8	---					5	
	SUS301J1	---	---	Pl, Sh, St/CR, S	---	---	205	---	570	---	45	187/90/200
EN 10088-2:1995	X10CrNi18-8	1.4310	---	St/CR, AT	≤ 6	---	250	---	600-950	---	40	---/---/---

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 240/A 240M-03c	301L	---	S30103	Pl, Sh, St	---	---	220	32	550	80	45	241/100/---
ASTM A 666-03	301L	---	S30103	Pl, Sh, St/A	---	---	220	32	550	80	45	241/100/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	345	50	690	100	40	---/---/---
				Pl, Sh, St/CW, 1/8 Hard	---	---	415	60	760	110	35	
				Pl, Sh, St/CW, 1/4 Hard	---	---	515	75	825	120	25	
				Pl, Sh, St/CW, 1/2 Hard	---	---	690	100	930	135	20	
JIS G 4304:1999	SUS301L	---	---	Pl, Sh, St/HR, S	---	---	215	---	550	---	45	187/90/200
JIS G 4305:1999	SUS301L	---	---	Pl, Sh, St/CR, S	---	---	215	---	550	---	45	207/95/218
				Pl, Sh, St/TRR, 1/4 H	---	---	345	---	690	---	40	---/---/---
				Pl, Sh, St/TRR, 1/2 H	---	---	410	---	760	---	35	---/---/---
				Pl, Sh, St/TRR, 3/4 H	---	---	480	---	820	---	25	---/---/---
				Pl, Sh, St/TRR, H	---	---	685	---	930	---	20	---/---/---
ASTM A 240/A 240M-03c	301LN	---	S30153	Pl, Sh, St	---	---	240	35	550	80	45	241/100/---
ASTM A 666-03	301LN	---	S30153	Pl, Sh, St/A	---	---	240	35	550	80	45	241/100/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	345	50	690	100	40	---/---/---
				Pl, Sh, St/CW, 1/8 Hard	---	---	415	60	760	110	35	
				Pl, Sh, St/CW, 1/4 Hard	---	---	515	75	825	120	25	
				Pl, Sh, St/CW, 1/2 Hard	---	---	690	100	930	135	20	
EN 10088-2:1995	X2CrNiN18-7	1.4318	---	St/CR, AT	≤ 6	---	350	---	650-850	---	35	---/---/---
				St/HR, AT	≤ 12	---	330	---				
				Pl/HR, AT	≤ 75	---	330	---	630-830	---	45	
ASTM A 240/A 240M-03c	302	---	S30200	Pl, Sh, St	---	---	205	30	515	75	40	201/92/---
ASTM A 666-03	302	---	S30200	Pl, Sh, St/A	---	---	205	30	515	75	40	201/92/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	310	45	585	85	40	---/---/---
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	35	
				Pl, Sh, St/CW, 1/4 Hard	---	≤ 0.030	515	75	860	125	10	
					---	> 0.030					12	
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	760	110	1035	150	9	
					---	≥ 0.015					10	
				Pl, Sh, St/CW, 3/4 Hard	---	< 0.015	930	135	1205	175	5	
					---	≥ 0.015					6	
				Pl, Sh, St/CW, Full Hard	---	< 0.015	965	140	1275	185	3	
					---	≥ 0.015					4	
JIS G 4304:1999	SUS302	---	---	Pl, Sh, St/HR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4305:1999	SUS302	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	187/90/200

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 167-99	302B	---	S30215	Pl, Sh, St/---	---	---	205	30	515	75	40	217/95/---
JIS G 4304:1999	SUS302B	---	---	Pl, Sh, St/HR, S	---	---	205	---	520	---	40	207/95/218
JIS G 4305:1999	SUS302B	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	207/95/218
JIS G 4312:1991	SUS302B	---	---	Pl, Sh/HR or CR, S	---	---	205	---	520	---	40	207/95/218
ASTM A 240/A 240M-03c	304	---	S30400	Pl, Sh, St	---	---	205	30	515	75	40	201/92/---
ASTM A 666-03	304	---	S30400	Pl, Sh, St/A	---	---	205	30	515	75	40	201/92/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	310	45	550	80	35	---/---/---
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	35	
				Pl, Sh, St/CW, 1/4 Hard	---	≤ 0.030	515	75	860	125	10	
					---	> 0.030					12	
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	760	110	1035	150	6	
					---	≥ 0.015					7	
JIS G 4304:1999	SUS304	---	---	Pl, Sh, St/HR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4305:1999	SUS304	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4312:1991	SUS304	---	---	Pl, Sh/HR or CR, S	---	---	205	---	520	---	40	187/90/200
EN 10088-2:1995	X5CrNi18-10	1.4301	---	St/CR, AT	≤ 6	---	230	---	540-750	---	45	---/---/---
				St/HR, AT	≤ 12	---	210	---	520-720			
				Pl/HR, AT	≤ 75	---	210	---				
ISO 4955:1994	X7CrNi18-9	---	---	Pl, Sh, St/TQ	0.5 ≤ a ≤ 75	---	195	---	500-700	---	see standard	192/---/---
ASTM A 240/A 240M-03c	304L	---	S30403	Pl, Sh, St	---	---	170	25	485	70	40	201/92/---
ASTM A 666-03	304L	---	S30403	Pl, Sh, St/A	---	---	170	25	485	70	40	201/92/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	310	45	550	80	40	---/---/---
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	30	
				Pl, Sh, St/CW, 1/4 Hard	---	≤ 0.030	515	75	860	125	8	
					---	> 0.030					10	
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	760	110	1035	150	5	
					---	≥ 0.015					6	
JIS G 4304:1999	SUS304L	---	---	Pl, Sh, St/HR, S	---	---	175	---	480	---	40	187/90/200
JIS G 4305:1999	SUS304L	---	---	Pl, Sh, St/CR, S	---	---	175	---	480	---	40	187/90/200
EN 10088-2:1995	X2CrNi19-11	1.4306	---	St/CR, AT	≤ 6	---	220	---	520-670	---	45	---/---/---
				St/HR, AT	≤ 12	---	200	---				
				Pl/HR, AT	≤ 75	---	200	---	500-650			
	X2CrNi18-9	1.4307	---	St/CR, AT	≤ 6	---	220	---	520-670	---	45	---/---/---
				St/HR, AT	≤ 12	---	200	---				
				Pl/HR, AT	≤ 75	---	200	---	500-650			

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 240/A 240M-03c	305	---	S30500	Pl, Sh, St	---	---	170	25	485	70	40	183/88/---
JIS G 4304:1999	SUS305	---	---	Pl, Sh, St/HR, S	---	---	175	---	480	---	40	187/90/200
JIS G 4305:1999	SUS305	---	---	Pl, Sh, St/CR, S	---	---	175	---	480	---	40	187/90/200
EN 10088-2:1995	X4CrNi18-12	1.4303	---	St/CR, A	≤ 6	---	220	---	500-650	---	45	---/---/---
ASTM A 240/A 240M-03c	304N	---	S30451	Pl, Sh, St	---	---	240	35	550	80	30	217/95/---
ASTM A 666-03	304N	---	S30451	Pl, Sh, St/A	---	---	240	35	550	80	30	217/95/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	310	45	620	90	40	---/---/---
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	37	
				Pl, Sh, St/CW, 1/4 Hard	---	---	515	75	860	125	12	
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	760	110	1035	150	6	
					---	≥ 0.015					8	
JIS G 4304:1999	SUS304N1	---	---	Pl, Sh, St/HR, S	---	---	275	---	550	---	35	217/95/220
JIS G 4305:1999	SUS304N1	---	---	Pl, Sh, St/CR, S	---	---	275	---	550	---	35	217/95/220
ASTM A 240/A 240M-03c	304LN	---	S30453	Pl, Sh, St	---	---	205	30	515	75	40	217/95/---
ASTM A 666-03	304LN	---	S30453	Pl, Sh, St/A	---	---	205	30	515	75	40	217/95/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	310	45	620	90	40	---/---/---
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	33	
				Pl, Sh, St/CW, 1/4 Hard	---	≤ 0.030	515	75	860	125	10	
					---	> 0.030					12	
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	760	110	1035	150	6	
					---	≥ 0.015					7	
JIS G 4304:1999	SUS304LN	---	---	Pl, Sh, St/HR, S	---	---	245	---	550	---	40	217/95/220
JIS G 4305:1999	SUS304LN	---	---	Pl, Sh, St/CR, S	---	---	245	---	550	---	40	217/95/220
EN 10088-2:1995	X2CrNiN18-10	1.4311	---	St/CR, AT	≤ 6	---	290	---	550-750	---	40	---/---/---
				St/HR, AT	≤ 12	---	270	---				
				Pl/HR, AT	≤ 75	---	270	---				
ASTM A 240/A 240M-03c	---	---	S30600	Pl, Sh, St	---	---	240	35	540	48	40	---/---/---
EN 10088-2:1995	X1CrNiSi18-15-4	1.4361	---	Pl/HR, AT	≤ 75	---	220	---	530-730	---	40	---/---/---
ASTM A 167-99	309	---	S30900	Pl, Sh, St/---	---	---	205	30	515	75	40	217/95/---
JIS G 4312:1991	SUH309	---	---	Pl, Sh/HR or CR, S	---	---	205	---	560	---	40	201/95/210

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 240/A 240M-03c	309S	---	S30908	Pl, Sh, St	---	---	205	30	515	75	40	217/95/---
JIS G 4304:1999	SUS309S	---	---	Pl, Sh, St/HR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4305:1999	SUS309S	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4312:1991	SUS309S	---	---	Pl, Sh/HR or CR, A	---	---	205	---	520	---	40	187/90/200
EN 10095:1999	X12CrNi23-13	1.4833	---	Pl, Sh, St/AT	≤ 75	---	210	---	500-700	---	see standard	192/---/---
ISO 4955:1994	X6CrNi23-14	---	---	Pl, Sh, St/TQ	---	---	210	---	500-700	---	see standard	192/---/---
ASTM A 167-99	310	---	S31000	Pl, Sh, St/---	---	---	205	30	515	75	40	217/95/---
JIS G 4312:1991	SUH310	---	---	Pl, Sh/HR or CR, S	---	---	205	---	590	---	35	201/95/210
ASTM A 240/A 240M-03c	310S	---	S31008	Pl, Sh, St	---	---	205	30	515	75	40	217/95/---
JIS G 4304:1999	SUS310S	---	---	Pl, Sh, St/HR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4305:1999	SUS310S	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4312:1991	SUS310S	---	---	Pl, Sh/HR or CR, A	---	---	205	---	520	---	40	187/90/200
ISO 4955:1994	X6CrNi25-21	---	---	Pl, Sh, St/TQ	≤ 100	---	210	---	500-700	---	see standard	192/---/---
ASTM A 240/A 240M-03c	310 MoLN	---	S31050	Pl, Sh, St	---	≤ 0.25	270	39	580	84	25	217/95/---
					---	> 0.25	255	37	540	78	25	217/95/---
EN 10088-2:1995	X1CrNiMoN25-22-2	1.4466	---	Pl/HR, AT	---	---	250	---	540-740	---	40	---/---/---
ASTM A 240/A 240M-03c	---	---	S31254	Sh, St	---	---	310	35	690	100	35	223/96/---
				Pl	---	---	310	35	655	95	35	223/96/---
EN 10088-2:1995	X1CrNiMoCuN20-18-7	1.4547	---	St/CR, AT	≤ 6	---	320	---	650-850	---	35	---/---/---
				St/HR, AT	≤ 12	---	300	---			35	
				Pl/HR, AT	≤ 75	---	300	---			40	

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 240/A 240M-03c	316	---	S31600	Pl, Sh, St	---	---	205	30	515	75	40	217/95/---
ASTM A 666-03	316	---	S31600	Pl, Sh, St/A	---	---	205	30	515	75	40	217/95/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	310	45	585	85	35	---/---/---
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	30	
				Pl, Sh, St/CW, 1/4 Hard	---	---	515	75	860	125	10	
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	760	110	1035	150	6	
					---	≥ 0.015					7	
JIS G 4304:1999	SUS316	---	---	Pl, Sh, St/HR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4305:1999	SUS316	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4312:1991	SUS316	---	---	Pl, Sh/HR or CR, A	---	---	205	---	520	---	40	187/90/200
EN 10088-2:1995	X5CrNiMo17-12-2	1.4401	---	St/CR, AT	≤ 6	---	240	---	530-680	---	40	---/---/---
				St/HR, AT	≤ 12	---	220	---				
				Pl/HR, AT	≤ 75	---	220	---	520-670	---	45	
	X3CrNiMo17-13-3	1.4436	---	St/CR, AT	≤ 6	---	240	---	550-700	---	40	---/---/---
				St/HR, AT	≤ 12	---	220	---				
				Pl/HR, AT	≤ 75	---	220	---	530-730	---		
ASTM A 240/A 240M-03c	316L	---	S31603	Pl, Sh, St	---	---	170	25	485	70	40	217/95/---
ASTM A 666-03	316L	---	S31603	Pl, Sh, St/A	---	---	170	25	485	70	40	217/95/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	310	45	585	85	35	---/---/---
				Flat Bar/CW, 1/16 Hard	---	>0.030	310	45	620	90	40	---/---/---
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	25	---/---/---
				Pl, Sh, St/CW, 1/4 Hard	---	---	515	75	860	125	8	---/---/---
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	760	110	1035	150	5	---/---/---
					---	≥ 0.015					6	
JIS G 4304:1999	SUS316L	---	---	Pl, Sh, St/HR, S	--	---	175	---	480	---	40	187/90/200
JIS G 4305:1999	SUS316L	---	---	Pl, Sh, St/CR, S	---	---	175	---	480	---	40	187/90/200
EN 10088-2:1995	X2CrNiMo17-12-2	1.4404	---	St/CR, AT	≤ 6	---	240	---	530-680	---	40	---/---/---
				St/HR, AT	≤ 12	---	220	---				
				Pl/HR, AT	≤ 75	---	220	---	520-670	---	45	
	X2CrNiMo17-12-3	1.4432	---	St/CR, AT	≤ 6	---	240	---	550-700	---	40	---/---/---
				St/HR, AT	≤ 12	---	220	---				
				Pl/HR, AT	≤ 75	---	220	---	520-670	---	45	
	X2CrNiMo18-14-3	1.4435	---	St/CR, AT	≤ 6	---	240	---	550-700	---	40	---/---/---
				St/HR, AT	≤ 12	---	220	---				
				Pl/HR, AT	≤ 75	---	220	---	520-670	---	45	

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 240/A 240M-03c	316N	---	S31651	Pl, Sh, St	---	---	240	35	550	80	35	217/95/---
ASTM A 666-03	316N	---	S31651	Pl, Sh, St/A	---	---	240	35	550	80	35	217/95/---
				Pl, Sh, St/CW, 1⁄16 Hard	---	---	310	45	620	90	35	---/---/---
				Pl, Sh, St/CW, 1⁄8 Hard	---	---	380	55	690	100	32	
				Pl, Sh, St/CW, 1⁄4 Hard	---	---	515	75	860	125	12	
				Pl, Sh, St/CW, 1⁄2 Hard	---	< 0.015	760	110	1035	150	6	
					---	≥ 0.015					8	
JIS G 4304:1999	SUS316N	---	---	Pl, Sh, St/HR, S	---	---	275	---	550	---	35	217/95/220
JIS G 4305:1999	SUS316N	---	---	Pl, Sh, St/CR, S	---	---	275	---	550	---	35	217/95/220
ASTM A 240/A 240M-03c	316LN	---	S31653	Pl, Sh, St	---	---	205	30	515	75	40	217/95/---
JIS G 4304:1999	SUS316LN	---	---	Pl, Sh, St/HR, S	---	---	245	---	550	---	40	217/95/220
JIS G 4305:1999	SUS316LN	---	---	Pl, Sh, St/CR, S	---	---	245	---	550	---	40	217/95/220
EN 10088-2:1995	X2CrNiMoN17-11-2	1.4406	---	St/CR, AT	≤ 6	---	300	---	580-780	---	40	---/---/---
				St/HR, AT	≤ 12	---	280	---				
				Pl/HR, AT	≤ 75	---	280	---				
	X2CrNiMoN17-13-3	1.4429	---	St/CR, AT	≤ 6	---	300	---	580-780	---	35	---/---/---
				St/HR, AT	≤ 12	---	280	---				
				Pl/HR, AT	≤ 75	---	280	---			40	
ASTM A 240/A 240M-03c	316Cb	---	S31640	Pl, Sh, St	---	---	205	30	515	75	30	217/95/---
EN 10088-2:1995	X6CrNiMoNb17-12-2	1.4580	---	Pl/HR, AT	≤ 75	---	220	---	520-720	---	40	---/---/---
ASTM A 240/A 240M-03c	316Ti	---	S31635	Pl, Sh, St	---	---	205	30	515	75	40	217/95/---
JIS G 4304:1999	SUS316Ti	---	---	Pl, Sh, St/HR, S	---	---	205	---	520	---	40	187/90//200
JIS G 4305:1999	SUS316Ti	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4312:1991	SUS316Ti	---	---	Pl, Sh/HR or CR, A	---	---	205	---	520	---	40	187/90//200
EN 10088-2:1995	X6CrNiMoTi17-12-2	1.4571	---	St/CR, AT	≤ 6	---	240	---	540-690	---	40	---/---/---
				St/HR, AT	≤ 12	---	220	---				
				Pl/HR, AT	≤ 75	---	220	---	520-670	---		
ASTM A 240/A 240M-03c	317L	---	S31700	Pl, Sh, St	---	---	205	30	515	75	40	217/95/---
JIS G 4304:1999	SUS317L	---	---	Pl, Sh, St/HR, S	---	---	175	---	480	---	40	187/90/200
JIS G 4305:1999	SUS317L	---	---	Pl, Sh, St/CR, S	---	---	175	---	480	---	40	187/90/200
EN 10088-2:1995	X2NiCrMo18-15-4	1.4438	---	St/CR, AT	≤ 6	---	240	---	550-700	---	35	---/---/---
				St/HR, AT	≤ 12	---	220	---				
				Pl/HR, AT	≤ 75	---	220	---	520-720	---	40	

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 240/A 240M-03c	317LN	---	S31753	Pl, Sh, St	---	---	240	35	550	80	40	217/95/---
JIS G 4304:1999	SUS317LN	---	---	Pl, Sh, St/HR, S	---	---	245	---	550	---	40	217/95/220
JIS G 4305:1999	SUS317LN	---	---	Pl, Sh, St/CR, S	---	---	245	---	550	---	40	217/95/220
EN 10088-2:1995	X2CrNiMoN18-12-4	1.4434	---	St/CR, AT	≤ 6	---	290	---	570-770	---	35	---/---/---
				St/HR, AT	≤ 12	---	270	---				
				Pl/HR, AT	≤ 75	---	270	---	540-740	---	40	
ASTM A 240/A 240M-03c	317LMN	---	S31726	Pl, Sh, St	---	---	240	35	550	80	40	223/96/---
JIS G 4304:1999	SUS317J1	---	---	Pl, Sh, St/HR, S	---	---	175	---	480	---	40	187/90/200
JIS G 4305:1999	SUS317J1	---	---	Pl, Sh, St/CR, S	---	---	175	---	480	---	40	187/90/200
EN 10088-2:1995	X2CrNiMoN17-13-5	1.4439	---	St/CR, AT	≤ 6	---	290	---	580-780	---	35	---/---/---
				St/HR, AT	≤ 12	---	270	---				
				Pl/HR, AT	≤ 75	---	270	---			40	
ASTM A 240/A 240M-03c	---	---	N08367	Sh, St	---	---	310	45	690	100	30	---/100/---
				Pl	---	---	310	45	655	95	30	241/---/---
ASTM B 688-96	---	---	N08366	Pl, Sh, St/HR or CR	≤ 4.8	≤ 3/16	240	35	515	75	30	---/95/---
					> 4.8	> 3/16						212/---/---
	---	---	N08367	Pl, Sh, St/HR or CR	≤ 4.8	≤ 3/16	310	45	690	100	30	---/100/---
					> 4.8	> 3/16			655	95	30	240/---/---
JIS G 4304:1999	SUS836L	---	---	Pl, Sh, St/HR, S	---	---	275	---	640	---	40	217/96/230
JIS G 4305:1999	SUS836L	---	---	Pl, Sh, St/CR, S	---	---	275	---	640	---	40	217/96/230
EN 10088-2:1995	1XNiCrMoCuN25-20-7	1.4529	---	Pl/HR, AT	≤ 75	---	300	---	650-850	---	40	---/---/---
ASTM A 240/A 240M-03c	904L	---	N08904	Pl, Sh, St	---	---	220	31	490	71	35	---/90/---
ASTM B 625-99	---	---	N08904	Pl, Sh, St/HR or CR, A	---	---	215	31	490	71	35	---/70-90/---
JIS G 4304:1999	SUS890L	---	---	Pl, Sh, St/HR, S	---	---	215	---	490	---	35	187/90/200
JIS G 4305:1999	SUS890L	---	---	Pl, Sh, St/CR, S	---	---	215	---	490	---	35	187/90/200
EN 10088-2:1995	X1NiCrMoCu25-20-5	1.4539	---	St/CR, AT	≤ 6	---	240	---	530-730	---	35	---/---/---
				St/HR, AT	≤ 12	---	220	---				
				Pl/HR, AT	≤ 75	---	220	---	520-720	---		

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 240/A 240M-03c	321	---	S32100	Pl, Sh, St	---	---	205	30	515	75	40	217/95/---
JIS G 4304:1999	SUS321	---	---	Pl, Sh, St/HR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4305:1999	SUS321	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4312:1991	SUS321	---	---	Pl, Sh/HR or CR, A	---	---	205	---	520	---	40	187/90/200
EN 10088-2:1995	X6CrNiTi18-10	1.4541	---	St/CR, AT	≤ 6	---	220	---	520-720	---	40	---/---/---
				St/HR, AT	≤ 12	---	200	---				
				Pl/HR, AT	≤ 75	---	200	---	500-700	---		
ISO 4955:1994	X7CrNiTi18-10	---	---	Pl, Sh, St/TQ	---	---	200	---	510-710	---	see standard	192/---/---
ASTM A 240/A 240M-03c	347	---	S34700	Pl, Sh, St	---	---	205	30	515	75	40	201/92/---
JIS G 4304:1999	SUS347	---	---	Pl, Sh, St/HR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4305:1999	SUS347	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4312:1991	SUS347	---	---	Pl, Sh/HR or CR, A	---	---	205	---	520	---	40	187/90/200
EN 10088-2:1995	X6CrNiNb18-10	1.4550	---	St/CR, AT	≤ 6	---	220	---	520-720	---	40	---/---/---
				St/HR, AT	≤ 12	---	200	---				
				Pl/HR, AT	≤ 75	---	200	---	500-700	---		
ISO 4955:1994	X7CrNiNb18-10	---	---	Pl, Sh, St/TQ	---	---	205	---	510-710	---	see standard	192/---/---

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.4A Chemical Composition of Precipitation-Hardening Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 693-03	630	---	S17400	0.07	1.00	1.00	0.040	0.030	15.0-17.5	3.0-5.0	---	Cu 3.0-5.0; Nb+Ta 0.15-0.45
JIS G 4304:1999	SUS630	---	---	0.07	1.00	1.00	0.040	0.030	15.50-17.50	3.00-5.00	---	Cu 3.00-5.00; Nb 0.15-0.45
JIS G 4305:1999	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
JIS G 4312:1991	SUS630	---	---	0.07	1.00	1.00	0.040	0.030	15.50-17.50	3.00-5.00	---	Cu 3.00-5.00; Nb 0.15-0.45
EN 10088-2:1995	X5CrNiCuNb16-4	1.4542	---	0.07	1.50	0.70	0.040	0.015	15.00-17.00	3.00-5.00	0.60	Cu 3.00-5.00; Nb 5 x C to 0.45
ASTM A 693-03	631	---	S17700	0.09	1.00	1.00	0.040	1.00	16.00-18.00	6.5-7.7	---	Al 0.75-1.50
JIS G 4304:1999	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 4305:1999	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 4312:1991	SUS631	---	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.50
EN 10088-2:1995	X7CrNiAl17-7	1.4568	---	0.09	1.00	0.70	0.040	0.015	16.00-18.00	6.50-7.80	---	Al 0.70-1.50
ASTM A 693-03	632	---	S15700	0.09	1.00	1.00	0.040	0.030	14.00-16.00	6.5-7.7	2.00-3.00	Al 0.75-1.50
EN 10088-2:1995	X8CrNiMoAl15-7-2	1.4532	---	0.10	1.20	0.70	0.040	0.015	14.00-16.00	6.50-7.80	2.00-3.00	Al 0.70-1.50

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 693-03	630	---	S17400	Pl, Sh, St/ S	0.038 ≤ t < 102	0.0015≤ t < 4.0	---	---	---	---	---	363/38/---
				Pl, Sh, St/ PHT: 900	t < 4.765	t < 0.1875	1170	170	1310	190	5	---/40-48/---
					4.762 ≤ t < 15.90	0.1875 ≤ t < 0.625	1170	170	1310	190	8	388-477/40-48/---
					15.90 ≤ t < 102	0.625 ≤ t < 4.0	1170	170	1310	190	10	388-477/40-48/---
				Pl, Sh, St/ PHT: 925	t < 4.765	t < 0.1875	1070	155	1170	170	5	---/38-46/---
					4.762 ≤ t < 15.90	0.1875 ≤ t < 0.625	1070	155	1170	170	8	375-477/38-47/---
					15.90 ≤ t < 102	0.625 ≤ t < 4.0	1070	155	1170	170	10	375-477/38-47/---
				Pl, Sh, St/ PHT: 1025	t < 4.765	t < 0.1875	1000	145	1070	155	5	---/35-43/---
					4.762 ≤ t < 15.90	0.1875 ≤ t < 0.625	1000	145	1070	155	8	321-415/33-42/---
					15.90 ≤ t < 102	0.625 ≤ t < 4.0	1000	145	1070	155	12	321-415/33-42/---
				Pl, Sh, St/ PHT: 1075	t < 4.765	t < 0.1875	860	125	1000	145	5	---/31-40/---
					4.762 ≤ t < 15.90	0.1875 ≤ t < 0.625	860	125	1000	145	9	293-375/29-38/---
					15.90 ≤ t < 102	0.625 ≤ t < 4.0	860	125	1000	145	13	293-375/29-38/---
				Pl, Sh, St/ PHT: 1100	t < 4.765	t < 0.1875	790	115	965	140	5	---/31-40/---
					4.762 ≤ t < 15.90	0.1875 ≤ t < 0.625	790	115	965	140	10	293-375/29-38/---
					15.90 ≤ t < 102	0.625 ≤ t < 4.0	790	115	965	140	14	93-375/29-38/---
				Pl, Sh, St/ PHT: 1150	t < 4.765	t < 0.1875	725	105	930	135	8	---/28-38/---
					4.762 ≤ t < 15.90	0.1875 ≤ t < 0.625	725	105	930	135	10	269-352/ 26-36/---
					15.90 ≤ t < 102	0.625 ≤ t < 4.0	725	105	930	135	16	269-352/ 26-36/---
				Pl, Sh, St/ PHT: 1400+1150	t < 4.765	t < 0.1875	515	75	790	115	9	255-331/26-36/---
					4.762 ≤ t < 15.90	0.1875 ≤ t < 0.625	515	75	790	115	11	248-321/24-34/---
					15.90 ≤ t < 102	0.625 ≤ t < 4.0	515	75	790	115	18	248-321/24-34/---
JIS G 4304:1999	SUS630	---	---	Pl, Sh, St/ HR, S	---	---	---	---	---	---	---	---/38/---
				Pl, Sh, St/ HR, H900	≤ 5	---	1175	---	1310	---	5	---/40 min/---
					5 < t ≤ 15	---					8	
					> 15	---					10	
				Pl, Sh, St/ HR, H1025	≤ 5	---	1000	---	1070	---	5	---/35 min/---
					5 < t ≤ 15	---					8	
					> 15	---					12	
				Pl, Sh, St/ HR, H1075	≤ 5	---	860	---	1000	---	5	---/31 min/---
					5 < t ≤ 15	---					9	
					> 15	---					13	
				Pl, Sh, St/ HR, H1150	≤ 5	---	725	---	930	---	8	---/28 min/---
					5 < t ≤ 15	---					10	
					> 15	---					16	

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)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 4305:1999	SUS630	---	---	Pl, Sh, St/ CR, S	---	---	---	---	---	---	---	363/38/---
				Pl, Sh, St/ CR, H900	≤ 5	---	1175	---	1310	---	5	375 min/40 min/---
					5 < t ≤ 15	---					8	
				Pl, Sh, St/ CR, H1025	≤ 5	---	1000	---	1070	---	5	331 min/35 min/---
					5 < t ≤ 15	---					8	
				Pl, Sh, St/ CR, H1075	≤ 5	---	860	---	1000	---	5	302 min/31 min/---
					5 < t ≤ 15	---					9	
				Pl, Sh, St/ CR, H1150	≤ 5	---	725	---	930	---	8	277 min/28 min/---
					5 < t ≤ 15	---					10	
JIS G 4312:1991	SUS630	---	---	Pl, Sh/ HR or CR, S	---	---	---	---	---	---	---	363/38/---
				Pl, Sh/ HR or CR, H900	≤ 5	---	1175	---	1310	---	5	375 min/40 min/---
					5 < t ≤ 15	---					8	
				Pl, Sh/ HR or CR, H1025	≤ 5	---	1000	---	1070	---	5	331 min/35 min/---
					5 < t ≤ 15	---					8	
				Pl, Sh/ HR or CR, H1075	≤ 5	---	860	---	1000	---	5	302 min/31 min/---
					5 < t ≤ 15	---					9	
				Pl, Sh/ HR or CR, H1150	≤ 5	---	725	---	930	---	8	277 min/28 min/---
					5 < t ≤ 15	---					10	
EN 10088-2:1995	X5CrNiCuNb16-4	1.4542	---	St/ CR, AT	≤ 6	---	---	---	≤ 1275	---	5	---/---/---
				St/ CR, P1300			1150	---	≥ 1300	---	3	
				St/ CR, P900			700	---	≥ 900	---	6	
				Pl/ HR, P1070	≤ 50	---	1000	---	1070-1270	---	8	---/---/---
				Pl/ HR, P950			800	---	950-1150	---	10	
				Pl/ HR, P850			600	---	850-1050	---	12	
				Pl/ HR, SR630			---	---	≤ 1050	---	---	

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 693-03	631	---	S17700	Pl, Sh, St/ S	t < 0.25	t < 0.010	450	65	1035	150	---	---
					0.25 ≤ t < 102	0.010 ≤ t < 4.0	380	55	1035	150	20	---/92 HRB/---
				Pl, Sh, St/ PHT: 1400+55+1050	0.038 ≤ t < 0.127	0.0015 ≤ t < 0.0050	1035	150	1240	180	---	---/38/---
					0.127 ≤ t < 0.25	0.0050 ≤ t < 0.0010	1035	150	1240	180	---	---/38/---
					0.25 ≤ t < 0.51	0.010 ≤ t < 0.020	1035	150	1240	180	---	---/38/---
					0.51 ≤ t < 4.762	0.020 ≤ t < 0.1875	1035	150	1240	180	---	---/38/---
					4.762 ≤ t < 15.88	0.1875 ≤ t < 0.625	965	140	1170	170	20	---/38/---
				Pl, Sh, St/ PHT: 1750+ minus 100+950	0.038 ≤ t < 0.127	0.0015 ≤ t < 0.0050	1310	190	1450	210	---	---/44/---
					0.127 ≤ t < 0.25	0.0050 ≤ t < 0.0010	1310	190	1450	210	---	---/44/---
					0.25 ≤ t < 0.51	0.010 ≤ t < 0.020	1310	190	1450	210	---	---/44/---
					0.51 ≤ t < 4.762	0.020 ≤ t < 0.1875	1310	190	1450	210	---	---/44/---
					4.762 ≤ t < 15.88	0.1875 ≤ t < 0.625	1240	180	1380	200	20	---/43/---
				Pl, Sh, St/ CR	0.038 ≤ t < 0.13	0.0015 ≤ t < 0.0050	1205	175	1380	200	---	---/41/---
				Pl, Sh, St/ CR + PHT: 900	0.038 ≤ t < 0.13	0.0015 ≤ t < 0.0050	1580	230	1655	240	---	---/46/---
JIS G 4304:1999	SUS631	---	---	Pl, Sh, St/ HR, S	---	---	380	---	1030	---	20	---/92/200
				Pl, Sh, St/ HR, TH1050	≤ 3	---	960	---	1140	---	3	---/35 min/345 min
					> 3	---					5	
				Pl, Sh, St/ HR, RH950	≤ 3	---	1030	---	1230	---	---	---/40 min/392 min
					> 3	---					4	
JIS G 4305:1999	SUS631	---	---	Pl, Sh, St/ CR, S	---	---	380 max	---	1030 max	---	20	192/92/200
				Pl, Sh, St/ CR, TH1050	≤ 3	---	960	---	1140	---	3	---/35 min/345 min
					> 3	---					5	
				Pl, Sh, St/ CR, RH950	≤ 3	---	1030	---	1230	---	---	---/40 min/392 min
					> 3	---					4	
JIS G 4312:1991	SUS631	---	---	Pl, Sh/ HR or CR, S	---	---	380 max	---	1030 max	---	20	192/92/200
				Pl, Sh/ HR or CR, TH1050	≤ 3	---	960	---	1140	---	3	---/35 min/345 min
					> 3	---					5	
				Pl, Sh/ HR or CR, RH950	≤ 3	---	1030	---	1230	---	---	---/40 min/392 min
					> 3	---					4	
EN 10088-2:1995	X7CrNiAl17-7	1.4568	---	St/ CR, AT	≤ 6	---	---	---	≤ 1030	---	19	---/---/---
				St/ CR, P1450			1310	---	≥ 1450	---	2	

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 693-03	632	---	S15700	Pl, Sh, St/ S	0.038 ≤ t < 102	0.0015≤ t < 4.0	450	65	1035	150	25	---/100HRB/---
				Pl, Sh, St/ 1400+55+1050	0.038 ≤ t < 0.127	0.0015 ≤ t < 0.0050	1170	170	1310	190	---	---/40/---
					0.127 ≤ t < 0.25	0.0050 ≤ t < 0.0010	1170	170	1310	190	---	---/40/---
					0.25 ≤ t < 0.51	0.010 ≤ t < 0.020	1170	170	1310	190	---	---/40/---
					0.51 ≤ t < 4.762	0.020 ≤ t < 0.1875	1170	170	1310	190	---	---/40/---
					4.762 ≤ t < 15.88	0.1875 ≤ t < 0.625	1170	170	1310	190	20	375/40/---
				Pl, Sh, St/ 1750+minus 100+950	0.038 ≤ t < 0.127	0.0015 ≤ t < 0.0050	1380	200	1550	225	---	---/46/---
					0.127 ≤ t < 0.25	0.0050 ≤ t < 0.0010	1380	200	1550	225	---	---/46/---
					0.25 ≤ t < 0.51	0.010 ≤ t < 0.020	1380	200	1550	225	---	---/46/---
					0.51 ≤ t < 4.762	0.020 ≤ t < 0.1875	1380	200	1550	225	---	---/46/---
					4.762 ≤ t < 15.88	0.1875 ≤ t < 0.625	1380	200	1550	225	20	429/45/---
				Pl, Sh, St/ CR	0.038 ≤ t < 0.13	0.0015 ≤ t < 0.0050	1205	175	1380	200	---	---/41/---
				Pl, Sh, St/ CR+900	0.038 ≤ t < 0.13	0.0015 ≤ t < 0.0050	1585	230	1655	240	---	---/46/---
EN 10088-2:1995	X8CrNiMoAl15-7-2	1.4532	---	St/ CR, AT	≤ 6	---	---	---	1100 max	---	20	---/---/---
				St/ CR, P1550	≤ 6	---	1380	---	1550	---	2	---/---/---

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.5A Chemical Composition of Duplex (Ferritic-Austenitic) Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 240/A 240M-03c	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
JIS G 4304:1999	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 4305:1999	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
EN 10088-2:1995	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
ASTM A 240/A 240M-03c	2304	---	S32304	0.030	2.50	1.00	0.040	0.030	21.5-24.5	3.0-5.5	0.05-0.60	N 0.05-0.20; Cu 0.05-0.60
EN 10088-2:1995	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	N 0.05-0.20; Cu 0.10-0.60
ASTM A 240/A 240M-03c	---	---	S32520	0.030	1.50	0.80	0.035	0.020	24.0-26.0	5.5-8.0	3.0-4.0	N 0.20-0.35; Cu 0.50-2.00
EN 10088-2:1995	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	N 0.15-0.30; Cu 1.00-2.50
ASTM A 240/A 240M-03c	2507	---	S32750	0.030	1.20	0.80	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	N 0.24-0.32; Cu 0.50
EN 10088-2:1995	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
ASTM A 240/A 240M-03c	---	---	S32760	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	N 0.20-0.30; Cu 0.50-1.00; W 0.50-1.00
EN 10088-2:1995	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	N 0.20-0.30; Cu 0.50-1.00; W 0.50-1.00

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.5B Mechanical Properties of Duplex (Ferritic-Austenitic) Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 240/A 240M-03c	2205	---	S32205	Pl, Sh, St	---	---	450	65	655	95	25	293/31/---
JIS G 4304:1999	SUS329J3L	---	---	Pl, Sh, St/HR, S	---	---	450	---	620	---	18	302/32/320
JIS G 4305:1999	SUS329J3L	---	---	Pl, Sh, St/CR, S	---	---	450	---	620	---	18	302/32/320
EN 10088-2:1995	X2CrNiMoN22-5-3	1.4462	---	St/CR, AT	≤ 6	---	480	---	660-950	---	20	---/---/---
				St/HR, AT	≤ 12	---	460	---				
				Pl/HR, AT	≤ 75	---	460	---	640-840	---	25	
ASTM A 240/A 240M-03c	2304	---	S32304	Pl, Sh, St	---	---	400	58	600	87	25	290/32/---
EN 10088-2:1995	X2CrNiN23-4	1.4362	---	St/CR, AT	≤ 6	---	420	---	600-850	---	20	---
				St/HR, AT	≤ 12	---	400	---	600-850	---	20	---
				Pl/HR, AT	≤ 75	---	400	---	630-800	---	25	---
ASTM A 240/A 240M-03c	---	---	S32520	Pl, Sh, St	---	---	550	80	770	112	25	310/---/---
EN 10088-2:1995	X2CrNiMoCuN25-6-3	1.4507	---	St/CR, AT	≤ 6	---	510	---	690-940	---	17	---
				St/HR, AT	≤ 12	---	490	---	690-940	---	17	---
				Pl/HR, AT	≤ 75	---	490	---	690-890	---	25	---
ASTM A 240/A 240M-03c	2507	---	S32750	Pl, Sh, St	---	---	550	80	795	116	15	310/32/---
EN 10088-2:1995	X2CrNiMoN25-7-4	1.4410	---	St/CR, AT	≤ 6	---	550	---	750-1000	---	15	---
				St/HR, AT	≤ 12	---	530	---	750-1000	---	15	---
				Pl/HR, AT	≤ 75	---	530	---	730-930	---	20	---
ASTM A 240/A 240M-03c	---	---	S32760	Pl, Sh, St	---	---	550	80	750	108	25	270/---/---
EN 10088-2:1995	X2CrNiMoCuWN25-7-4	1.4501	---	Pl/HR, AT	≤ 75	---	530	---	730-930	---	25	---

8.2 Stainless Steels: Bar

8.2.1A Chemical Composition of Martensitic Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 276-03	403	---	S40300	0.15	1.00	0.50	0.040	0.030	11.5013.0	0.60	---	---
JIS G 4303:1998	SUS403	---	---	0.15	1.00	0.50	0.040	0.030	11.50-13.00	---	---	---
JIS G 4311:1991	SUS403	---	---	0.15	1.00	0.50	0.040	0.030	11.50-13.00	---	---	---
JIS G 4318:1998	SUS403	---	---	0.15	1.00	0.50	0.040	0.030	11.50-13.00	---	---	---
ASTM A 276-03	410	---	S41000	0.08-0.15	1.00	1.00	0.040	0.030	11.5-13.5	---	---	---
JIS G 4303:1998	SUS410	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	---	---	---
JIS G 4311:1991	SUS410	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	---	---	---
JIS G 4318:1998	SUS410	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	---	---	---
EN 10088-3:1995	X12Cr13	1.4006	---	0.08-0.15	1.50	1.00	0.040	0.030	11.50-13.50	0.75	---	---
ASTM A 582/A 582M-95b (2000)	416	---	S41600	0.15	1.25	1.00	0.06	0.15 min	12.00-14.00	---	---	---
JIS G 4303:1998	SUS416	---	---	0.15	1.25	1.00	0.060	0.15 min	12.00-14.00	---	0.60	---
JIS G 4318:1998	SUS416	---	---	0.15	1.25	1.00	0.060	0.15 min	12.00-14.00	---	0.60	---
EN 10088-3:1995	X12CrS13	1.4005	---	0.08-0.15	1.50	1.00	0.040	0.15-0.35	12.00-14.00	---	0.60	---
JIS G 4303:1998	SUS420J1	---	---	0.16-0.25	1.00	1.00	0.040	0.030	12.00-14.00	---	---	---
JIS G 4318:1998	SUS420J1	---	---	0.16-0.25	1.00	1.00	0.040	0.030	12.00-14.00	---	---	---
EN 10088-3:1995	X20Cr13	1.4021	---	0.16-0.25	1.50	1.00	0.040	0.030	12.00-14.00	---	---	---
JIS G 4303:1998	SUS420J2	---	---	0.26-0.40	1.00	1.00	0.040	0.030	12.00-14.00	---	---	---
JIS G 4318:1998	SUS420J2	---	---	0.26-0.40	1.00	1.00	0.040	0.030	12.00-14.00	---	---	---
EN 10088-3:1995	X30Cr13	1.4028	---	0.26-0.35	1.50	1.00	0.040	0.030	12.00-14.00	---	---	---
ASTM A 582/A 582M-95b (2000)	420F	---	S42020	0.30-0.40	1.25	1.00	0.06	0.15 min	12.00-14.00	0.50	---	---
JIS G 4303:1998	SUS420F	---	---	0.26-0.40	1.25	1.00	0.060	0.15 min	12.00-14.00	---	0.60	---
JIS G 4318:1998	SUS420F	---	---	0.26-0.40	1.25	1.00	0.060	0.15 min	12.00-14.00	---	0.60	---
EN 10088-3:1995	X29CrS13	1.4029	---	0.25-0.32	1.50	1.00	0.040	0.15-0.25	12.00-13.50	---	0.60	---
ASTM A 276-03	431	---	S43100	0.20	1.00	1.00	0.040	0.030	15.0-17.0	1.25-2.5	---	---
JIS G 4303:1998	SUS431	---	---	0.20	1.00	1.00	0.040	0.030	15.00-17.00	1.25-2.50	---	---
JIS G 4311:1991	SUS431	---	---	0.20	1.00	1.00	0.040	0.030	15.00-17.00	1.25-2.50	---	---
EN 10088-3:1995	X17CrNi16-2	1.4057	---	0.12-0.22	1.50	1.00	0.040	0.030	15.00-17.00	1.50-2.50	---	---
ASTM A 276-03	440A	---	S44002	0.60-0.75	1.00	1.00	0.040	0.030	16.0-18.0	---	0.75	---
JIS G 4303:1998	SUS440A	---	---	0.60-0.75	1.00	1.00	0.040	0.030	16.00-18.00	---	---	---
EN 10088-3:1995	X70CrMo15	1.4109	---	0.65-0.75	1.00	0.70	0.040	0.030	14.00-16.00	---	0.40-0.80	---
ASTM A 276-03	440B	---	S44003	0.75-0.95	1.00	1.00	0.040	0.030	16.0-18.0	---	0.75	---
JIS G 4303:1998	SUS440B	---	---	0.75-0.95	1.00	1.00	0.040	0.030	16.00-18.00	---	---	---

8.2 Stainless Steels: Bar

8.2.1A Chemical Composition of Martensitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 276-03	440C	---	S44004	0.95-1.20	1.00	1.00	0.040	0.030	16.0-18.0	---	0.75	---
JIS G 4303:1998	SUS440C	---	---	0.95-1.20	1.00	1.00	0.040	0.030	16.00-18.00	---	---	---
JIS G 4318:1998	SUS440C	---	---	0.95-1.20	1.00	1.00	0.040	0.030	16.00-18.00	---	0.75	---
EN 10088-3:1995	X105CrMo17	1.4125	---	0.95-1.20	1.00	1.00	0.040	0.030	16.00-18.00	---	0.40-0.80	---

8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 276-03	403	---	S40300	Bar, Shape/HF, A	all	all	275	40	480	70	20	---/---/---
				Bar, Shape/CF, A			275	40	480	70	16	---/---/---
				Bar, Shape/HF, T			550	80	690	100	15	---/---/---
				Bar, Shape/CF, T			550	80	690	100	12	---/---/---
JIS G 4303:1998	SUS403	---	---	Bar/HF, Q	≤ 75	---	390	---	590	---	25	170 min/---/---
JIS G 4311:1991	SUS403	---	---	Bar/HF, Q	≤ 75	---	390	---	590	---	25	170 min/---/---
JIS G 4318:1998	SUS403	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
ASTM A 276-03	410	---	S41000	Bar, Shape/HF, A	all	all	275	40	480	70	20	---/---/---
				Bar, Shape/CF, A			275	40	480	70	16	---/---/---
				Bar, Shape/HF, T			550	80	690	100	15	---/---/---
				Bar, Shape/CF, T			550	80	690	100	12	---/---/---
JIS G 4303:1998	SUS410	---	---	Bar/HF, Q	≤ 75	---	345	---	540	---	25	159 min/---/---
JIS G 4311:1991	SUS410	---	---	Bar/Q, HF	≤ 75	---	345	---	540	---	25	159 min/---/---
JIS G 4318:1998	SUS410	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X12Cr13	1.4006	---	Bar/HF or CF, A	---	---	---	---	730 max	---	---	220/---/---
				Bar/ HF or CF, QT650	≤ 160	---	450	---	650-850	---	15	---/---/---
ASTM A 582/A 582M-95b (2000)	416	---	S41600	Bar/HF or CF, A	---	---	---	---	---	---	---	262/---/---
				Bar/HF or CF, T	---	---	---	---	---	---	---	248-302/---/---
				Bar/HF or CF, H	---	---	---	---	---	---	---	293-352/---/---
JIS G 4303:1998	SUS416	---	---	Bar/HF, Q	≤ 75	---	345	---	540	---	17	159 min/---/---
JIS G 4318:1998	SUS416	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X12CrS13	1.4005	---	Bar/HF or CF, A	---	---	---	---	730 max	---	---	220/---/---
				Bar/ HF or CF, QT650	≤ 160	---	450	---	650-850	---	12	---/---/---
JIS G 4303:1998	SUS420J1	---	---	Bar/HF, Q	≤ 75	---	440	---	640	---	20	192 min/---/---
JIS G 4318:1998	SUS420J1	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X20Cr13	1.4021	---	Bar/HF or CF, A	---	---	---	---	760 max	---	---	230/---/---
				Bar/HF or CF, T700	≤ 160	---	500	---	700-850	---	13	---/---/---
				Bar/HF or CF, T800	≤ 160	---	600	---	800-950	---	12	---/---/---
JIS G 4303:1998	SUS420J2	---	---	Bar/HF, Q	≤ 75	---	540	---	740	---	12	217 min/---/---
JIS G 4318:1998	SUS420J2	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X30Cr13	1.4028	---	Bar/HF or CF, A	---	---	---	---	800 max	---	---	245/---/---
				Bar/HF or CF, T850	≤ 160	---	650	---	850-1000	---	10	---/---/---

8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 582/A 582M-95b (2000)	420F	---	S42020	Bar/HF or CF, A	---	---	---	---	---	---	---	262/---/---
JIS G 4303:1998	SUS420F	---	---	Bar/HF, Q	≤ 75	---	540	---	740	---	8	217 min/---/---
JIS G 4318:1998	SUS420F	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X29CrS13	1.4029	---	Bar/HF or CF, A	---	---	---	---	800 max	---	---	245/---/---
				Bar/HF or CF, T850	≤ 160	---	650	---	850-1000	---	9	---/---/---
ASTM A 276-03	431	---	S43100	Bar, Shape/ HF or CF, A	all	all	---	---	---	---	---	285/---/---
JIS G 4303:1998	SUS431	---	---	Bar/HF, Q	≤ 75	---	590	---	780	---	15	229 min/---/---
JIS G 4311:1991	SUS431	---	---	Bar/HF, Q	≤ 75	---	590	---	780	---	15	229 min/---/---
EN 10088-3:1995	X17CrNi16-2	1.4057	---	Bar/HF or CF, A	---	---	---	---	950 max	---	---	295/---/---
				Bar/HF or CF, T800	≤ 60	---	600	---	800-950	---	14	---/---/---
					60< d ≤ 160	---					12	
				Bar/HF or CF, T900	≤ 60	---	700	---	900-1050	---	12	---/---/---
					60< d ≤ 160	---					10	
ASTM A 276-03	440A	---	S44002	Bar, Shape/HF, A	all	all	---	---	---	---	---	269/---/---
				Bar, Shape/CF, A	all	all	---	---	---	---	---	285/---/---
JIS G 4303:1998	SUS440A	---	---	Bar/HF, Q	≤ 75	---	---	---	---	---	---	---/54 min/---
EN 10088-3:1995	X70CrMo15	1.4109	---	Bar/HF or CF, A	≤ 100	---	---	---	900 max	---	---	280/---/---
ASTM A 276-03	440B	---	S44003	Bar, Shape/HF, A	all	all	---	---	---	---	---	269/---/---
				Bar, Shape/CF, A	all	all	---	---	---	---	---	285/---/---
JIS G 4303:1998	SUS440B	---	---	Bar/HF, Q	≤ 75	---	---	---	---	---	---	---/56 min/---
ASTM A 276-03	440C	---	S44004	Bar, Shape/HF, A	all	all	---	---	---	---	---	269/---/---
				Bar, Shape/CF, A	all	all	---	---	---	---	---	285/---/---
JIS G 4303:1998	SUS440C	---	---	Bar/HF, Q	≤ 75	---	---	---	---	---	---	---/58 min/---
JIS G 4318:1998	SUS440C	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X105CrMo17	1.4125	---	Bar/HF or CF, A	≤ 100	---	---	---	---	---	---	285/---/---

8.2 Stainless Steels: Bar

8.2.2A Chemical Composition of Ferritic Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 276-03	405	---	S40500	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.50	---	Al 0.10-0.30
JIS G 4303:1998	SUS405	---	---	0.08	1.00	1.00	0.040	0.030	11.50-14.50	---	---	Al 0.10-0.30
JIS G 4311:1991	SUS405	---	---	0.08	1.00	1.00	0.040	0.030	11.50-14.50	---	---	Al 0.10-0.30
EN 10088-3:1995	X6Cr13	1.4000	---	0.08	1.00	1.00	0.040	0.030	12.00-14.00	---	---	---
ISO 4955:1994	X6Cr13	---	---	0.08	1.0	1.0	0.040	0.030	12.0-14.0	1.0	---	---
ASTM A 276-03	430	---	S43000	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	---	---
JIS G 4303:1998	SUS430	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	---	---	---
JIS G 4311:1991	SUS430	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	---	---	---
JIS G 4318:1998	SUS430	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	---	---	---
EN 10088-3:1995	X6Cr17	1.4016	---	0.08	1.00	1.00	0.040	0.030	16.00-18.00	---	---	---
ASTM A 582/A 582M-95b (2000)	430F	---	S43020	0.12	1.25	1.00	0.060	0.15 min	16.00-18.00	---	---	---
JIS G 4303:1998	SUS430F	---	---	0.12	1.25	1.00	0.060	0.15 min	16.00-18.00	---	---	---
JIS G 4318:1998	SUS430F	---	---	0.12	1.25	1.00	0.060	0.15 min	16.00-18.00	---	---	---
EN 10088-3:1995	X6CrMoS17	1.4105	---	0.08	1.50	1.50	0.040	0.15-0.35	16.00-18.00	---	0.20-0.60	---
ISO 4955:1994	X6Cr17	---	---	0.08	1.0	1.0	0.040	0.030	16.0-18.0	1.0	---	---
ASTM A 582/A 582M-95b (2000)	---	---	S18235	0.025	0.50	1.00	0.030	0.15-0.35	17.05-18.50	1.00	2.00-2.50	N 0.025; Ti 0.30-1.00; C+N 0.035
EN 10088-3:1995	X2CrMoTiS18-2	1.4523	---	0.030	0.50	1.00	0.040	0.15-0.35	17.50-19.00	---	2.00-2.50	C+N 0.040
JIS G 4303:1998	SUS434	---	---	0.12	1.00	1.00	0.040	0.030	16.00-18.00	---	0.75-1.25	---
EN 10088-3:1995	X6CrMo17-1	1.4113	---	0.08	1.00	1.00	0.040	0.030	16.00-18.00	---	0.90-1.40	---
ASTM A 276-03	447	---	S44700	0.010	0.30	0.20	0.025	0.020	28.0-30.0	0.15	3.5-4.2	N 0.020; Cu 0.15; C+N 0.025
JIS G 4303:1998	SUS447J1	---	---	0.010	0.40	0.40	0.030	0.020	28.50-32.00	0.50	1.50-2.50	N 0.015; Cu 0.20; Ni+Cu 0.50
ASTM A 276-03	XM-27	---	S44627	0.010	0.40	0.40	0.020	0.020	25.0-27.5	0.50	0.75-1.50	N 0.015; Cu 0.20; Cb 0.05-0.20
JIS G 4303:1998	SUSXM27	---	---	0.010	0.40	0.40	0.030	0.020	25.00-27.50	0.50	0.75-1.50	N 0.015; Cu 0.20; Ni+Cu 0.50
ASTM A 276-03	446	---	S44600	0.20	1.50	1.00	0.040	0.030	23.0-27.0	0.75	---	N 0.25
JIS G 4311:1991	SUH446	---	---	0.20	1.50	1.00	0.040	0.030	23.00-27.00	---	---	N 0.25
ISO 4955:1994	X15CrN26	---	---	0.20	1.0	1.0	0.040	0.030	24.0-28.0	1.0	---	N 0.15-0.25
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

8.2 Stainless Steels: Bar

8.2.2B Mechanical Properties of Ferritic Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 276-03	405	---	S40500	Bar, Shape/HF, A	all	all	---	---	---	---	---	207/---/---
				Bar, Shape/CF, A	all	all	---	---	---	---	---	217/---/---
JIS G 4303:1998	SUS405	---	---	Bar/HF, A	≤ 75	---	175	---	410	---	20	183/---/---
JIS G 4311:1991	SUS405	---	---	Bar/HF, A	≤ 75	---	175	---	410	---	20	183/---/---
EN 10088-3:1995	X6Cr13	1.4000	---	Bar/HF or CF, A	≤ 25	---	230	---	400-630	---	20	200/---/---
ISO 4955:1994	X6Cr13	---	---	Bar/TA	---	---	230	---	400-630	---	see standard	197/---/---
ASTM A 276-03	430	---	S43000	Bar, Shape/ HF or CF, A	all	all	207	30	415	60	20	---/---/---
JIS G 4303:1998	SUS430	---	---	Bar/HF, A	≤ 75	---	205	---	450	---	22	183/---/---
JIS G 4311:1991	SUS430	---	---	Bar/HF, A	≤ 75	---	205	---	450	---	22	183/---/---
JIS G 4318:1998	SUS430	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X6Cr17	1.4016	---	Bar/HF or CF, A	≤ 100	---	240	---	400-630	---	20	200/---/---
ASTM A 582/A 582M-95b (2000)	430F	---	S43020	Bar/HF or CF, A	---	---	---	---	---	---	---	262/---/---
JIS G 4303:1998	SUS430F	---	---	Bar/HF, A	≤ 75	---	205	---	450	---	22	183/---/---
JIS G 4318:1998	SUS430F	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X6CrMoS17	1.4105	---	Bar/HF or CF, A	≤ 100	---	250	---	430-630	---	20	200/---/---
ISO 4955:1994	X6Cr17	---	---	Pl, Sh, St/TA	5 < t ≤ 15	---	250	---	430-630	---	see standard	197/---/---
ASTM A 582/A 582M-95b (2000)	---	---	S18235	Bar/HF or CF, A	---	---	---	---	---	---	---	207/---/---
EN 10088-3:1995	X2CrMoTiS18-2	1.4523	---	Bar/HF or CF, A	≤ 100	---	280	---	430-600	---	15	200/---/---
JIS G 4303:1998	SUS434	---	---	Bar/HF, A	≤ 75	---	205	---	450	---	22	183/---/---
EN 10088-3:1995	X6CrMo17-1	1.4113	---	Bar/HF or CF, A	≤ 100	---	280	---	440-660	---	18	200/---/---
ASTM A 276-03	447	---	S44700	Bar, Shape/HF, A	all	all	380	55	480	70	20	---/---/---
				Bar, Shape/CF, A	all	all	415	60	520	75	15	---/---/---
JIS G 4303:1998	SUS447J1	---	---	Bar/HF, A	≤ 75	---	295	---	450	---	20	228/---/---
ASTM A 276-03	XM-27	---	S44627	Bar, Shape/HF, A	all	all	275	40	450	65	20	219/---/---
				Bar, Shape/CF, A	all	all	275	40	450	65	16	219/---/---
JIS G 4303:1998	SUSXM27	---	---	Bar/HF, A	≤ 75	---	245	---	410	---	20	219/---/---
ASTM A 276-03	446	---	S44600	Bar, Shape/HF, A	all	all	275	40	450	65	20	219/---/---
				Bar, Shape/CF, A	all	all	275	40	450	65	16	219/---/---
JIS G 4311:1991	SUH446	---	---	Bar/HF, A	---	---	275	---	510	---	20	201/---/---
ISO 4955:1994	X15CrN26	---	---	Bar/TA	---	---	280	---	500-700	---	see standard	212/---/---
EN 10095:1999	X18CrN28	1.4749	---	Rod, Section/ A	≤ 25	---	280	---	500-700	---	see standard	212/---/---

8.2 Stainless Steels: Bar

8.2.3A Chemical Composition of Austenitic Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 276-03	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
JIS G 4303:1998	SUS201	---	---	0.15	5.50-7.50	1.00	0.060	0.030	16.00-18.00	3.50-5.50	---	N 0.25
ASTM A 276-03	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
JIS G 4303:1998	SUS202	---	---	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 4303:1998	SUS301	---	---	0.15	2.00	1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	---
EN 10088-3:1995	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	N 0.11
ASTM A 276-03	302	---	S30200	0.15	2.00	1.00	0.045	0.030	17.0-19.0	8.0-10.0	---	N 0.10
JIS G 4303:1998	SUS302	---	---	0.15	2.00	0.75	0.045	0.030	17.00-19.00	8.00-10.00	---	---
JIS G 4318:1998	SUS302	---	---	0.15	2.00	0.75	0.045	0.030	17.00-19.00	8.00-10.00	---	---
ASTM A 582/A 582M-95b (2000)	303	---	S30300	0.15	2.00	1.00	0.20	0.15 min	17.00-19.00	8.00-10.00	---	---
JIS G 4303:1998	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	SUS303	---	---	0.15	2.00	1.00	0.20	0.15 min	17.00-19.00	8.00-10.00	0.60	---
EN 10088-3:1995	X8CrNiS18-9	1.4305	---	0.10	2.00	1.00	0.045	0.15-0.35	17.00-19.00	8.00-10.00	---	N 0.11; Cu 1.00
ASTM A 582/A 582M-95b (2000)	303Se	---	S30323	0.15	2.00	1.00	0.20	0.06	17.00-19.00	8.00-10.00	---	Se 0.15 min
JIS G 4303:1998	SUS303Se	---	---	0.15	2.00	1.00	0.20	0.06	17.00-19.00	8.00-10.00	0.60	Se 0.15 min
JIS G 4318:1998	SUS303Se	---	---	0.15	2.00	1.00	0.20	0.06	17.00-19.00	8.00-10.00	0.60	Se 0.15 min
ASTM A 276-03	304	---	S30400	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
JIS G 4303:1998	SUS304	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
JIS G 4311:1991	SUS304	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
JIS G 4318:1998	SUS304	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
EN 10088-3:1995	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
ASTM A 276-03	304L	---	S30403	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
JIS G 4303:1998	SUS304L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	9.00-13.00	---	---
JIS G 4318:1998	SUS304L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	9.00-13.00	---	---
EN 10088-3:1995	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
ASTM A 276-03	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
JIS G 4303:1998	SUS304N1	---	---	0.08	2.50	1.00	0.045	0.030	18.00-20.00	7.00-10.50	---	N 0.10-0.25
ASTM A 276-03	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
JIS G 4303:1998	SUS304LN	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
EN 10088-3:1995	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
ASTM A 276-03	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
JIS G 4303:1998	SUS304N2	---	---	0.08	2.50	1.00	0.045	0.030	18.00-20.00	7.50-10.50	---	N 0.15-0.30; Nb 0.15

8.2 Stainless Steels: Bar

8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 276-03	305	---	S30500	0.12	2.00	1.00	0.045	0.030	17.0-19.0	11.0-13.0	---	---
JIS G 4303:1998	SUS305	---	---	0.12	2.00	1.00	0.045	0.030	17.00-19.00	10.50-13.00	---	---
JIS G 4318:1998	SUS305	---	---	0.12	2.00	1.00	0.045	0.030	17.00-19.00	10.50-13.00	---	---
EN 10088-3:1995	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
ASTM A 276-03	309S	---	S30908	0.08	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
JIS G 4303:1998	SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 4311:1991	SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 4318:1998	SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
ISO 4955:1994	X6CrNi23-14	---	---	0.08	2.0	1.0	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASTM A 276-03	310S	---	S31008	0.08	2.00	1.50	0.045	0.30	24.0-26.0	19.0-22.0	---	---
JIS G 4303:1998	SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 4311:1991	SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 4318:1998	SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
ISO 4955:1994	X6CrNi25-21	---	---	0.08	2.0	1.5	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A 276-03	316	---	S31600	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
JIS G 4303:1998	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 4311:1991	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	SUS316	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
EN 10088-3:1995	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
ASTM A 276-03	316L	---	S31603	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
JIS G 4303:1998	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	SUS316L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
EN 10088-3:1995	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
	X2CrNiMo17-12-3	1.4432	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.00	2.50-3.00	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
ASTM A 276-03	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
JIS G 4303:1998	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
ASTM A 276-03	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
JIS G 4303:1998	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
EN 10088-3:1995	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

8.2 Stainless Steels: Bar

8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 276-03	316Ti	---	S31635	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; Ti 5 x(C+N) to 0.70
JIS G 4303:1998	SUS316Ti	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti 5 x C min
JIS G 4311:1991	SUS316Ti	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti 5 x C min
EN 10088-3:1995	X6CrNiMoTi17-12-2	1.4571	---	0.08	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.0-2.50	Ti 5 x C to 0.70
ASTM A 276-03	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
JIS G 4303:1998	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 4311:1991	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 4303:1998	SUS317L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
EN 10088-3:1995	X2CrNiMo18-15-4	1.4438	---	0.030	2.00	1.00	0.045	0.030	17.50-19.50	13.00-16.00	3.00-4.00	N 0.11
JIS G 4303:1998	SUS 317J1	---	---	0.040	2.50	1.00	0.045	0.030	16.00-19.00	15.00-17.00	4.00-6.00	---
EN 10088-3:1995	X2CrNiMoN17-13-5	1.4439	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	12.50-14.50	4.00-5.00	N 0.12-0.22
ASTM B 691-02	---	---	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
JIS G 4303:1998	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
ASTM B 649-02	---	---	N08904	0.020	2.00	1.00	0.045	0.035	19.00-23.00	23.00-28.00	4.00-5.00	Cu 1.0-2.0
JIS G 4303:1998	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 10088-3:1995	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	N 0.15; Cu 1.20-2.00
ASTM A 276-03	321	---	S32100	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x (C+N) to 0.70
JIS G 4303:1998	SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C min
JIS G 4318:1998	SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C min
JIS G 4311:1991	SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C min
EN 10088-3:1995	X6CrNiTi18-10	1.4541	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.70
ISO 4955:1994	X7CrNiTi18-10	---	---	0.040-0.10	2.0	1.0	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.80
ASTM A 276-03	347	---	S34700	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 10 x C to 1.10
JIS G 4303:1998	SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C min
JIS G 4311:1991	SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C min
JIS G 4318:1998	SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C min
EN 10088-3:1995	X6CrNiNb18-10	1.4550	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00
ISO 4955:1994	X7CrNiNb18-10	---	---	0.040-0.10	2.0	1.0	0.045	0.030	17.0-19.0	9.0-12.0	---	Nb 10 x C to 1.2
ASTM A 276-03	309	---	S30900	0.20	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
JIS G 4311:1991	SUH309	---	---	0.20	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---
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
ASTM A 276-03	310	---	S31000	0.25	2.00	1.50	0.045	0.030	24.0-26.0	19.0-22.0	---	---
JIS G 4311:1991	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
ISO 4955:1994	X15CrNiSi25-21	---	---	0.20	2.0	1.5-2.5	0.045	0.030	24.0-26.0	19.0-22.0	---	---

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 276-03	201	---	S20100	Bar, Shape/ HF or CF, A	all	all	275	40	515	75	40	---/---/---
JIS G 4303:1998	SUS201	---	---	Bar/HF, S	≤ 180	---	275	---	520	---	40	241/100/253
ASTM A 276-03	202	---	S20200	Bar, Shape/ HF or CF, A	all	all	275	40	515	75	40	---/---/---
				Bar, Shape/ CF, B	≤ 19.05	≤ ¾	690	100	860	125	12	---/---/---
					19.05 < t ≤ 25.40	¾ < t ≤ 1	550	80	795	115	15	---/---/---
					25.40 < t ≤ 31.75	1 < t ≤ 1¼	450	65	725	105	20	---/---/---
					31.75 < t ≤ 38.10	1¼ < t ≤ 1½	345	50	690	100	24	---/---/---
					38.10 < t ≤ 44.45	1½ < t ≤ 1¾	310	45	655	95	28	---/---/---
JIS G 4303:1998	SUS202	---	---	Bar/HF, S	≤ 180	---	275	---	520	---	40	207/95/218
JIS G 4303:1998	SUS301	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	207/95/218
EN 10088-3:1995	X10CrNi18-8	1.4310	---	Bar/HF or CF, AT	≤ 40	---	195	---	500-750	---	40	230/---/---
ASTM A 276-03	302	---	S30200	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
				Bar, Shape/CF, B	≤ 19.05	≤ ¾	690	100	860	125	12	---/---/---
					19.05 < t ≤ 25.40	¾ < t ≤ 1	550	80	795	115	15	---/---/---
					25.40 < t ≤ 31.75	1 < t ≤ 1¼	450	65	725	105	20	---/---/---
					31.75 < t ≤ 38.10	1¼ < t ≤ 1½	345	50	690	100	24	---/---/---
					38.10 < t ≤ 44.45	1½ < t ≤ 1¾	310	45	655	95	28	---/---/---
JIS G 4303:1998	SUS302	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4318:1998	SUS302	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
ASTM A 582/A 582M-95b (2000)	303	---	S30300	Bar/HF or CF, A	---	---	---	---	---	---	---	262/---/---
JIS G 4303:1998	SUS303	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4318:1998	SUS303	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X8CrNiS18-9	1.4305	---	Bar/HF or CF, AT	≤ 160	---	190	---	500-750	---	35	230/---/---
ASTM A 582/A 582M-95b (2000)	303Se	---	S30323	Bar/HF or CF, A	---	---	---	---	---	---	---	262/---/---
JIS G 4303:1998	SUS303Se	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4318:1998	SUS303Se	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 276-03	304	---	S30400	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
				Bar, Shape/CF, B	≤ 19.05	≤ ¾	690	100	860	125	12	---/---/---
					19.05 < t ≤ 25.40	¾ < t ≤ 1	550	80	795	115	15	---/---/---
					25.40 < t ≤ 31.75	1 < t ≤ 1¼	450	65	725	105	20	---/---/---
					31.75 < t ≤ 38.10	1¼ < t ≤ 1½	345	50	690	100	24	---/---/---
					38.10 < t ≤ 44.45	1½ < t ≤ 1¾	310	45	655	95	28	---/---/---
				Bar, Shape/CF, S	≤ 50.8	≤ 2	515	75	650	95	25	---/---/---
					50.8 < t ≤ 63.5	2 < t ≤ 2½	450	65	620	90	30	---/---/---
					63.5 < t ≤ 76.2	2½ < t ≤ 3	380	55	550	80	30	---/---/---
JIS G 4303:1998	SUS304	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4311:1991	SUS304	---	---	Bar/HF, H	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4318:1998	SUS304	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X5CrNi18-10	1.4301	---	Bar/HF or CF, AT	≤ 160	---	190	---	500-700	---	L: 45	215/---/---
					160 < t ≤ 250	---					T: 35	
ASTM A 276-03	304L	---	S30403	Bar, Shape/HF, A	all	all	170	25	485	70	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	170	25	485	70	30	---/---/---
JIS G 4303:1998	SUS304L	---	---	Bar/HF, S	≤ 180	---	175	---	480	---	40	187/90/200
JIS G 4318:1998	SUS304L	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X2CrNi18-9	1.4307	---	Bar/HF or CF, AT	≤ 160	---	175	---	450-680	---	L: 45	215/---/---
					160 < t ≤ 250	---					T: 35	
ASTM A 276-03	304N	---	S30451	Bar, Shape/ HF or CF, A	all	all	240	35	550	80	30	---/---/---
				Bar, Shape/CF, B	≤ 19.05	≤ ¾	690	100	860	125	12	---/---/---
					19.05 < t ≤ 25.40	¾ < t ≤ 1	550	80	795	115	15	---/---/---
					25.40 < t ≤ 31.75	1 < t ≤ 1¼	450	65	725	105	20	---/---/---
					31.75 < t ≤ 38.10	1¼ < t ≤ 1½	345	50	690	100	24	---/---/---
					38.10 < t ≤ 44.45	1½ < t ≤ 1¾	310	45	655	95	28	---/---/---
				Bar, Shape/CF, S	≤ 50.8	≤ 2	515	75	650	95	25	---/---/---
					50.8 < t ≤ 63.5	2 < t ≤ 2½	450	65	620	90	30	---/---/---
					63.5 < t ≤ 76.2	2½ < t ≤ 3	380	55	550	80	30	---/---/---
JIS G 4303:1998	SUS304N1	---	---	Bar/HF, S	≤ 180	---	275	---	550	---	35	217/95/220

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 276-03	304LN	---	S30453	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS304LN	---	---	Bar/HF, S	≤ 180	---	245	---	550	---	40	217/95/220
EN 10088-3:1995	X2CrNiN18-10	1.4311	---	Bar/HF or CF, AT	≤ 160	---	270	---	550-760	---	L: 40	230/---/---
					160 < t ≤ 250	---					T: 30	
ASTM A 276-03	XM-21	---	S30452	Bar, Shape/ HF or CF, A	all	all	345	50	620	90	30	---/---/---
JIS G 4303:1998	SUS304N2	---	---	Bar/HF, S	≤ 180	---	345	---	690	---	35	250/100/260
ASTM A 276-03	305	---	S30500	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS305	---	---	Bar/HF, S	≤ 180	---	175	---	480	---	40	187/90/200
JIS G 4318:1998	SUS305	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X4CrNi18-12	1.4303	---	Bar/HF or CF, AT	≤ 160	---	190	---	500-700	---	L: 45	215/---/---
					160 < t ≤ 250	---					T: 35	
ASTM A 276-03	309S	---	S30908	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF,A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS309S	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4311:1991	SUS309S	---	---	Bar/HF, H	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4318:1998	SUS309S	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
ISO 4955:1994	X6CrNi23-14	---	---	Bar/TQ	---	---	210	---	500-700	---	see standard	192/---/---
ASTM A 276-03	310S	---	S31008	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS310S	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4311:1991	SUS310S	---	---	Bar/HF, H	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4318:1998	SUS310S	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
ISO 4955:1994	X6CrNi25-21	---	---	Pl, Sh, St/TQ	≤ 100	---	210	---	500-700	---	see standard	192/---/---

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 276-03	316	---	S31600	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
				Bar, Shape/CF, B	≤ 19.05	≤ ¾	690	100	860	125	12	---/---/---
					19.05 < t ≤ 25.40	¾ < t ≤ 1	550	80	795	115	15	---/---/---
					25.40 < t ≤ 31.75	1 < t ≤ 1¼	450	65	725	105	20	---/---/---
					31.75 < t ≤ 38.10	1¼ < t ≤ 1½	345	50	690	100	24	---/---/---
					38.10 < t ≤ 44.45	1½ < t ≤ 1¾	310	45	655	95	28	---/---/---
				Bar, Shape/CF, S	≤ 50.8	≤ 2	515	75	650	95	25	---/---/---
					50.8 < t ≤ 63.5	2 < t ≤ 2½	450	65	620	90	30	---/---/---
					63.5 < t ≤ 76.2	2½ < t ≤ 3	380	55	550	80	30	---/---/---
JIS G 4303:1998	SUS316	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4311:1991	SUS316	---	---	Bar/HF, H	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4318:1998	SUS316	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X5CrNiMo17-12-2	1.4401	---	Bar/HF or CF, AT	≤ 160	---	200	---	500-700	---	L: 40	215/---/---
					160 < t ≤ 250	---					T: 30	
	X3CrNiMo17-13-3	1.4436	---	Bar/HF or CF, AT	≤ 160	---	200	---	500-700	---	L: 40	215/---/---
					160 < t ≤ 250	---					T: 30	
ASTM A 276-03	316L	---	S31603	Bar, Shape/HF, A	all	all	170	25	485	70	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	170	25	485	70	30	---/---/---
JIS G 4303:1998	SUS316L	---	---	Bar/HF, S	≤ 180	---	175	---	480	---	40	187/90/200
JIS G 4318:1998	SUS316L	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X2CrNiMo17-12-2	1.4404	---	Bar/HF or CF, AT	≤ 160	---	200	---	500-700	---	L: 40	215/---/---
					160 < t ≤ 250	---					T: 30	
EN 10088-3:1995	X2CrNiMo17-12-3	1.4432	---	Bar/HF or CF, AT	≤ 160	---	200	---	500-700	---	L: 40	215/---/---
					160 < t ≤ 250	---					T: 30	
EN 10088-3:1995	X2CrNiMo18-14-3	1.4435	---	Bar/HF or CF, AT	≤ 160	---	200	---	500-700	---	L: 40	215/---/---
					160 < t ≤ 250	---					T: 30	

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 276-03	316N	---	S31651	Bar, Shape/ HF or CF, A	all	all	240	35	550	80	30	---/---/---
				Bar, Shape/CF, B	≤ 19.05	≤ ¾	690	100	860	125	12	---/---/---
					19.05 < t ≤ 25.40	¾ < t ≤ 1	550	80	795	115	15	---/---/---
					25.40 < t ≤ 31.75	1 < t ≤ 1¼	450	65	725	105	20	---/---/---
					31.75 < t ≤ 38.10	1¼ < t ≤ 1½	345	50	690	100	24	---/---/---
					38.10 < t ≤ 44.45	1½ < t ≤ 1¾	310	45	655	95	28	---/---/---
				Bar, Shape/CF, S	≤ 50.8	≤ 2	515	75	650	95	25	---/---/---
					50.8 < t ≤ 63.5	2 < t ≤ 2½	450	65	620	90	30	---/---/---
					63.5 < t ≤ 76.2	2½ < t ≤ 3	380	55	550	80	30	---/---/---
JIS G 4303:1998	SUS316N	---	---	Bar/HF, S	≤ 180	---	275	---	550	---	35	217/95/220
ASTM A 276-03	316LN	---	S31653	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS316LN	---	---	Bar/HF, S	≤ 180	---	245	---	550	---	40	217/95/220
EN 10088-3:1995	X2CrNiMoN17-11-2	1.4406	---	Bar/HF or CF, AT	≤ 160	---	280	---	580-800	---	L: 40	250/---/---
					160 < t ≤ 250	---					T: 30	
	X2CrNiMoN17-13-3	1.4429	---	Bar/HF or CF, AT	≤ 160	---	280	---	580-800	---	L: 40	250/---/---
					160 < t ≤ 250	---					T: 30	
ASTM A 276-03	316Ti	---	S31635	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS316Ti	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4311:1991	SUS316Ti	---	---	Bar/HF, H	≤ 180	---	205	---	520	---	40	187/90/200
EN 10088-3:1995	X6CrNiMoTi17-12-2	1.4571	---	Bar/HF or CF, AT	≤ 160	---	200	---	500-700	---	L: 40	215/---/---
					160 < t ≤ 250	---					T: 30	
ASTM A 276-03	317	---	S31700	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS317	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4311:1991	SUS317	---	---	Bar/HF, H	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4303:1998	SUS317L	---	---	Bar/HF, S	≤ 180	---	175	---	480	---	40	187/90/200
EN 10088-3:1995	X2CrNiMo18-15-4	1.4438	---	Bar/HF or CF, AT	≤ 160	---	200	---	500-700	---	L: 40	215/---/---
					160 < t ≤ 250	---					T: 30	
					160 < t ≤ 250	---					T: 30	

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/ Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
JIS G 4303:1998	SUS 317J1	---	---	Bar/HF, S	≤ 180	---	175	---	480	---	40	187/90/200
EN 10088-3:1995	X2CrNiMoN17-13-5	1.4439	---	Bar/HF or CF, AT	≤ 160	---	280	---	580-800	---	L: 35	250/---/---
					160 < t ≤ 250	---					T: 30	
ASTM B 691-02	---	---	N08367	Bar/HF or CF, A	all	all	310	45	655	95	30	---/---/---
JIS G 4303:1998	SUS836L	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	35	217/96/230
ASTM B 649-02	---	---	N08904	Bar/HF or CF, ST	all	all	220	31	490	71	35	---/---/---
JIS G 4303:1998	SUS890L	---	---	Bar/HF, S	≤ 180	---	215	---	490	---	35	187/90/200
EN 10088-3:1995	X1NiCrMoCu25-20-5	1.4539	---	Bar/HF or CF, AT	≤ 160	---	230	---	530-730	---	L: 35	230/---/---
					160 < t ≤ 250	---					T: 30	
ASTM A 276-03	321	---	S32100	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS321	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4318:1998	SUS321	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
JIS G 4311:1991	SUS321	---	---	Bar/HF, H	≤ 180	---	205	---	520	---	40	187/90/200
EN 10088-3:1995	X6CrNiTi18-10	1.4541	---	Bar/HF or CF, AT	≤ 160	---	190	---	500-700	---	L: 40	215/---/---
					160 < t ≤ 250	---					T: 30	
ISO 4955:1994	X7CrNiTi18-10	---	---	Bar/TQ	---	---	200	---	510-710	---	see standard	192/---/---
ASTM A 276-03	347	---	S34700	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS347	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4311:1991	SUS347	---	---	Bar/HF, H	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4318:1998	SUS347	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X6CrNiNb18-10	1.4550	---	Bar/HF or CF, AT	≤ 160	---	205	---	510-740	---	L: 40	230/---/---
					160 < t ≤ 250	---					T: 30	
ISO 4955:1994	X7CrNiNb18-10	---	---	Bar/TQ	---	---	205	---	510-710	---	see standard	192/---/---
ASTM A 276-03	309	---	S30900	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4311:1991	SUH309	---	---	Bar/HF, S	≤ 180	---	205	---	560	---	45	201/---/---
EN 10095:1999	X12CrNi23-13	1.4833	---	Bar/HF or CF, AT	---	---	210	---	500-700	---	see standard	192/---/---
ASTM A 276-03	310	---	S31000	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4311:1991	SUH310	---	---	Bar/HF, S	≤ 180	---	205	---	590	---	40	201/---/---
EN 10095:1999	X15CrNiSi25-21	1.4841	---	Bar/HF or CF, AT	---	---	230	---	550-750	---	see standard	223/---/---
ISO 4955:1994	X15CrNiSi25-21	---	---	Bar/TQ	---	---	230	---	550-750	---	see standard	223/---/---

8.2 Stainless Steels: Bar

8.2.4A Chemical Composition of Precipitation-Hardening Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 564/A 564M-02a	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
JIS G 4303:1998	SUS630	---	---	0.07	1.00	1.00	0.040	0.030	15.50-17.50	3.00-5.00	---	Cu 3.00-5.00; Nb 0.15-0.45
JIS G 4311:1991	SUS630	---	---	0.07	1.00	1.00	0.040	0.030	15.50-17.50	3.00-5.00	---	Cu 3.00-5.00; Nb 0.15-0.45
EN 10088-3:1995	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 5 x C to 0.45
ASTM A 564/A 564M-02a	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
JIS G 4303:1998	SUS631	---	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.5-7.75	---	Al 0.75-1.50
JIS G 4311:1991	SUS631	---	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.5-7.75	---	Al 0.75-1.50
EN 10088-3:1995	X7CrNiAl17-7	1.4568	---	0.09	1.00	0.70	0.040	0.015	16.00-18.00	6.50-7.80	---	Al 0.70-1.50

8.2 Stainless Steels: Bar

8.2.4B Mechanical Properties of Precipitation-Hardening Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 564/A 564M-02a	630	---	S17400	Bar, Shape/ HR & CF, A	---	---	---	---	---	---	---	363/38/---
				Bar, Shape/ HR & CF, H900	≤ 75	≤ 3	1170	170	1310	190	10	388/40/---
					75 < t ≤ 200	3 < t ≤ 8						
				Bar, Shape/ HR & CF, H925	≤ 75	≤ 3	1070	155	1170	170	10	375/38/---
					75 < t ≤ 200	3 < t ≤ 8						
				Bar, Shape/ HR & CF, H1025	≤ 200	≤ 8	1000	145	1070	155	12	331/35/---
				Bar, Shape/ HR & CF, H1075	≤ 200	≤ 8	860	125	1000	145	13	311/21/---
				Bar, Shape/ HR & CF, H1100	≤ 200	≤ 8	795	115	965	140	14	302/31/---
				Bar, Shape/ HR & CF, H1150	≤ 200	≤ 8	725	105	930	135	16	277/28/---
				Bar, Shape/ HR & CF, H1150M	≤ 200	≤ 8	520	75	795	115	18	255/24/---
				Bar, Shape/ HR & CF, H1150D	≤ 200	≤ 8	725	105	860	125	16	255/24/---
JIS G 4303:1998	SUS630	---	---	Bar/HF, S	≤ 75	---	---	---	---	---	---	---/38/---
				Bar/HF, H900			1175	---	1310	---	10	---/40 min/---
				Bar/HF, H1025			1000	---	1070	---	12	---/35 min/---
				Bar/HF, H1075			860	---	1000	---	13	---/31 min/---
				Bar/HF, H1150			725	---	930	---	16	---/28 min/---
JIS G 4311:1991	SUS630	---	---	Bar/HF, S	≤ 75	---	---	---	---	---	---	---/38/---
				Bar/HF, H900			1175	---	1310	---	10	---/40 min/---
				Bar/HF, H1025			1000	---	1070	---	12	---/35 min/---
				Bar/HF, H1075			860	---	1000	---	13	---/31 min/---
				Bar/HF, H1150			725	---	930	---	16	---/28 min/---
EN 10088-3:1995	X5CrNiCuNb16-4	1.4542	---	Bar/HF or CF, AT	≤ 100	---	---	---	1200 max	---	---	360/---/---
				Bar/HF or CF, P800			520	---	800-950	---	18	---/---/---
				Bar/HF or CF, P930			720	---	930-1100	---	16	---/---/---
				Bar/HF or CF, P960			790	---	960-1160	---	12	---/---/---
				Bar/HF or CF, P1070			1000	---	1070-1270	---	10	---/---/---

8.2 Stainless Steels: Bar

8.2.4B Mechanical Properties of Precipitation-Hardening Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 564/A 564M-02a	631	---	S17700	Bar, Shape/HR & CF, A	---	---	---	---	---	---	---	229/HRB98/---
				Bar, Shape/ HR & CF, RH950	≤ 100	≤ 4	1030	150	1280	185	6	388/41/---
				Bar, Shape/ HR & CF, TH1050	≤ 150	≤ 6	965	140	1170	170	6	352/38/---
JIS G 4303:1998	SUS631	---	---	Bar/HF, S	≤ 75	---	380	---	1030	---	20	---/---/---
				Bar/HF, RH950	≤ 75	---	1030	---	1230	---	4	---/---/---
				Bar/HF, TH1050	≤ 75	---	960	---	1140	---	5	---/---/---
JIS G 4311:1991	SUS631	---	---	Bar/HF, S	≤ 75	---	380	---	1030	---	20	---/---/---
				Bar/HF, RH950	≤ 75	---	1030	---	1230	---	4	---/---/---
				Bar/HF, TH1050	≤ 75	---	960	---	1140	---	5	---/---/---
EN 10088-3:1995	X7CrNiAl17-7	1.4568	---	Bar/HF or CF, AT	≤ 30	---	---	---	850 max	---	---	255/---/---

8.2 Stainless Steels: Bar

8.2.5A Chemical Composition of Duplex Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 276-03	---	---	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
JIS G 4303:1998	SUS 329J3L	---	---	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
EN 10088-3:1995	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

8.2.5B Mechanical Properties of Duplex Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 276-03	---	---	S31803	Bar, Shape/HF or CF, A	all	all	448	65	620	90	25	290/---/---
	---	---	S32205	Bar, Shape/HF or CF, A	all	all	450	65	655	95	25	290/---/---
JIS G 4303:1998	SUS 329J3L	---	---	Bar/HF, S	≤ 75	---	450	---	620	---	18	302/32/320
EN 10088-3:1995	X2CrNiMoN22-5-3	1.4462	---	Bar/HF or CF, AT	≤ 160	---	450	---	650-880	---	25	270/---/---

8.3 Non-Comparable Stainless Steel Standards: Plate, Sheet and Strip

ASTM A 167-99 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip												
Grade, Class, Type	308	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S30800	---	---	---	---	---	---	---	---	---	---	---
ASTM A 176-99 - Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip												
Grade, Class, Type	422	431	442	---	---	---	---	---	---	---	---	---
UNS Number	S42200	S43100	S44200	---	---	---	---	---	---	---	---	---
ASTM A 240/A 240M-03c - Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications												
Grade, Class, Type	---	800	800H	---	---	---	---	---	XM-19	XM-31	XM-17	XM-18
UNS Number	N08020	N08800	N08810	N08811	N08926	S20161	S20162	S20400	S20910	S21400	S21600	S21603
Grade, Class, Type	---	XM-29	---	304H	---	XM-21	---	---	---	309H	309Cb	309HCb
UNS Number	S21800	S24000	S28200	S30409	S30415	S30452	S30601	S30615	S30815	S30909	S30940	S30941
Grade, Class, Type	310H	310Cb	310HCb	---	---	---	---	316H	317	317LM	---	---
UNS Number	S31009	S31040	S31041	S31200	S31260	S31266	S31277	S31609	S31700	S31725	S31803	S32001
Grade, Class, Type	---	---	---	321H	255	---	---	---	329	---	---	---
UNS Number	S32003	S32050	S32101	S32109	S32550	S32615	S32654	S32803	S32900	S32906	S32950	S33228
Grade, Class, Type	334	---	347H	348	348H	---	---	---	XM-15	---	409	---
UNS Number	S33400	S34565	S34709	S34800	S34809	S35045	S35135	S35315	S38100	S38815	S40900	S40910
Grade, Class, Type	---	---	---	---	---	---	---	---	429	436	---	XM-33
UNS Number	S40920	S40930	S40945	S40975	S41045	S41500	S42000	S42035	S42900	S43600	S44500	S44626
Grade, Class, Type	XM-27	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S44627	S44635	S44660	S44700	S44800	S46800	---	---	---	---	---	---
ASTM A 666-03 - Annealed or Cold-Worked Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar												
Grade, Class, Type	---	205	XM-11	XM-14	---	---	---	---	---	---	---	---
UNS Number	S20400	S20500	S21904	S21460	---	---	---	---	---	---	---	---
ASTM A 693-03 - Precipitation-Hardening Stainless and Heat-Resisting Steel, Plate, Sheet and Strip												
Grade, Class, Type	633	634	635	XM-9	XM-12	XM-13	XM-16	XM-25	---	---	---	---
UNS Number	S35000	S35500	S17600	S36200	S15500	S13800	S45500	S45000	S46500	---	---	---
ASTM B 625-99 - UNS N08904, UNS N08925, UNS N08031, UNS N08932, UNS N08926, and UNS R20033 Plate, Sheet, and Strip												
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	N08925	N08932	N08031	N08926	R20033	---	---	---	---	---	---	---
JIS G 4304:1999 - Hot rolled stainless steel plates, sheets and strip												
Symbol of Grade	SUS303	SUS304N2	SUS304J1	SUS304J2	SUS315J1	SUS315J2	SUS316J1	SUS316J1L	SUS317	SUS317J2	SUS317J3L	SUSXM7
	SUSXM15J1	SUS429	SUS430J1L	SUS436L	SUS436J1L	SUS445J1	SUS445J2	SUS447J1	SUSXM27	SUS429J1	SUS440A	SUS329J1
	SUS329J4L	---	---	---	---	---	---	---	---	---	---	---

8.3 Non-Comparable Stainless Steel Standards: Plate, Sheet and Strip (Continued)

JIS G 4305:1999 - Cold rolled stainless steel plates, sheets and strip												
Symbol of Grade	SUS304N2	SUS304J1	SUS304J2	SUS315J1	SUS315J2	SUS316J1	SUS316J1L	SUS317	SUS317J2	SUS317J3L	SUSXM7	SUSXM15J1
	SUS329J1	SUS329J4L	SUS429	SUS430J1L	SUS436L	SUS436J1L	SUS445J1	SUS445J2	SUS447J1	SUSXM27	SUS429J1	SUS440A
JIS G 4312:1991 - Heat-resisting steel plates and sheets												
Symbol of Grade	SUS317	SUSXM151J1	SUS410L	SUS430J1L	SUS436J1L	SUS410	SUH330	SUH660	SUH661	SUH21	SUH409	---
EN 10088-2:1995 - Stainless Steels - Part 2: Technical Delivery Conditions for Sheet/Plate and Strip for General Purpose												
Steel Name	X6CrNiTi12	X2CrMoTi17-1	X6CrNi17-1	X2CrNbZr17	X2CrAlTi18-2	X39Cr13	X46Cr13	X50CrMoV15	X39CrMo17-1	X3CrNiMo13-4	X8CrNiS18-9	X1CrNi25-21
Steel Number	1.4516	1.4513	1.4017	1.4590	1.4605	1.4031	1.4034	1.4116	1.4122	1.4313	1.4305	1.4335
Steel Name	X1NiCrMoCu31-27-4		X1CrNiMoCuN25-25-5		X4CrNiMo16-5-1	X6CrMoNb17-1		---	---	---	---	---
Steel Number	1.4563		1.4537		1.4418	1.4526		---	---	---	---	---
EN 10095:1999 - Heat Resisting Steels and Nickel Alloys												
Steel Name	X10CrAlSi7	X10CrAlSi13	X10CrAlSi18	X10CrAlSi25	X3CrAlTi18-2	X8CrNiTi18-10	X15CrNiSi20-12	X12NiCrSi35-16	X15CrNiSi25-4	NiCr15Fe	NiCr20Ti	
Steel Number	1.4713	1.4724	1.4742	1.4762	1.4736	1.4878	1.4828	1.4864	1.4821	2.4816	2.4951	
Steel Name	NiCr22Mo9Nb		X6CrNiSiNCe19-10		X6NiCrSiNCe35-25		X10NiCrSiNb35-22		X9CrNiSiNCe21-11-2		X10NiCrAlTi32-21	
Steel Number	2.4856		1.4818		1.4854		1.4887		1.4835		1.4876	
Steel Name	X6NiCrNbCe32-27		X25CrMnNiN25-9-7		NiCr23Fe		NiCr28FeSiCe		X10NiCrSi35-19		X8CrNi25-21	
Steel Number	1.4877		1.4872		2.4851		2.4889		1.4886		1.4845	

8.4 Non-Comparable Stainless Steel Standards: Bar

ASTM A 276-03 - Stainless Steel Bars and Shapes												
Grade, Class, Type	---	---	205	XM-19	---	XM-10	XM-11	XM-29	XM-28	302B	---	308
UNS Number	N08367	S20160	S20500	S20910	S21800	S21900	S21904	S24000	S24100	S30215	S30454	S30800
Grade, Class, Type	---	309Cb	310Cb	---	314	316Cb	---	---	---	---	-	348
UNS Number	S30815	S30940	S31040	S31254	S31400	S31640	S31654	S31725	S31726	S32654	S34565	S34800
Grade, Class, Type	XM-26	---	---	---	---	429	444	---	XM-30	414	---	---
UNS Number	S31100	S32304	S32550	S32760	S40976	S42900	S44400	S44800	S41040	S41400	S41425	S41500
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S42010	---	---	---	---	---	---	---	---	---	---	---
ASTM A 564/A 564M-02a - Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes												
Grade, Class, Type	632	634	635	XM-12	XM-13	XM-16	---	XM-25	---	---	---	---
UNS Number	S15700	S35500	S17600	S15500	S13800	S45500	S45503	S45000	S46500	---	---	---
ASTM 582/A 582M-95b (2000) - Free-Machining Stainless Steel Bars												
Grade, Class, Type	XM-1	XM-5	XM-2	XM-6	416Se	420FSe	XM-34	---	430FSe	440F	440FSe	---
UNS Number	S20300	S30310	S30345	S41610	S41623	S42023	S18200	S41603	S43023	S44020	S44023	---
ASTM B 649-02 - Ni-Fe-Cr-Mo-Cu Low-Carbon Alloy (UNS N08904), Ni-Fe-Cr-Mo-Cu-N Low-Carbon Alloys (UNS N08925, UNS N08031, and UNS N08926), and Cr-Ni-Fe-N Low-Carbon Alloy (UNS R20033) Bar and Wire												
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	N08925	N08031	N08926	R20033	---	---	---	---	---	---	---	---
ASTM B 691-02 - Iron-Nickel-Chromium-Molybdenum Alloys (UNS N08366 and UNS N08367) Rod, Bar, and Wire												
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	N08366	---	---	---	---	---	---	---	---	---	---	---
JIS G 4303:1998 - Stainless Steel Bars												
Symbol of Grade	SUS303Cu	SUS304J3	SUS316J1	SUS316J1L	SUS316F	SUS317LN	SUSXM15J1	SUS329J1	SUS329J4L	SUS410L	SUS410J1	SUS410F2
	SUS420F2	SUS440F	SUSXM7	---	---	---	---	---	---	---	---	---
JIS G 4311:1991 - Heat-Resisting Steel Bars												
Symbol of Grade	SUSXM15J1	SUS410J1	SUH31	SUH35	SUH36	SUH37	SUH38	SUH330	SUH660	SUH661	SUH1	SUH3
	SUH4	SUH11	SUH600	SUH616	SUS410L	---	---	---	---	---	---	---
JIS G 4318:1998 - Cold Finished Stainless Steel Bars												
Symbol of Grade	SUS303Cu	SUS304J3	SUS305J1	SUS316F	SUS410F2	SUS420F2	SUS329J1	---	---	---	---	---

8.4 Non-Comparable Stainless Steel Standards: Bar (Continued)

EN 10088-3:1995 - Stainless Steels – Part 3: Technical Delivery Conditions for Semi-Finished Products, Bars, Rod and Sections for General Purposes												
Steel Name	X2CrNi12	X39Cr13	X46Cr13	X50CrMoV15	X14CrMoS17	X39CrMo17-1	X3CrNiMo13-4	X90CrMoV18	X2CrNi19-11	---	---	---
Steel Number	1.4003	1.4031	1.4034	1.4116	1.4104	1.4122	1.4313	1.4112	1.4306	---	---	---
Steel Name	X3CrNiCu18-9-4		X1NiCrMoCu25-20-5		X5CrNiMoCuNb14-5		X6CrNiMoNb17-12-2		X2CrNiMo18-14-3		X3CrNiCu19-9-2	
Steel Number	1.4567		1.4539		1.4594		1.4580		1.4435		1.4460	
Steel Name	X6NiCrCuS18-9-2		X3CrNiCuMo17-11-3-2		X1NiCrMoCu31-27-4		X1CrNiMoCuN25-25-5		X1CrNiMoCuN20-18-7		X1NiCrMoCuN25-20-7	
Steel Number	1.4570		1.4578		1.4563		1.4537		1.4547		1.4529	
Steel Name	X3CrNiMoN27-5-2		X2CrNiN23-4		X2CrNiMoCuN25-6-3		X2CrNiMoN25-7-4		X2CrNiMoCuWN25-7-4		X4CrNiMo16-5-1	
Steel Number	1.4460		1.4362		1.4507		1.4410		1.4501		1.4418	
Steel Name	X1CrNiSi18-15-4		---		----		----		----		----	
Steel Number	1.4361		---		----		----		----		----	
EN 10095:1999 - Heat Resisting Steels and Nickel Alloys												
Steel Name	X10CrAlSi7		X10CrAlSi13		X10CrAlSi18		X10CrAlSi25		X3CrAlTi18-2		X8CrNiTi18-10	
Steel Number	1.4713		1.4724		1.4742		1.4742		1.4736		1.4878	
Steel Name	X15CrNiSi20-12		X12NiCrSi35-16		X15CrNiSi25-4		NiCr15Fe		NiCr20Ti		NiCr22Mo9Nb	
Steel Number	1.4828		1.4864		1.4821		2.4816		2.4951		2.4856	
Steel Name	X6CrNiSiNCe19-10		X6NiCrSiNCe35-25		X10NiCrSiNb35-22		X9CrNiSiNCe21-11-2		X10NiCrAlTi32-21		X6NiCrNbCe32-27	
Steel Number	1.4818		1.4854		1.4887		1.4835		1.4876		1.4877	
Steel Name	X25CrMnNiN25-9-7		NiCr23Fe		NiCr28FeSiCe		X10NiCrSi35-19		X8CrNi25-21		---	
Steel Number	1.4872		2.4851		2.4889		1.4886		1.4845		---	
ISO 4955:1994 - Heat-Resisting Steels and Alloys												
Steel Type	X6CrTi12		X10CrAlSi13		X10CrAlSi18		X10CrAlSi25		X6NiCrSi36-19		X15CrNiSi20-12	
	X12NiCrSi35-16		X8NiCrAlTi32-21		X7CrNiSiNCe21-11		NiCr15Fe8		NiCr20Ti		NiCr22Mo9Nb	

Chapter 9

STEELS FOR SPECIAL USE

Free-Machining Steels

ASTM Standards

ASTM A 29/A 29M-03	General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished
ASTM A 576-90b (2000)	Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A 895-89 (2000)	Free-Machining Stainless Steel Plate, Sheet, and Strip

SAE Standard

SAE J403-NOV01	Chemical Compositions of SAE Carbon Steels

JIS Standard

JIS G 4804:1999	Free Cutting Carbon Steels

CEN Standards

EN 10087:1998	Free Cutting Steels - Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods
EN 10277-3:1999	Bright Steel Products - Technical Delivery Conditions - Part 3: Free-Cutting Steels

ISO Standard

ISO 683-9-1988	Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels - Part 9: Wrought Free-Cutting Steels

Spring Steels

ASTM Standards

ASTM A 313/A 313M-03	Stainless Steel Spring Wire
ASTM A 682/A 682M-02	General Requirements For Steel, Strip, High-Carbon, Cold-Rolled
ASTM A 689-97 (2000)	Carbon and Alloy Steel Bars for Springs

JIS Standards

JIS G 4801:1984	Spring Steels
JIS G 4802:1999	Cold-Rolled Steel Strip for Springs
JIS G 4313:1996	Cold Rolled Stainless Steel Strip for Springs

CEN Standard

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 10270-3:2001	Steel Wire for Mechanical Springs

ISO Standard

ISO 683-14-1992	Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels - Part 14: Hot-Rolled Steels for Quenched and Tempered Springs

Tool Steels

ASTM Standards

ASTM A 600-92a (1999)	Tool Steel High Speed
ASTM A 681-94 (1999)	Tool Steels Alloy
ASTM A 686-92 (1999)	Tool Steel, Carbon

SAE Standard

SAE J438 May 1970	Tool and Die Steels

JIS Standards

JIS G 4401: 2000	Carbon Tool Steels
JIS G 4403: 2000	High Speed Tool Steels
JIS G 4404: 2000	Alloy Tool Steels

ISO Standard

ISO 4957:1999	Tool Steels

Bearing Steels

ASTM Standards

ASTM A 295-98	High-Carbon Anti-Friction Bearing Steel
ASTM A 485-03	High Hardenability Antifriction Bearing Steel

JIS Standard

JIS G 4805:1999	High Carbon Chromium Bearing Steels

ISO Standard

ISO 683-17:1999	Heat-Treated Steels, Alloy Steels and Free-Cutting Steels - Part 17: Ball and Roller Bearing Steels

9.1 Free-Machining Steels

9.1.1 Chemical Composition of Resulfurized Carbon Steels for Free-Machining Applications

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	1109	---	G11090	0.08-0.13	0.60-0.90	---	0.040	0.08-0.13	---	---	---	---
ASTM A 576-90b (2000)	1109	---	G11090	0.08-0.13	0.60-0.90	---	0.040	0.08-0.13	---	---	---	---
JIS G 4804:1999	SUM 12	---	---	0.08-0.13	0.60-0.90	---	0.040	0.08-0.13	---	---	---	---
EN 10087:1998	10S20	1.0721	---	0.07-0.13	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	---
EN 10277-3:1999	10S20	1.0721	---	0.07-0.13	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	---
ISO 683-9:1988	10 S 20	---	---	0.07-0.13	0.70-1.10	0.15-0.40	0.06	0.15-0.25	---	---	---	---
ASTM A 29/A 29M-03	1110	---	G11100	0.08-0.13	0.30-0.60	---	0.040	0.08-0.13	---	---	---	---
ASTM A 576-90b (2000)	1110	---	G11100	0.08-0.13	0.30-0.60	---	0.040	0.08-0.13	---	---	---	---
JIS G 4804:1999	SUM 11	---	---	0.08-0.13	0.30-0.60	---	0.040	0.08-0.13	---	---	---	---
ASTM A 29/A 29M-03	1117	---	G11700	0.14-0.20	1.00-1.30	---	0.040	0.08-0.13	---	---	---	---
	1118	---	G11180	0.14-0.20	1.30-1.60	---	0.040	0.08-0.13	---	---	---	---
ASTM A 576-90b (2000)	1117	---	G11700	0.14-0.20	1.00-1.30	---	0.040	0.08-0.13	---	---	---	---
	1118	---	G11180	0.14–0.20	1.30–1.60	---	0.040	0.08-0.13	---	---	---	---
SAE J403-NOV01	1117	---	G11700	0.14-0.20	1.00-1.30	---	0.030	0.08-0.13	---	---	---	---
	1118	---	G11180	0.14-0.20	1.30-1.60	---	0.030	0.08-0.13	---	---	---	---
JIS G 4804:1999	SUM 31	---	---	0.14-0.20	1.00-1.30	---	0.040	0.08-0.13	---	---	---	---
	SUM 32	---	---	0.12-0.20	0.60-1.10	---	0.040	0.10-0.20	---	---	---	---
EN 10087:1998	15SMn13	1.0725	---	0.12-0.18	0.90-1.30	0.40	0.06	0.08-0.18	---	---	---	---
EN 10277-3:1999	15SMn13	1.0725	---	0.12-0.18	0.90-1.30	0.40	0.06	0.08-0.18	---	---	---	---
ISO 683-9:1988	17 SMn 20	---	---	0.14-0.20	1.20-1.60	0.15-0.40	0.06	0.15-0.25	---	---	---	---
ASTM A 29/A 29M-03	1137	---	G11370	0.32-0.39	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
ASTM A 576-90b (2000)	1137	---	G11370	0.32-0.39	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
SAE J403-NOV01	1137	---	G11370	0.32-0.39	1.35-1.65	---	0.030	0.08-0.13	---	---	---	---
JIS G 4804:1999	SUM 41	---	---	0.32-0.39	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
EN 10087:1998	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 10277-3:1999	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	---	---	---	---
ISO 683-9:1988	35 S 20	---	---	0.32-0.39	0.70-1.10	0.15-0.40	0.06	0.15-0.25	---	---	---	---
	35 SMn 20	---	---	0.32-0.39	0.90-1.40	0.15-0.40	0.06	0.15-0.25	---	---	---	---
ASTM A 29/A 29M-03	1139	---	G11390	0.35-0.43	1.35-1.65	---	0.040	0.13-0.20	---	---	---	---
ASTM A 576-90b (2000)	1139	---	G11390	0.35–0.43	1.35–1.65	---	0.040	0.13-0.20	---	---	---	---
SAE J403-NOV01	1138	---	G11380	0.34-0.40	0.70-1.00	---	0.030	0.08-0.13	---	---	---	---
EN 10087:1998	38SMn28	1.0760	---	0.35-0.40	1.20-1.50	0.40	0.06	0.24-0.33	---	---	---	---
EN 10277-3:1999	38SMn28	1.0760	---	0.35-0.40	1.20-1.50	0.40	0.06	0.24-0.33	---	---	---	---

9.1 Free-Machining Steels

9.1.1 Chemical Composition of Resulfurized Carbon Steels for Free-Machining Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	1140	---	G11400	0.37-0.44	0.70-1.00	---	0.040	0.08-0.13	---	---	---	---
ASTM A 576-90b (2000)	1140	---	G11400	0.37–0.44	0.70–1.00	---	0.040	0.08-0.13	---	---	---	---
SAE J403-NOV01	1140	---	G11400	0.37-0.44	0.70-1.00	---	0.030	0.08-0.13	---	---	---	---
ASTM A 29/A 29M-03	1141	---	G11410	0.37-0.45	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
ASTM A 576-90b (2000)	1141	---	G11410	0.37-0.45	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
SAE J403-NOV01	1141	---	G11410	0.37-0.45	1.35-1.65	---	0.030	0.08-0.13	---	---	---	---
JIS G 4804:1999	SUM 42	---	---	0.37-0.45	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
ASTM A 29/A 29M-03	1144	---	G11440	0.40-0.48	1.35-1.65	---	0.040	0.24-0.33	---	---	---	---
ASTM A 576-90b (2000)	1144	---	G11440	0.40-0.48	1.35-1.65	---	0.040	0.24-0.33	---	---	---	---
SAE J403-NOV01	1144	---	G11440	0.40-0.48	1.35-1.65	---	0.030	0.24-0.33	---	---	---	---
JIS G 4804:1999	SUM 43	---	---	0.40-0.48	1.35-1.65	---	0.040	0.24-0.33	---	---	---	---
EN 10087:1998	44SMn28	1.0762	---	0.40-0.48	1.30-1.70	0.40	0.06	0.24-0.33	---	---	---	---
EN 10277-3:1999	44SMn28	1.0762	---	0.40-0.48	1.30-1.70	0.40	0.06	0.24-0.33	---	---	---	---
ISO 683-9:1988	44 SMn 28	---	---	0.40-0.48	1.30-1.70	0.15-0.40	0.06	0.24-0.33	---	---	---	---
ASTM A 29/A 29M-03	1146	---	G11460	0.42-0.49	0.70-1.00	---	0.040	0.08-0.13	---	---	---	---
ASTM A 576-90b (2000)	1146	---	G11460	0.42-0.49	0.70-1.00	---	0.040	0.08-0.13	---	---	---	---
SAE J403-NOV01	1146	---	G11460	0.42-0.49	0.70-1.00	---	0.030	0.08-0.13	---	---	---	---
EN 10087:1998	46S20	1.0727	---	0.42-0.50	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	---
EN 10277-3:1999	46S20	1.0727	---	0.42-0.50	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	---
ISO 683-9:1988	46 S 20	---	---	0.42-0.50	0.70-1.10	0.15-0.40	0.06	0.15-0.25	---	---	---	---
ASTM A 29/A 29M-03	1151	---	G11510	0.48-0.55	0.70-1.00	---	0.040	0.08-0.13	---	---	---	---
ASTM A 576-90b (2000)	1151	---	G11510	0.48-0.55	0.70-1.00	---	0.040	0.08-0.13	---	---	---	---
SAE J403-NOV01	1151	---	G11510	0.48-0.55	0.70-1.00	---	0.030	0.08-0.13	---	---	---	---

9.1 Free-Machining Steels

9.1.2 Chemical Composition of Rephosphorized and Resulfurized Carbon Steels for Free-Machining Applications

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	1212	---	G12120	0.13	0.70-1.00	---	0.07-0.12	0.16-0.23	---	---	---	---
ASTM A 576-90b (2000)	1212	---	G12120	0.13	0.70-1.00	---	0.07-0.12	0.16-0.23	---	---	---	---
SAE J403-NOV01	1212	---	G12120	0.13	0.70-1.00	---	0.07-0.12	0.16-0.23	---	---	---	---
JIS G 4804:1999	SUM 21	---	---	0.13	0.70-1.00	---	0.07-0.12	0.16-0.23	---	---	---	---
ISO 683-9:1988	9 S 20	---	---	0.13	0.60-1.20	0.05	0.11	0.15-0.25	---	---	---	---
ASTM A 29/A 29M-03	1213	---	G12130	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	---
ASTM A 576-90b (2000)	1213	---	G12130	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	---
SAE J403-NOV01	1213	---	G12130	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	---
JIS G 4804:1999	SUM 22	---	---	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	---
EN 10087:1998	11SMn30	1.0715	---	0.14	0.90-1.30	0.05	0.11	0.27-0.33	---	---	---	---
EN 10277-3:1999	11SMn30	1.0715	---	0.14	0.90-1.30	0.05	0.11	0.27-0.33	---	---	---	---
ISO 683-9:1988	11 SMn 28	---	---	0.14	0.90-1.30	0.05	0.11	0.24-0.33	---	---	---	---
ASTM A 29/A 29M-03	1215	---	G12150	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	---
ASTM A 576-90b (2000)	1215	---	G12150	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	---
SAE J403-NOV01	1215	---	G12150	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	---
JIS G 4804:1999	SUM 23	---	---	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	---
JIS G 4804:1999	SUM 25	---	---	0.15	0.90-1.40	---	0.07-0.12	0.30-0.40	---	---	---	---
EN 10087:1998	11SMn37	1.0736	---	0.14	1.00-1.50	0.05	0.11	0.34-0.40	---	---	---	---
EN 10277-3:1999	11SMn37	1.0736	---	0.14	1.00-1.50	0.05	0.11	0.34-0.40	---	---	---	---
ISO 683-9:1988	12 SMn 35	---	---	0.15	1.00-1.50	0.05	0.11	0.30-0.40	---	---	---	---

9.1 Free-Machining Steels

9.1.3 Chemical Composition of Resulfurized and Leaded Carbon Steels for Free-Machining Applications

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	11 L 09	---	G11094	0.08-0.13	0.60-0.90	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
ASTM A 576-90b (2000)	11 L 09	---	G11094	0.08-0.13	0.60-0.90	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
EN 10087:1998	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 10277-3:1999	10SPb20	1.0722	---	0.07-0.13	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	Pb 0.20-0.35
ISO 683-9:1988	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
ASTM A 29/A 29M-03	11 L 17	---	G11174	0.14-0.20	1.00-1.30	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
ASTM A 576-90b (2000)	11 L 17	---	G11174	0.14-0.20	1.00-1.30	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
SAE J403-NOV01	11L17	---	G11174	0.14-0.20	1.00-1.30	---	0.030	0.08-0.13	---	---	---	Pb 0.15-0.35
JIS G 4804:1999	SUM 31 L	---	---	0.14-0.20	1.00-1.30	---	0.040	0.08-0.13	---	---	---	Pb 0.10-0.35
ASTM A 29/A 29M-03	11 L 37	---	G11374	0.32-0.39	1.35-1.65	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
ASTM A 576-90b (2000)	11 L 37	---	G11374	0.32-0.39	1.35-1.65	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
SAE J403-NOV01	11L37	---	G11374	0.32-0.39	1.35-1.65	---	0.030	0.08-0.13	---	---	---	Pb 0.15-0.35
EN 10087:1998	36SMnPb14	1.0765	---	0.32-0.39	1.30-1.70	0.40	0.06	0.10-0.18	---	---	---	Pb 0.15-0.35
EN 10277-3:1999	36SMnPb14	1.0765	---	0.32-0.39	1.30-1.70	0.40	0.06	0.10-0.18	---	---	---	Pb 0.15-0.35
ASTM A 29/A 29M-03	11 L 41	---	G11414	0.37-0.45	1.35-1.65	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
ASTM A 576-90b (2000)	11 L 41	---	G11414	0.37-0.45	1.35-1.65	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
SAE J403-NOV01	11L41	---	G11414	0.37-0.45	1.35-1.65	---	0.030	0.08-0.13	---	---	---	Pb 0.15-0.35
EN 10087:1998	38SMnPb28	1.0761	---	0.35-0.40	1.20-1.50	0.40	0.06	0.24-0.33	---	---	---	Pb 0.15-0.35
EN 10277-3:1999	38SMnPb28	1.0761	---	0.35-0.40	1.20-1.50	0.40	0.06	0.24-0.33	---	---	---	Pb 0.15-0.35
ASTM A 29/A 29M-03	11 L 44	---	G11444	0.40-0.48	1.35-1.65	---	0.040	0.24-0.33	---	---	---	Pb 0.15-0.35
ASTM A 576-90b (2000)	11 L 44	---	G11444	0.40-0.48	1.35-1.65	---	0.040	0.24-0.33	---	---	---	Pb 0.15-0.35
SAE J403-NOV01	11L44	---	G11444	0.40-0.48	1.35-1.65	---	0.030	0.24-0.33	---	---	---	Pb 0.15-0.35
EN 10087:1998	44SMnPb28	1.0763	---	0.40-0.48	1.30-1.70	0.40	0.06	0.24-0.33	---	---	---	Pb 0.15-0.35
EN 10277-3:1999	44SMnPb28	1.0763	---	0.40-0.48	1.30-1.70	0.40	0.06	0.24-0.33	---	---	---	Pb 0.15-0.35
ASTM A 29/A 29M-03	11 L 46	---	G11464	0.42-0.49	0.70-1.00	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
ASTM A 576-90b (2000)	11 L 46	---	G11464	0.42-0.49	0.70-1.00	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
SAE J403-NOV01	11L46	---	G11464	0.42-0.49	0.70-1.00	---	0.030	0.08-0.13	---	---	---	Pb 0.15-0.35
EN 10087:1998	46SPb20	1.0757	---	0.42-0.50	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	Pb 0.15-0.35
EN 10277-3:1999	46SPb20	1.0757	---	0.42-0.50	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	Pb 0.15-0.35

9.1 Free-Machining Steels

9.1.4 Chemical Composition of Rephosphorized, Resulfurized, and Leaded Carbon Steels for Free-Machining Applications

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-03	12 L 13	---	G12134	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	Pb 0.15-0.35
ASTM A 576-90b (2000)	12 L 13	---	G12134	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	Pb 0.15-0.35
SAE J403-NOV01	12L13	---	G12134	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	Pb 0.15-0.35
JIS G 4804:1999	SUM 22 L	---	---	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	Pb 0.10-0.35
EN 10087:1998	11SMnPb30	1.0718	---	0.14	0.90-1.30	0.05	0.11	0.27-0.33	---	---	---	Pb 0.20-0.35
EN 10277-3:1999	11SMnPb30	1.0718	---	0.14	0.90-1.30	0.05	0.11	0.27-0.33	---	---	---	Pb 0.20-0.35
ISO 683-9:1988	11 SMnPb 28	---	---	0.14	0.90-1.30	0.05	0.11	0.24-0.33	---	---	---	Pb 0.15-0.35
ASTM A 29/A 29M-03	12 L 14	---	G12144	0.15	0.85-1.15	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
ASTM A 576-90b (2000)	12 L 14	---	---	0.15	0.85-1.15	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
SAE J403-NOV01	12L14	---	G12144	0.15	0.85-1.15	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
JIS G 4804:1999	SUM 24 L	---	---	0.15	0.85-1.15	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.10-0.35
ASTM A 29/A 29M-03	12 L 15	---	G12154	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
ASTM A 576-90b (2000)	12 L 15	---	G12154	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
SAE J403-NOV01	12L15	---	G12154	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
JIS G 4804:1999	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	11SMnPb37	1.0737	---	0.14	1.00-1.50	0.05	0.11	0.34-0.40	---	---	---	Pb 0.20-0.35
EN 10277-3:1999	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	12 SMnPb 35	---	---	0.15	1.00-1.50	0.05	0.11	0.30-0.40	---	---	---	Pb 0.15-0.35

9.1.5 Chemical Composition of Free-Machining Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 895-89 (2000)	416	---	S41600	0.15	1.25	1.00	0.06	0.15 min	12.00-14.00	---	---	---
EN 10088-3:1995	X12CrS13	1.4005	---	0.08-0.15	1.50	1.00	0.040	0.15-0.35	12.00-14.00	---	0.60	---
ASTM A 895-89 (2000)	303	---	S30300	0.15	2.00	1.00	0.20	0.15 min	17.00-19.00	8.00-10.00	---	---
EN 10088-3:1995	X8CrNiS18-9	1.4305	---	0.10	2.00	1.00	0.045	0.15-0.35	17.00-19.00	8.00-10.00	---	N 0.11; Cu 1.00

9.2 Spring Steels

9.2.1 Chemical Composition of Cold Rolled Carbon Spring Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 682/A 682M-02	1040	---	G10400	0.37-0.44	0.60-0.90	0.15-0.30	0.035	0.040	---	---	---	---
ASTM A 689-97 (2000)	1040	---	G10400	0.37-0.44	0.60-0.90	0.15-0.30	0.040	0.050	---	---	---	---
EN 10089:2002	38Si7	1.5023	---	0.35-0.42	0.50-0.80	1.50-1.80	0.025	0.025	---	---	---	Cu+10Sn see standard
ASTM A 682/A 682M-02	1050	---	G10500	0.48-0.55	0.60-0.90	0.15-0.30	0.035	0.040	---	---	---	---
ASTM A 689-97 (2000)	1050	---	G10500	0.48-0.55	0.60-0.90	0.15-0.30	0.040	0.050	---	---	---	---
JIS G 4802:1999	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
EN 10089:2002	46Si7	1.5024	---	0.42-0.50	0.50-0.80	1.50-2.00	0.025	0.025	---	---	---	Cu+10Sn see standard
ASTM A 682/A 682M-02	1055	---	G10550	0.50-0.60	0.60-0.90	0.15-0.30	0.035	0.040	---	---	---	---
ASTM A 689-97 (2000)	1055	---	G10550	0.50-0.60	0.60-0.90	0.15-0.30	0.040	0.050	---	---	---	---
ASTM A 713-04	1055	---	G10550	0.50-0.60	0.60-0.90	---	0.040	0.050	---	---	---	---
JIS G 4802:1999	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
EN 10089:2002	56Si7	1.5026	---	0.52-0.60	0.60-0.90	1.60-2.00	0.025	0.025	---	---	---	Cu+10Sn see standard
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	---
ASTM A 682/A 682M-02	1060	---	G10600	0.55-0.65	0.60-0.90	0.15-0.30	0.035	0.040	---	---	---	---
ASTM A 689-97 (2000)	1060	---	G10600	0.55-0.65	0.60-0.90	0.15-0.30	0.040	0.050	---	---	---	---
ASTM A 713-04	1060	---	G10600	0.55-0.65	0.60-0.90	---	0.040	0.050	---	---	---	---
JIS G 4802:1999	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; Ni+Cr 0.35
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	---
ASTM A 682/A 682M-02	1064	---	G10640	0.60-0.70	0.50-0.80	0.15-0.30	0.035	0.040	---	---	---	---
	1065	---	G10650	0.60-0.70	0.60-0.90	0.15-0.30	0.035	0.040	---	---	---	---
ASTM A 713-04	1064	---	G10640	0.60-0.70	0.50-0.80	---	0.035	0.040	---	---	---	---
	1065	---	G10650	0.60-0.70	0.60-0.90	---	0.035	0.040	---	---	---	---
JIS G 4802:1999	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; Ni+Cr 0.35
ASTM A 682/A 682M-02	1070	---	G10700	0.65-0.75	0.60-0.90	0.15-0.30	0.035	0.040	---	---	---	---
ASTM A 689-97 (2000)	1070	---	G10700	0.65-0.75	0.60-0.90	0.15-0.30	0.040	0.050	---	---	---	---
ASTM A 713-04	1070	---	G10700	0.65-0.75	0.60-0.90	---	0.040	0.050	---	---	---	---
JIS G 4802:1999	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; Ni+Cr 0.35
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	---
ASTM A 682/A 682M-02	1074	---	G10740	070-0.80	0.50-0.80	0.15-0.30	0.035	0.040	---	---	---	---
ASTM A 713-04	1074	---	G10740	070-0.80	0.50-0.80	---	0.040	0.050	---	---	---	---
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 A 689-97 (2002)	1078	---	G10780	0.72-0.85	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 713-04	1078	---	G10780	0.72-0.85	0.30-0.60	---	0.040	0.050	---	---	---	---
JIS G 4801:1984	SUP 3	---	---	0.75-0.90	0.30-0.60	0.15-0.35	0.035	0.035	---	---	---	Cu 0.30

9.2 Spring Steels

9.2.1 Chemical Composition of Cold Rolled Carbon Spring Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 682/A 682M-02	1085	---	G10850	0.80-0.95	0.70-1.00	0.15-0.30	0.035	0.040	---	---	---	---
ASTM A 713-04	1084	---	G10840	0.80-0.93	0.60-0.90	0.15-0.30	0.040	0.050	---	---	---	---
JIS G 4802:1999	SK5-CSP	---	---	0.80-0.90	0.50	0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
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	---
ASTM A 682/A 682M-02	1086	---	G10860	0.80-0.93	0.30-0.50	0.15-0.30	0.035	0.040	---	---	---	---
ASTM A 713-04	1086	---	G10860	0.80-0.93	0.30-0.50	---	0.040	0.050	---	---	---	---
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 A 682/A 682M-02	1095	---	G10950	0.90-1.03	0.30-0.50	0.15-0.30	0.035	0.040	---	---	---	---
ASTM A 689-97 (2000)	1095	---	G10950	0.90-1.03	0.30-0.50	0.15-0.30	0.040	0.050	---	---	---	---
ASTM A 713-04	1095	---	G10950	0.90-1.03	0.30-0.50	---	0.040	0.050	---	---	---	---
JIS G 4802:1999	SK4-CSP	---	---	0.90-1.00	0.50	0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
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	---

9.2 Spring Steels

9.2.2 Chemical Composition of Hot Rolled Alloy Spring Steels

9.2.2.1 Chemical Composition of Hot Rolled Si Alloy Spring Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4801:1984	SUP 6	---	---	0.56-0.64	0.70-1.00	1.50-1.80	0.035	0.035	---	---	---	Cu 0.30
ISO 683-14:1992	59 Si 7	---	---	0.55-0.63	0.60-1.00	1.60-2.00	0.030	0.030	---	---	---	---
ASTM A 689-97 (2002)	9260	---	G92600	0.56-0.64	0.75-1.00	1.80-2.20	0.035	0.040	---	---	---	---
JIS G 4801:1984	SUP 7	---	---	0.56-0.64	0.70-1.00	1.80-2.20	0.035	0.035	---	---	---	Cu 0.30

9.2.2.2 Chemical Composition of Hot Rolled Cr Alloy Spring Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 689-97 (2002)	5155	---	G51550	0.51-0.59	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	---	---	---
JIS G 4801:1984	SUP 9	---	---	0.52-0.60	0.65-0.95	0.15-0.35	0.035	0.035	0.65-0.95	---	---	Cu 0.30
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+10Sn see standard
ISO 683-14:1992	55 Cr 3	---	---	0.52-0.59	0.70-1.00	0.15-0.40	0.030	0.030	0.70-1.00	---	---	---
ASTM A 689-97 (2002)	5160	---	G51600	0.56-0.64	0.75-1.00	0.15-0.35	0.035	0.040	0.70-0.90	---	---	---
JIS G 4801:1984	SUP 9 A	---	---	0.56-0.64	0.70-1.00	0.15-0.35	0.035	0.035	0.70-1.00	---	---	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+10Sn see standard

9.2.2.3 Chemical Composition of Hot Rolled Cr-Si Alloy Spring Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4801:1984	SUP 12	---	---	0.51-0.59	0.60-0.90	1.20-1.60	0.035	0.035	0.60-0.90	---	---	---
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+10Sn see standard
ISO 683-14:1992	55 SiCr 6 3	---	---	0.51-0.59	0.50-0.80	1.20-1.60	0.030	0.030	0.55-0.85	---	---	---

9.2 Spring Steels

9.2.2.4 Chemical Composition of Hot Rolled Cr-Mo Alloy Spring Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 689-97 (2002)	4161	---	G41610	0.56-0.64	0.75-1.00	0.15-0.35	0.035	0.040	0.70-0.90	---	0.25-0.35	---
JIS G 4801:1984	SUP 13	---	---	0.56-0.64	0.70-1.00	0.15-0.35	0.035	0.035	0.70-0.90	---	0.25-0.35	---
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+10Sn see standard
	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+10Sn see standard
	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+10Sn see standard
ISO 683-14:1992	60 CrMo 3 3	---	---	0.56-0.64	0.70-1.00	0.15-0.40	0.030	0.030	0.70-1.00	---	0.25-0.35	---

9.2.2.5 Chemical Composition of Hot Rolled Cr-V Alloy Spring Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4801:1984	SUP 10	---	---	0.47-0.55	0.65-0.95	0.15-0.35	0.035	0.035	0.80-1.10	---	---	V 0.15-0.25; Cu 0.30
JIS G 4802:1999	SUP10-CSP	---	---	0.47-0.55	0.65-0.95	0.15-0.35	0.035	0.035	0.80-1.10	---	---	V 0.15-0.25
EN 10089:2002	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+10Sn see standard
EN 10132-4:2002	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
ISO 683-14:1992	51 CrV 4	---	---	0.47-0.55	0.60-1.00	0.10-.0.40	0.030	0.030	0.80-1.10	---	---	V 0.10-0.25
ASTM A 689-97 (2002)	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
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+10Sn see standard

9.2.2.6 Chemical Composition of Hot Rolled Cr-B Alloy Spring Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 689-97 (2002)	51 B 60	---	G51601	0.56-0.64	0.75-1.00	0.15-0.35	0.035	0.040	0.70-.090	---	---	B 0.0005-0.003
JIS G 4801:1984	SUP 11 A	---	---	0.56-0.64	0.70-1.00	0.15-0.35	0.035	0.035	0.70-1.00	---	---	B 0.0005; Cu 0.30
ISO 683-14:1992	60 CrB 3	---	---	0.56-0.64	0.70-1.00	0.15-0.40	0.030	0.030	0.60-0.90	---	---	B 0.0008

9.2 Spring Steels

9.2.3 Chemical Composition of Stainless Spring Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4313:1996	SUS 420J2-CSP	---	---	0.26-0.40	1.00	1.00	0.040	0.030	12.00-14.00	---	---	---
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	---	---	---
ASTM A 313/A 313M-03	302	---	S30200	0.12	2.00	1.00	0.045	0.030	17.0-19.0	8.0-10.0	---	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 10270-3:2001	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	N 0.11
JIS G 4313:1996	SUS 301-CSP	---	---	0.15	0.50-2.00	0.20-1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	---
ASTM A 313/A 313M-03	304	---	S30400	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10
JIS G 4313:1996	SUS 304-CSP	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	8.00-10.50	---	---
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
ASTM A 313/A 313M-03	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
ASTM A 313/A 313M-03	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
JIS G 4313:1996	SUS 631-CSP	---	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.5-7.75	---	Al 0.75-1.50

9.3 Tool Steels

9.3.1 Chemical Composition of Carbon Tool Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4401:2000	SK65	---	---	0.60-0.70	0.50	0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
ISO 4957:1999	C70U	---	---	0.65-0.75	0.10-0.40	0.10-0.30	0.030	0.030	---	---	---	---
SAE J438-1970	W108	---	T72301	0.70-0.85	---	---	---	---	---	---	---	---
JIS G 4401:2000	SK75	---	---	0.70-0.80	0.50	0.35	0.030	0.030	0.030	0.25	---	Cu 0.25
ISO 4957:1999	C80U	---	---	0.75-0.85	0.10-0.40	0.10-0.30	0.030	0.030	---	---	---	---
ASTM A 686-92 (1999)	W1-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; W 0.15; Cu 0.20
JIS G 4401:2000	SK85	---	---	0.80-0.90	0.50	0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
ASTM A 686-92 (1999)	W1-A-8½	---	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; W 0.15; Cu 0.20
SAE J438-1970	W109	---	T72301	0.85-0.95	---	---	---	---	---	---	---	---
ISO 4957:1999	C90U	---	---	0.85-0.95	0.10-0.40	0.10-0.30	0.030	0.030	---	---	---	---
ASTM A 686-92 (1999)	W1-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; W 0.15; Cu 0.20
JIS G 4401:2000	SK95	---	---	0.90-1.00	0.50	0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
ASTM A 686-92 (1999)	W1-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; W 0.15; Cu 0.20
SAE J438-1970	W110	---	T72301	0.95-1.10	---	---	---	---	---	---	---	---
JIS G 4401:2000	SK105	---	---	1.00-1.10	0.50	0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
ISO 4957:1999	C105U	---	---	1.00-1.10	0.10-0.40	0.10-0.30	0.030	0.030	---	---	---	---
ASTM A 686-92 (1999)	W1-A-11½	---	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; W 0.15; Cu 0.20
SAE J438-1970	W112	---	T72301	1.10-1.30	---	---	---	---	---	---	---	---
JIS G 4401:2000	SK120	---	---	1.10-1.30	0.50	0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
ISO 4957:1999	C120U	---	---	1.15-1.25	0.10-0.40	0.10-0.30	0.030	0.030	---	---	---	---
ASTM A 686-92 (1999)	W2-A-9½	---	---	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; W 0.15; Cu 0.20
JIS G 4404:2000	SKS 43	---	---	1.00-1.10	0.30	0.25	0.030	0.030	0.20	0.25	---	V 0.10-0.25; Cu 0.25
ISO 4957:1999	105V	---	---	1.00-1.10	0.10-0.40	0.10-0.30	---	---	---	---	---	V 0.10-0.20
ASTM A 686-92 (1999)	W2-A-8½	---		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; W 0.15; Cu 0.20
JIS G 4404:2000	SKS 44	---	---	0.80-0.90	0.30	0.25	0.030	0.030	0.20	0.25	---	V 0.10-0.25; Cu 0.25

9.3 Tool Steels

9.3.2 Chemical Composition of High Speed Tool Steels

9.3.2.1 Chemical Composition of Tungsten Type High Speed Tool Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 600-92a (1999)	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
SAE J438-1970	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
JIS G 4403:2000	SKH2	---	---	0.73-0.83	0.40	0.40	0.030	0.030	3.80-4.50	0.25	---	V 0.80-1.20; W 17.00-19.00; Cu 0.25
ISO 4957:1999	HS18-0-1	---	---	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
ASTM A 600-92a (1999)	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
SAE J438-1970	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
JIS G 4403:2000	SKH3	---	---	0.73-0.83	0.40	0.40	0.030	0.030	3.80-4.50	0.25	---	V 0.80-1.20; W 17.00-19.00; Co 4.50-5.50; Cu 0.25
ASTM A 600-92a (1999)	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
SAE J438-1970	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
JIS G 4403:2000	SKH4	---	---	0.73-0.83	0.40	0.40	0.030	0.030	3.80-4.50	0.25	---	V 1.00-1.50; W 17.00-19.00; Co 9.00-11.00; Cu 0.25
ASTM A 600-92a (1999)	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 4403:2000	SKH10	---	---	1.45-1.60	0.40	0.40	0.030	0.030	3.80-4.50	0.25	---	V 4.20-5.20; W 11.50-13.50; Co 4.20-5.20; Cu 0.25

9.3 Tool Steels

9.3.2 Chemical Composition of High Speed Tool Steels

9.3.2.2 Chemical Composition of Molybdenum Type High Speed Tool Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 600-92a (1999)	M2	---	T11301	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
SAE J438-1970	M2	---	T11301	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
JIS G 4403:2000	SKH51	---	---	0.80-0.90	0.40	0.40	0.030	0.030	3.80-4.50	0.25	4.50-5.50	V 1.60-2.20; W 5.50-6.70; Cu 0.25
ISO 4957:1999	HS6-5-2	---	---	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
ASTM A 600-92a (1999)	M3 Cl 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
SAE J438-1970	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
JIS G 4403:2000	SKH52	---	---	1.00-1.10	0.40	0.40	0.030	0.030	3.80-4.50	0.25	4.80-6.20	V 2.30-2.80; W 5.50-6.70; Cu 0.25
ISO 4957:1999	HS6-6-2	---	---	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
ASTM A 600-92a (1999)	M3 Cl 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
JIS G 4403:2000	SKH53	---	---	1.10-1.25	0.40	0.40	0.030	0.030	3.80-4.50	0.25	4.60-5.30	V 2.80-3.30; W 5.70-6.70; Cu 0.25
ISO 4957:1999	HS6-5-3	---	---	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
ASTM A 600-92a (1999)	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
SAE J438-1970	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
JIS G 4403:2000	SKH54	---	---	1.25-1.40	0.40	0.40	0.030	0.030	3.80-4.50	0.25	4.50-5.50	V 3.90-4.50; W 5.30-6.50; Cu 0.25
ISO 4957:1999	HS6-5-4	---	---	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
ASTM A 600-92a (1999)	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
JIS G 4403:2000	SKH58	---	---	0.95-1.05	0.40	0.50	0.030	0.030	3.50-4.50	0.25	8.20-9.20	V1.70-2.20; W 1.50-2.10; Cu 0.25
ISO 4957:1999	HS2-9-2	---	---	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 1.50-210
ASTM A 600-92a (1999)	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 4403:2000	SKH56	---	---	0.85-0.95	0.40	0.40	0.030	0.030	3.80-4.50	0.25	4.60-5.30	V 1.70-2.20; W 5.70-6.70; Co 7.00-9.00; Cu 0.25
ASTM A 600-92a (1999)	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
JIS G 4403:2000	SKH59	---	---	1.00-1.15	0.40	0.25	0.030	0.030	3.50-4.50	---	9.00-10.00	V 0.90-1.40; W 1.20-1.90; Cu 0.25
ISO 4957:1999	HS2-9-1-8	---	---	1.05-1.15	0.70	0.45	0.030	0.030	3.50-4.50	---	9.00-10.0	V 0.90-1.30; W 1.20-1.90; Co 7.50-8.50
JIS G 4403:2000	SKH55	---	---	0.85-0.95	0.40	0.40	0.030	0.030	3.80-4.50	0.25	4.60-5.30	V 1.70-2.20; W 5.70-6.70; Co 4.50-5.50; Cu 0.25
ISO 4957:1999	HS6-5-2-5	---	---	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
JIS G 4403:2000	SKH57	---	---	1.20-1.35	0.40	0.40	0.030	0.030	3.80-4.50	0.25	3.00-4.00	V 3.00-3.70; W 9.00-11.00; Co 9.00-11.00; Cu 0.25
ISO 4957:1999	HS10-4-3-10	---	---	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

9.3 Tool Steels

9.3.3 Chemical Composition of Cold Work Tool Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 681-94 (1999)	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
SAE J438-1970	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
JIS G 4404:2000	SKD 12	---	---	0.95-1.05	0.60-0.90	0.40	0.030	0.030	4.50-5.50	0.50	0.80-1.20	V 0.20-0.50; Cu 0.25
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
ASTM A 681-94 (1999)	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
SAE J438-1970	D2	---	T30402	1.40-1.60	0.30-0.50	0.10-0.60	---	---	11.00-13.00	---	0.70-1.20	V 0.80; Co 0.60
JIS G 4404:2000	SKD 11	---	---	1.40-1.60	0.60	0.40	0.030	0.030	11.00-13.00	0.50	0.80-1.20	V 0.20-0.50; Cu 0.25
ASTM A 681-94 (1999)	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
SAE J438-1970	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
JIS G 4404:2000	SKD 1	---	---	1.80-2.40	0.60	0.40	0.030	0.030	12.00-15.00	---	---	Cu 0.25
ISO 4957:1999	X210Cr12	---	---	1.90-2.20	0.20-0.60	0.10-0.60	0.030	0.030	11.00-13.00	---	---	---

9.3 Tool Steels

9.3.4 Chemical Composition of Hot Work Tool Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 681-94 (1999)	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
JIS G 4404:2000	SKD 7	---	---	0.28-0.38	0.60	0.50	0.030	0.030	2.50-3.50	0.25	2.50-3.00	V 0.40-0.70; Cu 0.25
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
ASTM A 681-94 (1999)	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
SAE J438-1970	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
JIS G 4404:2000	SKD 6	---	---	0.32-0.42	0.50	0.80-1.20	0.030	0.030	4.50-5.50	0.25	1.00-1.50	V 0.30-0.50; Cu 0.25
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
ASTM A 681-94 (1999)	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
SAE J438-1970	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
JIS G 4404:2000	SKD 62	---	---	0.32-0.42	0.50	0.80-1.20	0.030	0.030	4.50-5.50	0.25	1.00-1.50	V 0.20-0.60; W 1.00-1.50; Cu 0.25
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
ASTM A 681-94 (1999)	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
SAE J438-1970	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
JIS G 4404:2000	SKD 61	---	---	0.32-0.42	0.50	0.80-1.20	0.030	0.030	4.50-5.50	0.25	1.00-1.50	V 0.80-1.20; Cu 0.25
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
ASTM A 681-94 (1999)	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
JIS G 4404:2000	SKD 8	---	---	0.35-0.45	0.60	0.50	0.030	0.030	4.00-4.70	0.25	0.30-0.50	V 1.70-2.20; W 3.80-4.50; Co 3.80-4.50; Cu 0.25
ISO 4957:1999	38CrCoWV18-17-17	---	---	0.35-0.45	0.25-0.50	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 A 681-94 (1999)	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
SAE J438-1970	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
JIS G 4404:2000	SKD 5	---	---	0.25-0.35	0.60	0.40	0.030	0.030	2.00-3.00	0.25	---	V 0.30-0.50; W 9.00-10.00; Cu 0.25
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 4404:2000	SKT 4	---	---	0.50-0.60	0.60-1.00	0.35	0.030	0.030	0.70-1.00	1.30-2.00	0.20-0.50	V 0.20; Cu 0.25
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

9.3.5 Chemical Composition of Special Purpose Tool Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 681-94 (1999)	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	---
SAE J438-1970	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
JIS G 4404:2000	SKS 51	---	---	0.75-0.85	0.50	0.35	0.030	0.030	0.20-0.50	1.30-2.00	---	Cu 0.25
ASTM A 681-94 (1999)	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; Ni+Cu 0.75
JIS G 4404:2000	SKS 11	---	---	1.20-1.30	0.50	0.35	0.030	0.030	0.20-0.50	0.25	---	W 3.00-4.00; V 0.10-0.30; Cu 0.25

9.4 Bearing Steels

9.4.1 Chemical Composition of Bearing Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 295-98	52100	---	---	0.93-1.05	0.25-0.45	0.15-0.35	0.025	0.015	1.35-1.60	0.25	0.10	Cu 0.30; Al 0.050; O 0.0015
JIS G 4805:1999	SUJ 2	---	---	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
ISO 683-17:1999	B1, 100Cr6	---	---	0.93-1.05	0.25-0.45	0.15-0.35	0.025	0.015	1.35-1.60	---	0.10	Cu 0.30; Al 0.050; O 0.0015
ASTM A 485-03	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	Cu 0.30; Al 0.050; O 0.0015; Ti 0.0050
	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	Cu 0.30; Al 0.050; O 0.0015
JIS G 4805:1999	SUJ 3	---	---	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
ISO 683-17:1999	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	Cu 0.30; Al 0.050; O 0.0015
ASTM A 485-03	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	Cu 0.30; Al 0.050; O 0.0015
ISO 683-17:1999	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	Cu 0.30; Al 0.050; O 0.0015
ASTM A 485-03	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	Cu 0.30; Al 0.050; O 0.0015
ISO 683-17:1999	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	Cu 0.30; Al 0.050; O 0.0015
ASTM A 485-03	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	Cu 0.30; Al 0.050; O 0.0015
ISO 683-17:1999	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	Cu 0.30; Al 0.050; O 0.0015
ASTM A 485-03	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	Cu 0.30; Al 0.050; O 0.0015
ISO 683-17:1999	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	Cu 0.30; Al 0.050; O 0.0015
ASTM A 485-03	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	Cu 0.30; Al 0.050; O 0.0015
ISO 683-17:1999	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	Cu 0.30; Al 0.050; O 0.0015
ASTM A 485-03	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	Cu 0.30; Al 0.050; O 0.0015
ISO 683-17:1999	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	Cu 0.30; Al 0.050; O 0.0015

9.5 Non-Comparable Free-Machining Steels

ASTM A 29/A 29M-03 – General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished												
Grade	1108	1116	1119	1132	1145	1211	---	---	---	---	---	---
UNS Number	G11080	G11160	G11190	G11320	G11450	G12110	---	---	---	---	---	---
ASTM A 576-90b (2000) – Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality												
Grade	1116	1119	1132	1145	1211	---	---	---	---	---	---	---
UNS Number	G11160	G11190	G11320	G11450	G12110	---	---	---	---	---	---	---
ASTM A 895-89 (2000) – Free-Machining Stainless Steel Plate, Sheet, and Strip												
Grade	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S30323	S41623	S42020	S42023	S43020	S43023	---	---	---	---	---	---
SAE J403-NOV01 – Chemical Compositions of SAE Carbon Steels												
SAE Number	1126	1132	---	---	---	---	---	---	---	---	---	---
UNS Number	G11260	G11320	---	---	---	---	---	---	---	---	---	---
EN 10087:1998 – Free Cutting Steels - Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods												
Steel Name	35SPb20	---	---	---	---	---	---	---	---	---	---	---
Steel Number	1.0756	---	---	---	---	---	---	---	---	---	---	---
EN 10277-3:1999 – Bright Steel Products - Technical Delivery Conditions - Part 3: Free-Cutting Steels												
Steel Name	35SPb20	---	---	---	---	---	---	---	---	---	---	---
Steel Number	1.0756	---	---	---	---	---	---	---	---	---	---	---

9.6 Non-Comparable Spring Steels

ASTM A 313/A 313M-03 Standard Specification for Stainless Steel Spring Wire												
Grade	XM-28	305	321	347	XM-16	---	---	---	---	---	---	---
UNS Number	S24100	S30500	S32100	S34700	S45500	S20430	---	---	---	---	---	---
ASTM A 682/A 682M-02 – General Requirements For Steel, Strip, High-Carbon, Cold-Rolled												
Grade	1030	1035	1045	1080	---	---	---	---	---	---	---	---
UNS Number	G10300	G10350	G10450	G1080	---	---	---	---	---	---	---	---
JIS G 4313:1996 – Cold Rolled Stainless Steel Strip for Springs												
Grade Designation	SUS 632J1-CSP		---	---	---	---	---	---	---	---	---	---
EN 10089:2002 Hot Rolled Steels for Quenched and Tempered Springs – Technical Delivery Conditions												
Steel Name	56SiCr7	61SiCr7	45SiCrV6-2	60SiCrV7	46SiCrMo6	50SicrMo6	52SiCrNi5	52crMoV4	---	---	---	---
Steel Number	1.7106	1.7108	1.8151	1.8153	1.8062	1.8063	1.7117	1.7701	---	---	---	---
EN 10132-4:2000 – Cold Rolled Narrow Steel Strip for Heat Treatment - Technical Delivery Conditions - Part 4: Spring Steels and Other Applications												
Steel Name	48Si7	56Si7	75Ni8	80CrV2	102Cr6	125Cr2	C125S	---	---	---	---	---
Steel Number	1.5021	1.5026	1.5634	1.2235	1.2067	1.2002	1.1224	---	---	---	---	---
EN 10151:2002 Stainless Steel Strip for Springs – Technical Delivery Conditions												
Steel Name	X6Cr17	X20Cr13	X11CrNiMnN19-8-6		X12CrMnNiN17-7-5	---	---	---	---	---	---	---
Steel Number	1.4016	1.4021	1.4369		1.4372	---	---	---	---	---	---	---
EN 10270-3:2001 Steel Wire for Mechanical Springs – Part 3: Stainless Spring Steel Wire												
Steel Name	X5CrNiMo17-12-2		X7CrNiAl17-7		---	---	---	---	---	---	---	---
Steel Number	1.4401		1.4568		---	---	---	---	---	---	---	---
ISO 683-14:1992 – Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels - Part 14: Hot-Rolled Steels for Quenched and Tempered Springs												
Steel Name	56 SiCr 7	61 SiCr 7	60 CrMo 3 1	52 CrMoV 4	---	---	---	---	---	---	---	---

9.7 Non-Comparable Tool Steels

ASTM A 600-92a (1999) – Tool Steel High Speed												
Type	T2	T6	T8	M1	M6	M10	M30	M33	M34	M41	M43	M44
UNS Number	T12002	T12006	T12008	T11301	T11306	T11310	T11330	T11333	T11334	T11341	T11343	T11344
Type	M46	M47	M48	M62	M50	M52	---	---	---	---	---	---
UNS Number	T11346	T11347	---	---	T11350	T11352	---	---	---	---	---	---
ASTM A 681-94 (1999) – Tool Steels Alloy												
Type	H14	H22	H23	H24	H25	H26	H41	H42	H43	A3	A4	A5
UNS Number	T20814	T20822	T20823	T20824	T20825	T20826	T20841	T20842	T20843	T30103	T30104	T30105
Type	A6	A7	A8	A9	A10	D4	D5	D7	O1	O2	O6	O7
UNS Number	T30106	T30107	T30108	T30109	T30110	T30404	T30405	T30407	T31501	T31502	T31506	T31507
Type	S1	S2	S4	S5	S6	S7	L2	L3	F1	P2	P3	P4
UNS Number	T41901	T41902	T41904	T41905	T41906	T41907	T61202	T61203	T60601	T51602	T51603	T51604
Type	P5	P6	P20	P21	---	---	---	---	---	---	---	---
UNS Number	T51605	T51606	T51620	T51621	---	---	---	---	---	---	---	---
ASTM A 686-92 (1999) – Tool Steel, Carbon												
Type	W1-C	W2-C	W5	---	---	---	---	---	---	---	---	---
UNS Number	T72301	T72302	T72305	---	---	---	---	---	---	---	---	---
SAE J438-1970 – Tool and Die Steels												
SAE Designation	W209	W210	W310	S1	S2	S5	O1	O2	O6	D5	D7	T2
UNS Number	T72302	T72302	---	T41901	T41902	T41905	T31501	T31502	T31506	T30405	T30407	T12002
SAE Designation	T8	M1	L7	---	---	---	---	---	---	---	---	---
UNS Number	T12008	T11301	---	---	---	---	---	---	---	---	---	---
JIS G 4401:2000 – Carbon Tool Steels												
Grade	SK140	SK90	SK80	SK70	SK60	---	---	---	---	---	---	---
JIS G 4403:2000 – High Speed Tool Steels												
Grade	SKH40	SKH50	---	---	---	---	---	---	---	---	---	---
JIS G 4404:2000 – Alloy Tool Steels												
Grade	SKS 2	SKS 21	SKS 5	SKS 7	SKS 8	SKS 81	SKS 4	SKS 41	SKS 3	SKS 31	SKS 93	SKS 94
Grade	SKS 95	SKD 4	SKD 2	SKD 10	SKT 3	SKT 6	---	---	---	---	---	---
ISO 4957:1999 – Tool Steels												
Steel Name	50WCrV8	60WCrV8	102Cr6	21MnCr5	70MnMoCr8	90MnCrV8	95MnWCr5	X153CrMoV12	X210CrW12	35CrMo7	40CrMnNiMo8-6-4	
Steel Name	45NiCrMo16	X40Cr14	X38CrMo16	X38CrMoV5-3	50CrMoV13-15		HS0-4-1	HS1-4-2	HS1-8-1	HS3-3-2	HS6-5-2C	HS6-5-3C
Steel Name	HS6-5-3-8	C45U	---	---	---	---	---	---	---	---	---	---

9.8 Non-Comparable Bearing Steels

ASTM A 295-98 – High-Carbon Anti-Friction Bearing Steel												
Grade	5195	1070M	5160	---	---	---	---	---	---	---	---	---
UNS Number	G51950	---	G51600	K19526	---	---	---	---	---	---	---	---
ASTM A 485-03 – High Hardenability Antifriction Bearing Steel												
Number	2	3	4	---	---	---	---	---	---	---	---	---
Name	Grade 2	Grade 3	Grade 4	---	---	---	---	---	---	---	---	---
UNS Number	K19195	K19965	K19990	---	---	---	---	---	---	---	---	---
JIS G 4805:1999 – High Carbon Chromium Bearing Steels												
Grade	SUJ 1	SUJ 4	SUJ 5	---	---	---	---	---	---	---	---	---
ISO 683-17:1999 – Heat-Treated Steels, Alloy Steels and Free-Cutting Steels - Part 17: Ball and Roller Bearing Steels												
Number	B20	B21	B22	B23	B24	B25	B26	B27	B28	B29	B30	B31
Name	20Cr3	20Cr4	20MnCr4-2	17MnCr5	19MnCr5	15CrMo4	20CrMo4	20MnCrMo4-2	20NiCrMo2	20NiCrMo7	18CrNiMo7-6	18NiCrMo14-6
Number	B32	B40	B41	B42	B43	B50	B51	B52	B53		B60	
Name	16NiCrMo16-5	C56E2	56Mn4	70Mn4	43CrMo4	X47Cr14	X65Cr14	X106CrMo17	X89CrMoV18-1		80MoCrV42-16	
Number	B61		B62		B63		---	---	---	---	---	---
Name	13MoCrNi42-16-14		X82WMoCrV6-5-4		X75WCrV18-4-1		---	---	---	---	---	---

Appendix 1

ASTM FERROUS METAL STANDARDS

Designation	Title
ASTM A 1-00	Standard Specification for Carbon Steel Tee Rails
ASTM A 2-02	Standard Specification for Carbon Steel Girder Rails of Plain, Grooved, and Guard Types
ASTM A 3-01	Standard Specification for Steel Joint Bars, Low, Medium, and High Carbon (Non-Heat-Treated)
ASTM A 6/A 6M-03c	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 20/A 20M-02	Standard Specification for General Requirements for Steel Plates for Pressure Vessels
ASTM A 27/A 27M-03	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A 29/A 29M-03	Standard Specification for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished, General Requirements for
ASTM A 31-00	Standard Specification for Steel Rivets and Bars for Rivets, Pressure Vessels
ASTM A 34/A 34M-01	Standard Practice for Sampling and Procurement Testing of Magnetic Materials
ASTM A 36/A 36M-03a	Standard Specification for Carbon Structural Steel
ASTM A 47/A 47M-99	Standard Specification for Ferritic Malleable Iron Castings
ASTM A 48/A 48M-03	Standard Specification for Gray Iron Castings
ASTM A 49-01	Standard Specification for Heat-Treated Carbon Steel Joint Bars, Microalloyed Joint Bars, and Forged Carbon Steel Compromise Joint Bars
ASTM A 53/A 53M-02	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 65-01	Standard Specification for Steel Track Spikes
ASTM A 66-01	Standard Specification for Steel Screw Spikes
ASTM A 67-00	Standard Specification for Steel Tie Plates, Low-Carbon and High-Carbon Hot-Worked
ASTM A 74-03b	Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A 82-02	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A 90/A 90M-01	Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM A 99-03	Standard Specification for Ferromanganese
ASTM A 100-93 (2000)	Standard Specification for Ferrosilicon
ASTM A 101-93 (2000)	Standard Specification for Ferrochromium
ASTM A 102-93 (2000)	Standard Specification for Ferrovanadium
ASTM A 105/A 105M-03	Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A 106-02a	Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 108-03	Standard Specification for Steel Bars, Carbon and Alloy, Cold-Finished
ASTM A 109/A 109M-03	Standard Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled
ASTM A 111-99a	Standard Specification for Zinc-Coated (Galvanized) Iron Telephone and Telegraph Line Wire
ASTM A 116-00	Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A 121-99	Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A 123/A 123M-02	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 125-96 (2001)	Standard Specification for Steel Springs, Helical, Heat-Treated
ASTM A 126-95 (2001)	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 128/A 128M-93 (2003)	Standard Specification for Steel Castings, Austenitic Manganese
ASTM A 131/A 131M-01	Standard Specification for Structural Steel for Ships
ASTM A 132-89 (2000)	Standard Specification for Ferromolybdenum
ASTM A 134-96 (2001)	Standard Specification for Pipe, Steel, Electric-Fusion (Arc)-Welded (Sizes NPS 16 and Over)
ASTM A 135-01	Standard Specification for Electric-Resistance-Welded Steel Pipe
ASTM A 139-00	Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
ASTM A 143/A 143M-03	Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A 144-02	Specification for Ferrotungsten
ASTM A 146-64 (2000)	Standard Specification for Molybdenum Oxide Products
ASTM A 148/A 148M-03	Standard Specification for Steel Castings, High Strength, for Structural Purposes
ASTM A 153/A 153M-03	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 159-83 (2001)	Standard Specification for Automotive Gray Iron Castings
ASTM A 167-99	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 176-99	Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 178/A 178M-02	Standard Specification for Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes
ASTM A 179/A 179M-90a (2001)	Standard Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes
ASTM A 181/A 181M-01	Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
ASTM A 182/A 182M-02	Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A 183-03	Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A 184/A 184M-01	Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185-02	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

Designation	Title
ASTM A 192/A 192M-02	Standard Specification for Seamless Carbon Steel Boiler Tubes for High-Pressure Service
ASTM A 193/A 193M-03	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M-03b	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A 197/A 197M-00	Standard Specification for Cupola Malleable Iron
ASTM A 202/A 202M-03	Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Manganese-Silicon
ASTM A 203/A 203M-97 (2003)	Standard Specification for Pressure Vessel Plates, Alloy Steel, Nickel
ASTM A 204/A 204M-03	Standard Specification for Pressure Vessel Plates, Alloy Steel, Molybdenum
ASTM A 209/A 209M-03	Standard Specification for Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes
ASTM A 210/A 210M-02	Standard Specification for Seamless Medium-Carbon Steel Boiler and Superheater Tubes
ASTM A 213/A 213M-03c	Standard Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
ASTM A 214/A 214M-96 (2001)	Standard Specification for Electric-Resistance-Welded Carbon Steel Heat-Exchanger and Condenser Tubes
ASTM A 216/A 216M-93 (2003)	Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High- Temperature Service
ASTM A 217/A 217M-02	Standard Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure- Containing Parts, Suitable for High-Temperature Service
ASTM A 220/A 220M-99	Standard Specification for Pearlitic Malleable Iron
ASTM A 225/A 225M-03	Standard Specification for Pressure Vessel Plates, Alloy Steel, Manganese-Vanadium-Nickel
ASTM A 227/A 227M-99	Standard Specification for Steel Wire, Cold-Drawn for Mechanical Springs
ASTM A 228/A 228M-02	Standard Specification for Steel Wire, Music Spring Quality
ASTM A 229/A 229M-99	Standard Specification for Steel Wire, Oil-Tempered for Mechanical Springs
ASTM A 230/A 230M-99	Standard Specification for Steel Wire, Oil-Tempered Carbon Valve Spring Quality
ASTM A 231/A 231M-96(2002)	Standard Specification for Chromium-Vanadium Alloy Steel Spring Wire
ASTM A 232/A 232M-99	Standard Specification for Chromium-Vanadium Alloy Steel Valve Spring Quality Wire
ASTM A 234/A 234M-03	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 239-95 (1999)	Standard Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles
ASTM A 240/A 240M-03c	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A 242/A 242M-03a	Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A 247-67 (1998)	Standard Test Method for Evaluating the Microstructure of Graphite in Iron Castings
ASTM A 249/A 249M-03a	Standard Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes
ASTM A 250/A 250M-95 (2001)	Standard Specification for Electric-Resistance-Welded Ferritic Alloy-Steel Boiler and Superheater Tubes
ASTM A 252-98 (2002)	Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM A 254-97 (2002)	Standard Specification for Copper-Brazed Steel Tubing
ASTM A 255-02	Standard Test Method for Determining Hardenability of Steel
ASTM A 262-02a	Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
ASTM A 263-03	Standard Specification for Stainless Chromium Steel-Clad Plate
ASTM A 264-03	Standard Specification for Stainless Chromium-Nickel Steel-Clad Plate
ASTM A 265-03	Standard Specification for Nickel and Nickel-Base Alloy-Clad Steel Plate
ASTM A 266/A 266M-03a	Standard Specification for Carbon Steel Forgings for Pressure Vessel Components
ASTM A 268/A 268M-03	Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
ASTM A 269-02a	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A 270-03a	Standard Specification for Seamless and Welded Austenitic Stainless Steel Sanitary Tubing
ASTM A 275/A 275M-98 (2003)	Standard Test Method for Magnetic Particle Examination of Steel Forgings
ASTM A 276-03	Standard Specification for Stainless Steel Bars and Shapes
ASTM A 278/A 278M-01	Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650°F (350°C)
ASTM A 283/A 283M-03	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 285/A 285M-03	Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength
ASTM A 288-91 (2003)	Standard Specification for Carbon and Alloy Steel Forgings for Magnetic Retaining Rings for Turbine Generators
ASTM A 289/A 289M-97 (2003)	Standard Specification for Alloy Steel Forgings for Nonmagnetic Retaining Rings for Generators
ASTM A 290-02	Standard Specification for Carbon and Alloy Steel Forgings for Rings for Reduction Gears

Designation	Title
ASTM A 291-03	Standard Specification for Steel Forgings, Carbon and Alloy, for Pinions, Gears and Shafts for Reduction Gears
ASTM A 295-98	Standard Specification for High-Carbon Anti-Friction Bearing Steel
ASTM A 297/A 297M-97 (2003)	Standard Specification for Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for General Application
ASTM A 299/A 299M-02	Standard Specification for Pressure Vessel Plates, Carbon Steel, Manganese-Silicon
ASTM A 302/A 302M-03	Standard Specification for Pressure Vessel Plates, Alloy Steel, Manganese-Molybdenum and Manganese-Molybdenum-Nickel
ASTM A 304-02	Standard Specification for Carbon and Alloy Steel Bars Subject to End-Quench Hardenability Requirements
ASTM A 307-03	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 308/A 308M-03	Standard Specification for Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot-Dip Process
ASTM A 309-01	Standard Test Method for Weight and Composition of Coating on Terne Sheet by the Triple-Spot Test
ASTM A 311/A 311M-95 (2000)	Standard Specification for Cold-Drawn, Stress-Relieved Carbon Steel Bars Subject to Mechanical Property Requirements
ASTM A 312/A 312M-03	Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 313/A 313M-03	Standard Specification for Stainless Steel Spring Wire
ASTM A 314-97 (2002)	Standard Specification for Stainless Steel Billets and Bars for Forging
ASTM A 319-71 (2001)	Standard Specification for Gray Iron Castings for Elevated Temperatures for Non-Pressure Containing Parts
ASTM A 320/A 320M-03	Standard Specification for Alloy/Steel Bolting Materials for Low-Temperature Service
ASTM A 321-90 (2001)	Standard Specification for Steel Bars, Carbon, Quenched and Tempered
ASTM A 322-91 (2001)	Standard Specification for Steel Bars, Alloy, Standard Grades
ASTM A 323-93 (2000)	Standard Specification for Ferroboron
ASTM A 324-73 (2000)	Standard Specification for Ferrotitanium
ASTM A 325M-00	Standard Specification for High-Strength Bolts for Structural Steel Joints [Metric]
ASTM A 325-02	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 327M-91 (1997)	Standard Test Methods for Impact Testing of Cast Irons (Metric)
ASTM A 327-91 (1997)	Standard Test Methods for Impact Testing of Cast Irons
ASTM A 328/A 328M-03	Standard Specification for Steel Sheet Piling
ASTM A 331-95 (2000)	Standard Specification for Steel Bars, Alloy, Cold-Finished
ASTM A 333/A 333M-99	Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service
ASTM A 334/A 334M-99	Standard Specification for Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service
ASTM A 335/A 335M-03	Standard Specification for Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
ASTM A 336/A 336M-03a	Standard Specification for Alloy Steel Forgings for Pressure and High-Temperature Parts
ASTM A 338-84 (1998)	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 A 340-03a	Standard Terminology of Symbols and Definitions Relating to Magnetic Testing
ASTM A 341/A 341M-00	Standard Test Method for Direct Current Magnetic Properties of Materials Using D-C Permeameters and the Ballistic Test Methods
ASTM A 342/A 342M-99	Standard Test Methods for Permeability of Feebly Magnetic Materials
ASTM A 343/ A 343M-03	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 A 345-98	Standard Specification for Flat-Rolled Electrical Steels for Magnetic Applications
ASTM A 348/A 348M-00	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 A 350/A 350M-02b	Standard Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components
ASTM A 351/A 351M-03	Standard Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
ASTM A 352/A 352M-03	Standard Specification for Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service
ASTM A 353/A 353M-93 (1999)	Standard Specification for Pressure Vessel Plates, Alloy Steel, 9 Percent Nickel, Double-Normalized and Tempered
ASTM A 354-03a	Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
ASTM A 355-89 (2000)	Standard Specification for Steel Bars, Alloys, for Nitriding
ASTM A 356/A 356M-98 (2003)	Standard Specification for Steel Castings, Carbon, Low Alloy, and Stainless Steel, Heavy-Walled for Steam Turbines
ASTM A 358/A 358M-01	Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service
ASTM A 363-03	Standard Specification for Zinc-Coated (Galvanized) Steel Overhead Ground Wire Strand
ASTM A 367-60 (1999)	Standard Test Methods of Chill Testing of Cast Iron

Designation	Title
ASTM A 368-95a (2000)	Standard Specification for Stainless Steel Wire Strand
ASTM A 369/A 369M-02	Standard Specification for Carbon and Ferritic Alloy Steel Forged and Bored Pipe for High-Temperature Service
ASTM A 370-03a	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 372/A 372M-03	Standard Specification for Carbon and Alloy Steel Forgings for Thin-Walled Pressure Vessels
ASTM A 376/A 376M-02a	Standard Specification for Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service
ASTM A 377-03	Standard Index of Specifications for Ductile-Iron Pressure Pipe
ASTM A 380-99e1	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A 381-96 (2001)	Standard Specification for Metal-Arc-Welded Steel Pipe for Use With High-Pressure Transmission Systems
ASTM A 384/ A 384M-02	Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A 385-03	Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A 387/A 387M-03	Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
ASTM A 388/A 388M-03	Standard Practice for Ultrasonic Examination of Heavy Steel Forgings
ASTM A 389/A 389M-03	Standard Specification for Steel Castings, Alloy, Specially Heat-Treated, for Pressure-Containing Parts, Suitable for High-Temperature Service
ASTM A 390-95 (2001)	Standard Specification for Zinc-Coated (Galvanized) Steel Poultry Fence Fabric (Hexagonal and Straight Line)
ASTM A 391/A 391M-01	Standard Specification for Grade 80 Alloy Steel Chain
ASTM A 392-03	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 394-00	Standard Specification for Steel Transmission Tower Bolts, Zinc-Coated and Bare
ASTM A 395/A 395M-99	Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
ASTM A 400-69 (2000)	Standard Practice for Steel Bars, Selection Guide, Composition, and Mechanical Properties
ASTM A 401/A 401M-03	Standard Specification for Steel Wire, Chromium-Silicon Alloy
ASTM A 403/A 403M-03a	Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
ASTM A 407-93 (1998)	Standard Specification for Steel Wire, Cold-Drawn, for Coiled-Type Springs
ASTM A 409/A 409M-01	Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service
ASTM A 411-03	Standard Specification for Zinc-Coated (Galvanized) Low-Carbon Steel Armor Wire
ASTM A 413/A 413M-01	Standard Specification for Carbon Steel Chain
ASTM A 414/A 414M-01	Standard Specification for Steel, Sheet, Carbon, for Pressure Vessels
ASTM A 416/A 416M-02	Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM A 417-93 (1998)	Standard Specification for Steel Wire, Cold-Drawn, for Zig-Zag, Square-Formed, and Sinuous-Type Upholstery Spring Units
ASTM A 418-99 (2003)	Standard Test Method for Ultrasonic Examination of Turbine and Generator Steel Rotor Forgings
ASTM A 420/A 420M-03	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service
ASTM A 421/A 421M-02	Standard Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete
ASTM A 423/A 423M-95 (2000)	Standard Specification for Seamless and Electric-Welded Low-Alloy Steel Tubes
ASTM A 424-00	Standard Specification for Steel, Sheet, for Porcelain Enameling
ASTM A 426/A 426M-02	Standard Specification for Centrifugally Cast Ferritic Alloy Steel Pipe for High-Temperature Service
ASTM A 427-02	Standard Specification for Wrought Alloy Steel Rolls for Cold and Hot Reduction
ASTM A 428/A 428M-01	Standard Test Method for Weight [Mass] of Coating on Aluminum-Coated Iron or Steel Articles
ASTM A 434-90a (2000)	Standard Specification for Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered
ASTM A 435/A 435M-90 (2001)	Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates
ASTM A 436-84 (2001)	Standard Specification for Austenitic Gray Iron Castings
ASTM A 437/A 437M-01a	Standard Specification for Alloy-Steel Turbine-Type Bolting Material Specially Heat Treated for High-Temperature Service
ASTM A 439-83 (1999)	Standard Specification for Austenitic Ductile Iron Castings
ASTM A 447/A 447M-93 (2003)	Standard Specification for Steel Castings, Chromium-Nickel-Iron Alloy (25-12 Class), for High-Temperature Service
ASTM A 449-00	Standard Specification for Quenched and Tempered Steel Bolts and Studs
ASTM A 450/A 450M-03	Standard Specification for General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes
ASTM A 451/A 451M-02	Standard Specification for Centrifugally Cast Austenitic Steel Pipe for High-Temperature Service
ASTM A 453/A 453M-03	Standard Specification for High-Temperature Bolting Materials, with Expansion Coefficients Comparable to Austenitic Stainless Steels
ASTM A 455/A 455M-03	Standard Specification for Pressure Vessel Plates, Carbon Steel, High-Strength Manganese
ASTM A 456/A 456M-99 (2003)	Standard Specification for Magnetic Particle Examination of Large Crankshaft Forgings

Designation	Title
ASTM A 459-97 (2003)	Standard Specification for Zinc-Coated Flat Steel Armoring Tape
ASTM A 460-94 (1999)	Standard Specification for Copper-Clad Steel Wire Strand
ASTM A 463/A 463M-02a	Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 466/A 466M-01	Standard Specification for Weldless Chain
ASTM A 467/A 467M-01	Standard Specification for Machine and Coil Chain
ASTM A 469-94a (1999)	Standard Specification for Vacuum-Treated Steel Forgings for Generator Rotors
ASTM A 470-03	Standard Specification for Vacuum-Treated Carbon and Alloy Steel Forgings For Turbine Rotors and Shafts
ASTM A 471-02	Standard Specification for Vacuum-Treated Alloy Steel Forgings for Turbine Rotor Disks and Wheels
ASTM A 472-98 (2003)	Standard Test Method for Heat Stability of Steam Turbine Shafts and Rotor Forgings
ASTM A 473-01	Standard Specification for Stainless Steel Forgings
ASTM A 474-03	Standard Specification for Aluminum-Coated Steel Wire Strand
ASTM A 475-03	Standard Specification for Zinc-Coated Steel Wire Strand
ASTM A 476/A 476M-00	Standard Specification for Ductile Iron Castings for Paper Mill Dryer Rolls
ASTM A 478-97 (2002)	Standard Specification for Chromium-Nickel Stainless Steel Weaving and Knitting Wire
ASTM A 479/A 479M-03	Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
ASTM A 480/A 480M-03c	Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A 481-94 (2000)	Standard Specification for Chromium Metal
ASTM A 482-93 (2000)	Standard Specification for Ferrochrome-Silicon
ASTM A 483-64 (2000)	Standard Specification for Silicomanganese
ASTM A 484/A 484M-03a	Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings
ASTM A 485-03	Standard Specification for High Hardenability Antifriction Bearing Steel
ASTM A 487/A 487M-93 (2003)	Standard Specification for Steel Castings Suitable for Pressure Service
ASTM A 488/A 488M-01	Standard Practice for Steel Castings, Welding, Qualifications of Procedures and Personnel
ASTM A 489-03	Standard Specification for Carbon Steel Lifting Eyes
ASTM A 490M-03	Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints [Metric]
ASTM A 490-02	Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A 491-03	Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A 492-95 (2000)	Standard Specification for Stainless Steel Rope Wire
ASTM A 493-95 (2000)	Standard Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging
ASTM A 494/A 494M-03a	Standard Specification for Castings, Nickel and Nickel Alloy
ASTM A 495-94 (2000)	Standard Specification for Calcium-Silicon Alloys
ASTM A 496-02	Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497/A 497M-02	Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete
ASTM A 498-98	Standard Specification for Seamless and Welded Carbon, Ferritic, and Austenitic Alloy Steel Heat-Exchanger Tubes with Integral Fins
ASTM A 499-89 (2002)	Standard Specification for Steel Bars and Shapes, Carbon Rolled from "T" Rails
ASTM A 500-03a	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501-01	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 502-03	Standard Specification for Rivets, Steel, Structural
ASTM A 503/A 503M-01(2001)	Standard Specification for Ultrasonic Examination of Large Forged Crankshafts
ASTM A 504-93 (1999)	Standard Specification for Wrought Carbon Steel Wheels
ASTM A 505-00	Standard Specification for Steel, Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A 506-00	Standard Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled
ASTM A 507-00	Standard Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled
ASTM A 508/A 508M-03	Standard Specification for Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels
ASTM A 510M-03	Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel [Metric]
ASTM A 510-03	Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
ASTM A 511-96	Standard Specification for Seamless Stainless Steel Mechanical Tubing
ASTM A 512-96 (2001)	Standard Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing
ASTM A 513-00	Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
ASTM A 514/A 514M-00a	Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 515/A 515M-03	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516/A 516M-03	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

Designation	Title
ASTM A 517/A 517M-93 (1999)	Standard Specification for Pressure Vessel Plates, Alloy Steel, High-Strength, Quenched and Tempered
ASTM A 518/A 518M-99 (2003)	Standard Specification for Corrosion-Resistant High-Silicon Iron Castings
ASTM A 519-03	Standard Specification for Seamless Carbon and Alloy Steel Mechanical Tubing
ASTM A 521-03	Standard Specification for Steel, Closed-Impression Die Forgings for General Industrial Use
ASTM A 522/A 522M-01	Standard Specification for Forged or Rolled 8 and 9% Nickel Alloy Steel Flanges, Fittings, Valves, and Parts for Low-Temperature Service
ASTM A 523-96 (2001)	Standard Specification for Plain End Seamless and Electric-Resistance-Welded Steel Pipe for High-Pressure Pipe-Type Cable Circuits
ASTM A 524-96 (2001)	Standard Specification for Seamless Carbon Steel Pipe for Atmospheric and Lower Temperatures
ASTM A 529/A 529M-03	Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 530/A 530M-03	Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe
ASTM A 531/A 531M-91 (2001)	Standard Practice for Ultrasonic Examination of Turbine-Generator Steel Retaining Rings
ASTM A 532/A 532M-93a (2003)	Standard Specification for Abrasion-Resistant Cast Irons
ASTM A 533/A 533M-93 (1999)	Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered, Manganese-Molybdenum and Manganese-Molybdenum-Nickel
ASTM A 534-01	Standard Specification for Carburizing Steels for Anti-Friction Bearings
ASTM A 536-84 (1999)	Standard Specification for Ductile Iron Castings
ASTM A 537/A 537M-95 (2000)	Standard Specification for Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel
ASTM A 540/A 540M-00	Standard Specification for Alloy-Steel Bolting Materials for Special Applications
ASTM A 541/A 541M-95 (1999)	Standard Specification for Quenched and Tempered Carbon and Alloy Steel Forgings for Pressure Vessel Components
ASTM A 542/A 542M-99	Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched-and-Tempered, Chromium-Molybdenum, and Chromium-Molybdenum-Vanadium
ASTM A 543/A 543M-93 (1999)	Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered Nickel-Chromium-Molybdenum
ASTM A 550-78 (2000)	Standard Specification for Ferrocolumbium
ASTM A 551-94 (1999)	Standard Specification for Steel Tires
ASTM A 553/A 553M-95 (2000)	Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered 8 and 9 Percent Nickel
ASTM A 554-03	Standard Specification for Welded Stainless Steel Mechanical Tubing
ASTM A 555/A 555M-97 (2002)	Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods
ASTM A 556/A 556M-96 (2001)	Standard Specification for Seamless Cold-Drawn Carbon Steel Feedwater Heater Tubes
ASTM A 560/A 560M-93 (1998)	Standard Specification for Castings, Chromium-Nickel Alloy
ASTM A 561-71 (1999)	Standard Recommended Practice for Macrotech Testing of Tool Steel Bars
ASTM A 562/A 562M-90 (2001)	Standard Specification for Pressure Vessel Plates, Carbon Steel, Manganese-Titanium for Glass or Diffused Metallic Coatings
ASTM A 563M-03	Standard Specification for Carbon and Alloy Steel Nuts [Metric]
ASTM A 563-00	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 564/A 564M-02a	Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A 565-03b	Standard Specification for Martensitic Stainless Steel Bars, Forgings, and Forging Stock for High-Temperature Service
ASTM A 568/A 568M-03	Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A 571/A 571M-01	Standard Specification for Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low-Temperature Service
ASTM A 572/A 572M-03a	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 573/A 573M-00a	Standard Specification for Structural Carbon Steel Plates of Improved Toughness
ASTM A 574M-00	Standard Specification for Alloy Steel Socket-Head Cap Screws [Metric]
ASTM A 574-00	Standard Specification for Alloy Steel Socket-Head Cap Screws
ASTM A 575-96 (2002)	Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 576-90b (2000)	Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A 577/A 577M-90 (2001)	Standard Specification for Ultrasonic Angle-Beam Examination of Steel Plates
ASTM A 578/A 578M-96 (2001)	Standard Specification for Straight-Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications
ASTM A 579-01	Standard Specification for Superstrength Alloy Steel Forgings
ASTM A 580/A 580M-98	Standard Specification for Stainless Steel Wire
ASTM A 581/A 581M-95b (2000)	Standard Specification for Free-Machining Stainless Steel Wire and Wire Rods
ASTM A 582/A 582M-95b (2000)	Standard Specification for Free-Machining Stainless Steel Bars
ASTM A 586-98	Standard Specification for Zinc-Coated Parallel and Helical Steel Wire Structural Strand and Zinc-Coated Wire for Spun-In-Place Structural Strand
ASTM A 587-96 (2001)	Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry

Designation	Title
ASTM A 588/A 588M-03	Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi [345 MPa] Minimum Yield Point to 4-in. [100 mm] Thick
ASTM A 589-96 (2001)	Standard Specification for Seamless and Welded Carbon Steel Water-Well Pipe
ASTM A 591/A 591M-98	Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Weight [Mass] Applications
ASTM A 592/A 592M-89 (1999)	Standard Specification for High-Strength Quenched and Tempered Low-Alloy Steel Forged Fittings and Parts for Pressure Vessels
ASTM A 595-98 (2002)	Standard Specification for Steel Tubes, Low-Carbon, Tapered for Structural Use
ASTM A 596/A 596M-95 (1999)	Standard Test Method for Direct-Current Magnetic Properties of Materials Using the Ballistic Method and Ring Specimens
ASTM A 597-87 (1999)	Standard Specification for Cast Tool Steel
ASTM A 598/A 598M-02	Standard Test Method for Magnetic Properties Of Magnetic Amplifier Cores
ASTM A 599/A 599M-02	Standard Specification for Tin Mill Products, Electrolytic Tin-Coated, Cold-Rolled Sheet
ASTM A 600-92a (1999)	Standard Specification for Tool Steel High Speed
ASTM A 601-96 (2000)	Standard Specification for Electrolytic Manganese Metal
ASTM A 602-94 (1998)	Standard Specification for Automotive Malleable Iron Castings
ASTM A 603-98 (2003)	Standard Specification for Zinc-Coated Steel Structural Wire Rope
ASTM A 604-93 (2003)	Standard Test Method for Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets
ASTM A 606-01	Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 608/A 608M-02	Standard Specification for Centrifugally Cast Iron-Chromium-Nickel High-Alloy Tubing for Pressure Application at High Temperatures
ASTM A 609/A 609M-91 (2002)	Standard Practice for Castings, Carbon, Low-Alloy, and Martensitic Stainless Steel, Ultrasonic Examination Thereof
ASTM A 610-79 (2000)	Standard Test Methods for Sampling and Testing Ferroalloys for Determination of Size
ASTM A 612/A 612M-03	Standard Specification for Pressure Vessel Plates, Carbon Steel, High Strength, for Moderate and Lower Temperature Service
ASTM A 615/A 615M-04	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 618-01	Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 623M-03	Standard Specification for Tin Mill Products, General Requirements [Metric]
ASTM A 623-03	Standard Specification for Tin Mill Products, General Requirements
ASTM A 624/A 624M-03	Standard Specification for Tin Mill Products, Electrolytic Tin Plate, Single Reduced
ASTM A 625/A 625M-03	Standard Specification for Tin Mill Products, Black Plate, Single Reduced
ASTM A 626/A 626M-03	Standard Specification for Tin Mill Products, Electrolytic Tin Plate, Double Reduced
ASTM A 627-03	Standard Test Methods for Tool-Resisting Steel Bars, Flats, and Shapes for Detention and Correctional Facilities
ASTM A 629-88 (1994)	Standard Specification for Tool-Resisting Steel Flat Bars and Shapes for Security Applications
ASTM A 630-03	Standard Test Methods for Determination of Tin Coating Weights for Electrolytic Tin Plate
ASTM A 632-02a	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service
ASTM A 633/A 633M-01	Standard Specification for Normalized High-Strength Low-Alloy Structural Steel Plates
ASTM A 635/A 635M-02	Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Commercial Steel, Drawing Steel, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, Hot-Rolled, General Requirements for
ASTM A 636-76 (2000)	Standard Specification for Nickel Oxide Sinter
ASTM A 638/A 638M-00	Standard Specification for Precipitation Hardening Iron Base Superalloy Bars, Forgings, and Forging Stock for High-Temperature Service
ASTM A 640-97 (2002)	Standard Specification for Zinc-Coated Steel Strand for Messenger Support of Figure 8 Cable
ASTM A 641/A 641M-03	Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 644-98 (2003)	Standard Terminology Relating to Iron Castings
ASTM A 645/A 645M-99a	Standard Specification for Pressure Vessel Plates, Five Percent Nickel Alloy Steel, Specially Heat Treated
ASTM A 646-95 (1999)	Standard Specification for Premium Quality Alloy Steel Blooms and Billets for Aircraft and Aerospace Forgings
ASTM A 648-95 (2000)	Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Pipe
ASTM A 649/A 649M-99 (2003)	Standard Specification for Forged Steel Rolls Used for Corrugating Paper Machinery
ASTM A 650/A 650M-03	Standard Specification for Tin Mill Products, Black Plate, Double Reduced
ASTM A 653/A 653M-03	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 656/A 656M-03	Standard Specification for Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability
ASTM A 657/A 657M-03	Standard Specification for Tin Mill Products, Black Plate Electrolytic Chromium-Coated, Single and Double Reduced
ASTM A 659/A 659M-97 (2001)	Standard Specification for Commercial Steel (CS), Sheet and Strip, Carbon (0.16 Maximum to 0.25 Maximum Percent), Hot-Rolled

Designation	Title
ASTM A 660-96 (2001)	Standard Specification for Centrifugally Cast Carbon Steel Pipe for High-Temperature Service
ASTM A 662/A 662M-03	Standard Specification for Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service
ASTM A 663/A 663M-89 (2000)	Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties
ASTM A 664-99	Standard Practice for Identification of Standard Electrical Steel Grades in ASTM Specifications
ASTM A 666-03	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A 667/A 667M-87 (2003)	Standard Specification for Centrifugally Cast Dual Metal (Gray and White Cast Iron) Cylinders
ASTM A 668/A 668M-03	Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A 671-96 (2001)	Standard Specification for Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures
ASTM A 672-96 (2001)	Standard Specification for Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures
ASTM A 673/A 673M-02	Standard Specification for Sampling Procedure for Impact Testing of Structural Steel
ASTM A 674-00	Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids
ASTM A 675/A 675M-03	Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 677/A 677M-99	Standard Specification for Nonoriented Electrical Steel Fully Processed Types
ASTM A 678/A 678M-00a	Standard Specification for Quenched-and-Tempered Carbon and High-Strength Low-Alloy Structural Steel Plates
ASTM A 679/A 679M-00	Standard Specification for Steel Wire, High Tensile Strength, Cold Drawn
ASTM A 681-94 (1999)	Standard Specification for Tool Steels Alloy
ASTM A 682/A 682M-02	Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled, General Requirements For
ASTM A 683/A 683M-99	Standard Specification for Nonoriented Electrical Steel, Semiprocessed Types
ASTM A 684/A 684M-86 (2002)	Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled
ASTM A 686-92 (1999)	Standard Specification for Tool Steel, Carbon
ASTM A 688/A 688M-03	Standard Specification for Welded Austenitic Stainless Steel Feedwater Heater Tubes
ASTM A 689-97 (2002)	Standard Specification for Carbon and Alloy Steel Bars for Springs
ASTM A 690/A 690M-00a	Standard Specification for High-Strength Low-Alloy Steel H-Piles and Sheet Piling for Use in Marine Environments
ASTM A 691-98 (2002)	Standard Specification for Carbon and Alloy Steel Pipe, Electric-Fusion-Welded for High-Pressure Service at High Temperatures
ASTM A 693-03	Standard Specification for Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A 694/A 694M-03	Standard Specification for Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service
ASTM A 696-90a (2000)	Standard Specification for Steel Bars, Carbon, Hot-Wrought or Cold-Finished, Special Quality, for Pressure Piping Components
ASTM A 697/A 697M-03	Standard Test Method for Alternating Current Magnetic Properties of Laminated Core Specimen Using Voltmeter-Ammeter-Wattmeter Methods
ASTM A 698/A 698M-02	Standard Test Method for Magnetic Shield Efficiency in Attenuating Alternating Magnetic Fields
ASTM A 700-99e1	Standard Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment
ASTM A 701-96 (2000)	Standard Specification for Ferromanganese-Silicon
ASTM A 702-89 (2000)	Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought
ASTM A 703/A 703M-03	Standard Specification for Steel Castings, General Requirements, for Pressure-Containing Parts
ASTM A 704/A 704M-01	Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
ASTM A 705/A 705M-95 (2000)	Standard Specification for Age-Hardening Stainless Steel Forgings
ASTM A 706/A 706M-04	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 707/A 707M-02	Standard Specification for Forged Carbon and Alloy Steel Flanges for Low-Temperature Service
ASTM A 709/A 709M-03a	Standard Specification for Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges
ASTM A 710/A 710M-02	Standard Specification for Age-Hardening Low-Carbon Nickel-Copper-Chromium-Molybdenum-Columbium Alloy Structural Steel Plates
ASTM A 711-03	Standard Specification for Steel Forging Stock
ASTM A 712-97 (2002)	Standard Test Method for Electrical Resistivity of Soft Magnetic Alloys
ASTM A 713-93 (1998)	Standard Specification for Steel Wire, High-Carbon Spring, for Heat-Treated Components
ASTM A 714-99 (2003)	Standard Specification for High-Strength Low-Alloy Welded and Seamless Steel Pipe
ASTM A 716-03	Standard Specification for Ductile Iron Culvert Pipe
ASTM A 717/A 717M-01	Standard Test Method for Surface Insulation Resistivity of Single-Strip Specimens
ASTM A 719/A 719M-02	Standard Test Method for Lamination Factor of Magnetic Materials
ASTM A 720/A 720M-02	Standard Test Method for Ductility of Nonoriented Electrical Steel
ASTM A 721/A 721M-02	Standard Test Method for Ductility of Oriented Electrical Steel
ASTM A 722/A 722M-98 (2003)	Standard Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete
ASTM A 723/A 723M-02	Standard Specification for Alloy Steel Forgings for High-Strength Pressure Component Application
ASTM A 724/A 724M-99	Standard Specification for Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, Quenched and Tempered, for Welded Layered Pressure Vessels

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ASTM A 726-00	Standard Specification for Cold-Rolled Magnetic Lamination Quality Steel, Semiprocessed Types
ASTM A 727/A 727M-02	Standard Specification for Carbon Steel Forgings for Piping Components with Inherent Notch Toughness
ASTM A 729-93 (1999)	Standard Specification for Alloy Steel Axles, Heat-Treated, for Mass Transit and Electric Railway Service
ASTM A 730-93 (1999)	Standard Specification for Forgings, Carbon and Alloy Steel, for Railway Use
ASTM A 732/A 732M-02	Standard Specification for Castings, Investment, Carbon and Low Alloy Steel for General Application, and Cobalt Alloy for High Strength at Elevated Temperatures
ASTM A 733-03	Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 734/A 734M-87a (2003)	Standard Specification for Pressure Vessel Plates, Alloy Steel and High-Strength Low-Alloy Steel, Quenched-and-Tempered
ASTM A 735/A 735M-03	Standard Specification for Pressure Vessel Plates, Low-Carbon Manganese-Molybdenum-Columbium Alloy Steel, for Moderate and Lower Temperature Service
ASTM A 736/A 736M-03	Standard Specification for Pressure Vessel Plates, Low-Carbon Age-Hardening Nickel-Copper-Chromium-Molybdenum-Columbium and Nickel-Copper-Manganese-Molybdenum-Columbium Alloy Steel
ASTM A 737/A 737M-99	Standard Specification for Pressure Vessel Plates, High-Strength, Low-Alloy Steel
ASTM A 738/A 738M-03a	Standard Specification for Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service
ASTM A 739-90a (2000)	Standard Specification for Steel Bars, Alloy, Hot-Wrought, for Elevated Temperature or Pressure-Containing Parts, or Both
ASTM A 740-98 (2003)	Standard Specification for Hardware Cloth (Woven or Welded Galvanized Steel Wire Fabric)
ASTM A 741-98 (2003)	Standard Specification for Zinc-Coated Steel Wire Rope and Fittings for Highway Guardrail
ASTM A 742/A 742M-03	Standard Specification for Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe
ASTM A 743/A 743M-03	Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM A 744/A 744M-00	Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service
ASTM A 745/A 745M-94 (2003)	Standard Practice for Ultrasonic Examination of Austenitic Steel Forgings
ASTM A 746-03	Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM A 747/A 747M-99	Standard Specification for Steel Castings, Stainless, Precipitation Hardening
ASTM A 748/A 748M-87 (2003)	Standard Specification for Statically Cast Chilled White Iron-Gray Iron Dual Metal Rolls for Pressure Vessel Use
ASTM A 749/A 749M-97 (2002)	Standard Specification for Steel, Strip, Carbon and High-Strength, Low-Alloy, Hot-Rolled, General Requirements for
ASTM A 750-77 (1994)	Standard Specification for Steel Air Ventilating Grille Units for Detention Areas
ASTM A 751-01	Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
ASTM A 752M-93 (2003)	Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Alloy Steel [Metric]
ASTM A 752-93 (2003)	Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Alloy Steel
ASTM A 753-02	Standard Specification for Wrought Nickel-Iron Soft Magnetic Alloys (UNS K94490, K94840, N14076, N14080)
ASTM A 754/A 754M-96 (2000)	Standard Test Method for Coating Weight (Mass) of Metallic Coatings on Steel by X-Ray Fluorescence
ASTM A 755/A 755M-03	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 A 756-94 (2001)	Standard Specification for Stainless Anti-Friction Bearing Steel
ASTM A 757/A 757M-00	Standard Specification for Steel Castings, Ferritic and Martensitic, for Pressure-Containing and Other Applications, for Low-Temperature Service
ASTM A 758/A 758M-00	Standard Specification for Wrought-Carbon Steel Butt-Welding Piping Fittings with Improved Notch Toughness
ASTM A 759-00	Standard Specification for Carbon Steel Crane Rails
ASTM A 760/A 760M-01a	Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
ASTM A 761/A 761M-03	Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
ASTM A 762/A 762M-00	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A 763-93 (1999)e1	Standard Practices for Detecting Susceptibility to Intergranular Attack in Ferritic Stainless Steels
ASTM A 764-95 (2001)	Standard Specification for Metallic Coated Carbon Steel Wire, Coated at Size and Drawn to Size for Mechanical Springs
ASTM A 765/A 765M-01	Standard Specification for Carbon Steel and Low-Alloy Steel Pressure-Vessel-Component Forgings with Mandatory Toughness Requirements
ASTM A 767/A 767M-00b	Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A 768-95 (2001)	Standard Specification for Vacuum-Treated 12% Chromium Alloy Steel Forgings for Turbine Rotors and Shafts

Designation	Title
ASTM A 769/A 769M-00	Standard Specification for Carbon and High-Strength Electric Resistance Welded Steel Structural Shapes
ASTM A 770/A 770M-03	Standard Specification for Through-Thickness Tension Testing of Steel Plates for Special Applications
ASTM A 771/A 771M-95 (2001)	Standard Specification for Seamless Austenitic and Martensitic Stainless Steel Tubing for Liquid Metal-Cooled Reactor Core Components
ASTM A 772/A 772M-00	Standard Test Method for ac Magnetic Permeability of Materials Using Sinusoidal Current
ASTM A 773/A 773M-01	Standard Test Method for dc Magnetic Properties of Materials Using Ring and Permeameter Procedures with dc Electronic Hysteresigraphs
ASTM A 774/A 774M-02	Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures
ASTM A 775/A 775M-01	Standard Specification for Epoxy-Coated Reinforcing Steel Bars
ASTM A 778-01	Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products
ASTM A 779/A 779M-00	Standard Specification for Steel Strand, Seven-Wire, Uncoated, Compacted, Stress-Relieved for Prestressed Concrete
ASTM A 780-01	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 781/A 781M-03a	Standard Specification for Castings, Steel and Alloy, Common Requirements, for General Industrial Use
ASTM A 782/A 782M-90 (2001)	Standard Specification for Pressure-Vessel Plates, Quenched-and-Tempered, Manganese-Chromium-Molybdenum-Silicon Zirconium Alloy Steel
ASTM A 786/A 786M-00b	Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM A 787-01	Standard Specification for Electric-Resistance-Welded Metallic-Coated Carbon Steel Mechanical Tubing
ASTM A 788-03a	Standard Specification for Steel Forgings, General Requirements
ASTM A 789/A 789M-02a	Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service
ASTM A 790/A 790M-03	Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe
ASTM A 792/A 792M-03	Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM A 793-96 (2001)	Standard Specification for Rolled Floor Plate, Stainless Steel
ASTM A 794-97 (2002)	Standard Specification for Commercial Steel (CS), Sheet, Carbon (0.16% Maximum to 0.25% Maximum), Cold-Rolled
ASTM A 795-00	Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM A 796/A 796M-03	Standard Practice for Structural Design of Corrugated Steel Pipe, Pipe-Arches, and Arches for Storm and Sanitary Sewers and Other Buried Applications
ASTM A 798/A 798M-01	Standard Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
ASTM A 799/A 799M-92 (2002)	Standard Practice for Steel Castings, Stainless, Instrument Calibration, for Estimating Ferrite Content
ASTM A 800/A 800M-01	Standard Practice for Steel Casting, Austenitic Alloy, Estimating Ferrite Content Thereof
ASTM A 801/A 801M-99	Standard Specification for Wrought Iron-Cobalt High Magnetic Saturation Alloys UNS R30005 and K92650
ASTM A 802/A 802M-95 (2001)	Standard Practice for Steel Castings, Surface Acceptance Standards, Visual Examination
ASTM A 803/A 803M-03	Standard Specification for Welded Ferritic Stainless Steel Feedwater Heater Tubes
ASTM A 804/A 804M-99	Standard Test Methods for Alternating-Current Magnetic Properties of Materials at Power Frequencies Using Sheet-Type Test Specimens
ASTM A 805-93 (2002)	Standard Specification for Steel, Flat Wire, Carbon, Cold-Rolled
ASTM A 807/A 807M-02e1	Standard Practice for Installing Corrugated Steel Structural Plate Pipe for Sewers and Other Applications
ASTM A 808/A 808M-00a	Standard Specification for High-Strength, Low-Alloy Carbon, Manganese, Columbium, Vanadium Steel of Structural Quality with Improved Notch Toughness
ASTM A 809-03	Standard Specification for Aluminum-Coated (Aluminized) Carbon Steel Wire
ASTM A 810-01	Standard Specification for Zinc-Coated (Galvanized) Steel Pipe Winding Mesh
ASTM A 811-03	Standard Specification for Soft Magnetic Iron Parts Fabricated by Powder Metallurgy (P/M) Techniques
ASTM A 813/A 813M-01	Standard Specification for Single- or Double-Welded Austenitic Stainless Steel Pipe
ASTM A 814/A 814M-03	Standard Specification for Cold-Worked Welded Austenitic Stainless Steel Pipe
ASTM A 815/A 815M-01a	Standard Specification for Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings
ASTM A 817-03	Standard Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcelled Tension Wire
ASTM A 818-91 (2001)	Standard Specification for Coppered Carbon Steel Wire
ASTM A 820-01	Standard Specification for Steel Fibers for Fiber-Reinforced Concrete
ASTM A 821/A 821M-99	Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks
ASTM A 822-90 (2000)	Standard Specification for Seamless Cold-Drawn Carbon Steel Tubing for Hydraulic System Service
ASTM A 823-99 (2003)	Standard Specification for Statically Cast Permanent Mold Gray Iron Castings
ASTM A 824-01	Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence

Designation	Title
ASTM A 827/A 827M-02	Standard Specification for Plates, Carbon Steel, for Forging and Similar Applications
ASTM A 829/A 829M-00	Standard Specification for Alloy Structural Steel Plates
ASTM A 830/A 830M-02	Standard Specification for Plates, Carbon Steel, Structural Quality, Furnished to Chemical Composition Requirements
ASTM A 831/A 831M-95 (2000)	Standard Specification for Austenitic and Martensitic Stainless Steel Bars, Billets, and Forgings for Liquid Metal Cooled Reactor Core Components
ASTM A 832/A 832M-99e1	Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum-Vanadium
ASTM A 833-84 (2001)	Standard Practice for Indentation Hardness of Metallic Materials by Comparison Hardness Testers
ASTM A 834-95 (2001)	Standard Specification for Common Requirements for Iron Castings for General Industrial Use
ASTM A 835-84 (2000)	Standard Specification for Sizes of Ferroalloys and Alloy Additives
ASTM A 836/A 836M-02	Standard Specification for Titanium-Stabilized Carbon Steel Forgings for Glass-Lined Piping and Pressure Vessel Service
ASTM A 837/A 837M-03	Standard Specification for Steel Forgings, Alloy, for Carburizing Applications
ASTM A 838-02	Standard Specification for Free-Machining Ferritic Stainless Soft Magnetic Alloys for Relay Applications
ASTM A 839-02	Standard Specification for Iron-Phosphorus Powder Metallurgy (P/M) Parts for Soft Magnetic Applications
ASTM A 840/A 840M-00	Standard Specification for Fully Processed Magnetic Lamination Steel
ASTM A 841/A 841M-03a	Standard Specification for Steel Plates for Pressure Vessels, Produced by Thermo-Mechanical Control Process (TMCP)
ASTM A 842-85 (1997)	Standard Specification for Compacted Graphite Iron Castings
ASTM A 844/A 844M-93 (1999)	Standard Specification for Steel Plates, 9% Nickel Alloy, for Pressure Vessels, Produced by the Direct-Quenching Process
ASTM A 845-85 (2000)	Standard Specification for Titanium Scrap for Use in Deoxidation and Alloying of Steel
ASTM A 846-85 (2000)	Standard Specification for Aluminum Scrap for Use in Deoxidation and Alloying of Steel
ASTM A 847-99a (2003)	Standard Specification for Cold-Formed Welded and Seamless High Strength, Low Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance
ASTM A 848-01	Standard Specification for Low-Carbon Magnetic Iron
ASTM A 849-00	Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
ASTM A 852/A 852M-03	Standard Specification for Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi [485 MPa] Minimum Yield Strength to 4 in. [100 mm] Thick
ASTM A 853-93 (2003)	Standard Specification for Steel Wire, Carbon, for General Use
ASTM A 854/A 854M-98 (2003)	Standard Specification for Metallic-Coated Steel Smooth High-Tensile Fence and Trellis Wire
ASTM A 855/A 855M-03	Standard Specification for Zinc-5% Aluminum-Mischmetal Alloy-Coated Steel Wire Strand
ASTM A 856/A 856M-03	Standard Specification for Zinc-5% Aluminum-Mischmetal Alloy-Coated Carbon Steel Wire
ASTM A 857/A 857M-00a	Standard Specification for Steel Sheet Piling, Cold Formed, Light Gage
ASTM A 858/A 858M-00	Standard Specification for Heat-Treated Carbon Steel Fittings for Low-Temperature and Corrosive Service
ASTM A 859/A 859M-02	Standard Specification for Age-Hardening Alloy Steel Forgings for Pressure Vessel Components
ASTM A 860/A 860M-00	Standard Specification for Wrought High-Strength Low-Alloy Steel Butt-Welding Fittings
ASTM A 861-02	Standard Specification for High-Silicon Iron Pipe and Fittings
ASTM A 862/A 862M-98	Standard Practice for Application of Asphalt Coatings to Corrugated Steel Sewer and Drainage Pipe
ASTM A 865-03	Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints
ASTM A 866-01	Standard Specification for Medium Carbon Anti-Friction Bearing Steel
ASTM A 867-03	Standard Specification for Iron-Silicon Relay Steels
ASTM A 871/A 871M-03	Standard Specification for High-Strength Low-Alloy Structural Steel Plate With Atmospheric Corrosion Resistance
ASTM A 872/A 872M-02	Standard Specification for Centrifugally Cast Ferritic/Austenitic Stainless Steel Pipe for Corrosive Environments
ASTM A 874/A 874M-98	Standard Specification for Ferritic Ductile Iron Castings Suitable for Low-Temperature Service
ASTM A 875/A 875M-02a	Standard Specification for Steel Sheet, Zinc-5% Aluminum Alloy-Coated by the Hot-Dip Process
ASTM A 876-03	Standard Specification for Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types
ASTM A 877/A 877M-99	Standard Specification for Steel Wire, Chromium-Silicon Alloy Valve Spring Quality
ASTM A 878/A 878M-99	Standard Specification for Steel Wire, Modified Chromium Vanadium Valve Spring Quality

Designation	Title
ASTM A 879-00	Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
ASTM A 880-95	Standard Practice for Criteria for Use in Evaluation of Testing Laboratories and Organizations for Examination and Inspection of Steel, Stainless Steel, and Related Alloys
ASTM A 881/A 881M-02	Standard Specification for Steel Wire, Deformed, Stress-Relieved or Low-Relaxation for Prestressed Concrete Railroad Ties
ASTM A 882/A 882M-02a	Standard Specification for Filled Epoxy-Coated Seven-Wire Prestressing Steel Strand
ASTM A 883/A 883M-01	Standard Test Method for Ferrimagnetic Resonance Linewidth and Gyromagnetic Ratio of Nonmetallic Magnetic Materials
ASTM A 884/A 884M-02	Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement
ASTM A 885/A 885M-96 (2002)	Standard Specification for Steel Sheet, Zinc and Aramid Fiber Composite Coated for Corrugated Steel Sewer, Culvert, and Underdrain Pipe
ASTM A 886/A 886M-02	Standard Specification for Steel Strand, Indented, Seven-Wire Stress-Relieved for Prestressed Concrete
ASTM A 887-89 (2000)	Standard Specification for Borated Stainless Steel Plate, Sheet, and Strip for Nuclear Application
ASTM A 888-03	Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM A 889/A 889M-03	Standard Test Method for Alternating-Current Magnetic Properties of Materials at Low Inductions Using the Wattmeter-Varmeter-Ammeter-Voltmeter Method and 25-cm (250-mm) Epstein Frame
ASTM A 890/A 890M-99 (2003)	Standard Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Application
ASTM A 891-98 (2003)	Standard Specification for Precipitation Hardening Iron Base Superalloy Forgings for Turbine Rotor Disks and Wheels
ASTM A 892-88 (2001)	Standard Guide for Defining and Rating the Microstructure of High Carbon Bearing Steels
ASTM A 893/A 893M-03	Standard Test Method for Complex Dielectric Constant of Nonmetallic Magnetic Materials at Microwave Frequencies
ASTM A 894/A 894M-00	Standard Test Method for Saturation Magnetization or Induction of Nonmetallic Magnetic Materials
ASTM A 895-89 (2000)	Standard Specification for Free-Machining Stainless Steel Plate, Sheet, and Strip
ASTM A 896-89 (1999)	Standard Practice for Conducting Case Studies on Galvanized Structures
ASTM A 897/A 897M-03	Standard Specification for Austempered Ductile Iron Castings
ASTM A 898/A 898M-91 (2001)	Standard Specification for Straight Beam Ultrasonic Examination of Rolled Steel Structural Shapes
ASTM A 899-91 (2002)	Standard Specification for Steel Wire, Epoxy-Coated
ASTM A 900/A 900M-01	Standard Test Method for Lamination Factor of Amorphous Magnetic Strip
ASTM A 901-03	Standard Specification for Amorphous Magnetic Core Alloys, Semi-Processed Types
ASTM A 902-03	Standard Terminology Relating to Metallic Coated Steel Products
ASTM A 903/A 903M-99 (2003)	Standard Specification for Steel Castings, Surface Acceptance Standards, Magnetic Particle and Liquid Penetrant Inspection
ASTM A 904-98	Standard Specification for 50 Nickel-50 Iron Powder Metallurgy (P/M) Soft Magnetic Alloys
ASTM A 905-93 (1998)	Standard Specification for Steel Wire, Pressure Vessel Winding
ASTM A 906/A 906M-02	Standard Specification for Grade 80 and Grade 100 Alloy Steel Chain Slings for Overhead Lifting
ASTM A 908-03	Standard Specification for Stainless Steel Needle Tubing
ASTM A 909-03	Standard Specification for Steel Forgings, Microalloy, for General Industrial Use
ASTM A 910/A 910M-99	Standard Specification for Uncoated, Weldless, 2- and 3-Wire Steel Strand for Prestressed Concrete
ASTM A 911/A 911M-02	Standard Specification for Uncoated, Stress-Relieved Steel Bars for Prestressed Concrete Ties
ASTM A 912-93 (1998)	Standard Test Method for Alternating-Current Magnetic Properties of Amorphous Materials at Power Frequencies Using Wattmeter-Ammeter-Voltmeter Method with Toroidal Specimens
ASTM A 913/A 913M-03	Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST)
ASTM A 914/A 914M-92 (1999)e1	Standard Specification for Steel Bars Subject to Restricted End-Quench Hardenability Requirements
ASTM A 915/A 915M-93 (2003)	Standard Specification for Steel Castings, Carbon, and Alloy, Chemical Requirements Similar to Standard Wrought Grades
ASTM A 917-00	Standard Specification for Steel Sheet, Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface (General Requirements)
ASTM A 918-00	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 A 920/A 920M-02a	Standard Specification for Steel Bars, Microalloy, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 921/A 921M-93 (1999)	Standard Specification for Steel Bars, Microalloy, Hot-Wrought, Special Quality, for Subsequent Hot Forging
ASTM A 922-93 (2000)	Standard Specification for Silicon Metal
ASTM A 923-03	Standard Test Methods for Detecting Detrimental Intermetallic Phase in Wrought Duplex Austenitic/Ferritic Stainless Steels
ASTM A 924/A 924M-99	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

Designation	Title
ASTM A 925-03	Standard Specification for Zinc-5% Aluminum-Mischmetal Alloy-Coated Steel Overhead Ground Wire Strand
ASTM A 926-03	Standard Test Method for Comparing the Abrasion Resistance of Coating Materials for Corrugated Metal Pipe
ASTM A 927/A 927M-99	Standard Test Method for Alternating-Current Magnetic Properties of Toroidal Core Specimens Using the Voltmeter-Ammeter-Wattmeter Method
ASTM A 928/A 928M-00	Standard Specification for Ferritic/Austenitic (Duplex) Stainless Steel Pipe Electric Fusion Welded with Addition of Filler Metal
ASTM A 929/A 929M-01	Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
ASTM A 930-03	Standard Practice for Life-Cycle Cost Analysis of Corrugated Metal Pipe Used for Culverts, Storm Sewers, and Other Buried Conduits
ASTM A 931-96 (2002)	Standard Test Method for Tension Testing of Wire Ropes and Strand
ASTM A 932/A 932M-01	Standard Test Method for Alternating-Current Magnetic Properties of Amorphous Materials at Power Frequencies Using Wattmeter-Ammeter-Voltmeter Method with Sheet Specimens
ASTM A 933/A 933M-95 (2001)	Standard Specification for Vinyl (PVC) Coated Steel Wire and Welded Wire Fabric for Reinforcement
ASTM A 934/A 934M-03	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A 937/A 937M-01	Standard Test Method for Determining Interlaminar Resistance of Insulating Coatings Using Two Adjacent Test Surfaces
ASTM A 938-97 (2003)	Standard Test Method for Torsion Testing of Wire
ASTM A 939-96 (2001)	Standard Test Method for Ultrasonic Examination from Bored Surfaces of Cylindrical Forgings
ASTM A 940-96 (2001)	Standard Specification for Vacuum Treated Steel Forgings, Alloy, Differentially Heat Treated, for Turbine Rotors
ASTM A 941-03	Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys
ASTM A 942-95 (2001)	Standard Specification for Centrifugally Cast White Iron/Gray Iron Dual Metal Abrasion- Resistant Roll Shells
ASTM A 943/A 943M-01	Standard Specification for Spray-Formed Seamless Austenitic Stainless Steel Pipes
ASTM A 944-99	Standard Test Method for Comparing Bond Strength of Steel Reinforcing Bars to Concrete Using Beam-End Specimens
ASTM A 945/A 945M-00	Standard Specification for High-Strength Low-Alloy Structural Steel Plate with Low Carbon and Restricted Sulfur for Improved Weldability, Formability, and Toughness
ASTM A 946-95 (2000)	Standard Specification for Chromium, Chromium-Nickel and Silicon Alloy Steel Plate, Sheet, and Strip for Corrosion and Heat Resisting Service
ASTM A 947M-95 (2000)	Standard Specification for Textured Stainless Steel Sheet [Metric]
ASTM A 949/A 949M-01	Standard Specification for Spray-Formed Seamless Ferritic/Austenitic Stainless Steel Pipe
ASTM A 950/A 950M-99 (2003)	Standard Specification for Fusion Bonded Epoxy-Coated Structural Steel H-Piles and Sheet Piling
ASTM A 951-02	Standard Specification for Masonry Joint Reinforcement
ASTM A 952/A 952M-02	Standard Specification for Forged Grade 80 and Grade 100 Steel Lifting Components and Welded Attachment Links
ASTM A 953-02	Standard Specification for Austenitic Chromium-Nickel-Silicon Alloy Steel Seamless and Welded Tubing
ASTM A 954-02	Standard Specification for Austenitic Chromium-Nickel-Silicon Alloy Steel Seamless and Welded Pipe
ASTM A 955M/ A 955M-03b	Standard Specification for Deformed and Plain Stainless Steel Bars For Concrete Reinforcement
ASTM A 956-02	Standard Test Method for Leeb Hardness Testing of Steel Products
ASTM A 957-03	Standard Specification for Investment Castings, Steel and Alloy, Common Requirements, for General Industrial Use
ASTM A 958-00	Standard Specification for Steel Castings, Carbon, and Alloy, with Tensile Requirements, Chemical Requirements Similar to Standard Wrought Grades
ASTM A 959-03	Standard Guide for Specifying Harmonized Standard Grade Compositions for Wrought Stainless Steels
ASTM A 960-03	Standard Specification for Common Requirements for Wrought Steel Piping Fittings
ASTM A 961-02	Standard Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications
ASTM A 962/A 962M-03	Standard Specification for Common Requirements for Steel Fasteners or Fastener Materials, or Both, Intended for Use at Any Temperature from Cryogenic to the Creep Range
ASTM A 964/A 964M-03	Standard Specification for Corrugated Steel Box Culverts
ASTM A 965/A 965M-02	Standard Specification for Steel Forgings, Austenitic, for Pressure and High Temperature Parts
ASTM A 966/A 966M-96 (2001)	Standard Test Method for Magnetic Particle Examination of Steel Forgings Using Alternating Current
ASTM A 967-01e1	Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts
ASTM A 968/A 968M-96 (2001)	Standard Specification for Chromium, Chromium-Nickel, and Silicon Alloy Steel Bars and Shapes for Corrosion and Heat-Resisting Service
ASTM A 970/A 970M-98	Standard Specification for Welded or Forged Headed Bars for Concrete Reinforcement

Designation	Title
ASTM A 971-00	Standard Test Method for Measuring Edge Taper and Crown of Flat-Rolled Electrical Steel Coils
ASTM A 972/A 972M-00	Standard Specification for Fusion Bonded Epoxy-Coated Pipe Piles
ASTM A 973/A 973M-01	Standard Specification for Grade 100 Alloy Steel Chain
ASTM A 974-97 (2003)	Standard Specification for Welded Wire Fabric Gabions and Gabion Mattresses (Metallic Coated or Polyvinyl Chloride (PVC) Coated)
ASTM A 975-97 (2003)	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 A 976-03	Standard Classification of Insulating Coatings by Composition, Relative Insulating Ability and Application
ASTM A 977/A 977M-02	Standard Test Method for Magnetic Properties of High-Coercivity Permanent Magnet Materials Using Hysteresigraphs
ASTM A 978/A 978M-97 (2002)e1	Standard Specification for Composite Ribbed Steel Pipe, Precoated and Polyethylene Lined for Gravity Flow Sanitary Sewers, Storm Sewers, and Other Special Applications
ASTM A 979/A 979M-03	Standard Specification for Concrete Pavements and Linings Installed in Corrugated Steel Structures in the Field
ASTM A 980-97 (2003)	Standard Specification for Steel, Sheet, Carbon, Ultra High Strength Cold Rolled
ASTM A 981-97 (2002)	Standard Test Method for Evaluating Bond Strength for 15.2 mm (0.6 in.) Diameter Prestressing Steel Strand, Grade 270, Uncoated, Used in Prestressed Ground Anchors
ASTM A 982-02	Standard Specification for Steel Forgings, Stainless, for Compressor and Turbine Airfoils
ASTM A 983/A 983M-01	Standard Specification for Continuous Grain Flow Forged Carbon and Alloy Steel Crankshafts for Medium Speed Diesel Engines
ASTM A 984/A 984M-03	Standard Specification for Steel Line Pipe, Black, Plain-End, Electric-Resistance-Welded
ASTM A 985/A 985M-03	Standard Specification for Steel Investment Casting General Requirements, for Pressure-Containing Parts
ASTM A 986/A 986M-01	Standard Specification for Magnetic Particle Examination of Continuous Grain Flow Crankshaft Forgings
ASTM A 987-00	Standard Test Method for Measuring Shape Characteristics of Tin Mill Products
ASTM A 988-98 (2002)	Standard Specification for Hot Isostatically-Pressed Stainless Steel Flanges, Fittings, Valves, and Parts for High Temperature Service
ASTM A 989-98 (2002)	Standard Specification for Hot Isostatically-Pressed Alloy Steel Flanges, Fittings, Valves, and Parts for High Temperature Service
ASTM A 990-03	Standard Specification for Chastings, Iron-Nickel-Chromium and Nickel Alloys, Specially Controlled for Pressure Retaining Parts for Corrosion Service
ASTM A 991/A 991M-98	Standard Test Method for Conducting Temperature Uniformity Surveys of Furnaces Used to Heat Treat Steel Products
ASTM A 992/A 992M-03	Standard Specification for Structural Steel Shapes
ASTM A 993-98	Standard Test Method for Dynamic Tear Testing of Cast Irons to Establish Transition Temperature
ASTM A 994-03	Standard Guide for Editorial Procedures and Form of Product Specifications for Steel, Stainless Steel, and Related Alloys
ASTM A 995/A 995M-98 (2003)	Standard Specification for Casting, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts
ASTM A 996/A 996M-03b	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM A 997-98 (2003)	Standard Practice for Investment Castings, Surface Acceptance Standards, Visual Examination
ASTM A 998/A 998M-98	Practice for Structural Design of Reinforcements for Fittings in Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
ASTM A 999/A 999M-01	Standard Specification for General Requirements for Alloy and Stainless Steel Pipe
ASTM A 1000-99	Standard Specification for Steel Wire, Carbon and Alloy Specialty Spring Quality
ASTM A 1001-01	Standard Specification for High Strength Steel Castings in Heavy Sections
ASTM A 1002-99 (2003)	Standard Specification for Castings, Nickel-Aluminum Ordered Alloy
ASTM A 1003/A 1003M-02a	Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members
ASTM A 1004/A 1004M-99	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 A 1005/A 1005M-00e1	Standard Specification for Steel Line Pipe, Black, Plain End, Longitudinal and Helical Seam, Double Submerged-Arc Welded
ASTM A 1006/A 1006M-00	Standard Specification for Steel Line Pipe, Black, Plain End, Laser Beam Welded
ASTM A 1007-02	Standard Specification for Carbon Steel Wire for Wire Rope
ASTM A 1008/A 1008M-03	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A 1009-00	Standard Specification for Soft Magnetic MnZn Ferrite Core Materials for High Frequency (10 kHz-1 MHz) Power Transformer and Filter Inductor Applications
ASTM A 1010/ A 1010M-01e1	Standard Specification for Higher-Strength Martensitic Stainless Steel Plate, Sheet, and Strip
ASTM A 1011/A 1011M-03a	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

Designation	Title
ASTM A 1012-02	Standard Specification for Seamless and Welded Ferritic, Austenitic and Duplex Alloy Steel Condenser and Heat Exchanger Tubes With Integral Fins
ASTM A 1013-00	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 A 1014-03	Standard Specification for Precipitation-Hardening Bolting Material (UNS N07718) for High Temperature Service
ASTM A 1015-01	Standard Guide for Videoborescoping of Tubular Products for Sanitary Applications
ASTM A 1016/A 1016M-02a	Standard Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes
ASTM A 1017/A 1017M-01	Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum-Tungsten
ASTM A 1018/A 1018M-03a	Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability
A1019/A1019M-01	Standard Specification for Closed Rib Steel Pipe with Diameter of 36 in. [900 mm] or Less, Polymer Precoated for Sewers and Drains
A1020/A1020M-02	Standard Specification for Steel Tubes, Carbon and Carbon Manganese, Fusion Welded, for Boiler, Superheater, Heat Exchanger and Condenser Applications
A1021-02	Standard Specification for Martensitic Stainless Steel Forgings and Forging Stock for High-Temperature Service
A1022-01	Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement
A1023/A1023M-02	Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes
A1024/A1024M-02	Standard Specification for Steel Line Pipe, Black, Plain-End, Seamless
A1025-02	Standard Specification for Ferroalloys, General Requirements
A1026-03	Standard Specification for Alloy Steel Structural Shapes for Use in Building Framing
A1028-03	Standard Specification for Stainless Steel Bars for Compressor and Turbine Airfoils
A1030/A1030M-03	Standard Practice for Measuring Flatness Characteristics of Coated Sheet Products
A1031-04	Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Alloy, Drawing Steel and Structural Steel, Hot-Rolled

Appendix

2

ASTM DISCONTINUED FERROUS METAL STANDARDS

Discontinued	Replaced By
A 4 (1965)	A 3 – Steel Joint Bars, Low, Medium and High Carbon (Non-Heat-Treated)
A 5 (1979)	A 3 – Steel Joint Bars, Low, Medium and High Carbon (Non-Heat-Treated)
A 7 (1967)	A 36 – Carbon Structural Steel (For Rolled Shapes) A 283 – Low and Intermediate Tensile Strength Carbon Steel Plates A 306 – Discontinued 1975; Replaced by A 663 – Steel Bars, Carbon, Merchant Quality, Mechanical Properties, and A 675 – Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
A 8 (1963)	No Replacement
A 9 (1940)	No Replacement
A 10 (1970)	A 283 – Low and Intermediate Tensile Strength Carbon Steel Plates
A 11 (1930)	A 113 – Discontinued 1979; No Replacement
A 12 (1934)	A 131 – Structural Steel for Ships
A 13 (1934)	A 131 – Structural Steel for Ships
A 14 (1950)	A 68 – Discontinued 1975; Replaced by A 689 – Carbon and Alloy Steel Bars for Springs
A 15 (1969)	A 615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 16 (1969)	A 616 – Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
A 17 (1945)	A 273 & A 274 – Discontinued 1975; Replaced by A 711 – Steel Forging Stock
A 18 (1940)	A 236 – Discontinued 1981; No Replacement
A 19 (1936)	A 236 – Discontinued 1981; No Replacement
A 21 (2003)	No Replacement
A 22 (1934)	A 57 – Discontinued 1966; Replaced by A 504 – Wrought Carbon Steel Wheels
A 23 (1917)	A 57 – Discontinued 1966; Replaced by A 504 – Wrought Carbon Steel Wheels
A 24 (1917)	A 57 – Discontinued 1966; Replaced by A 504 – Wrought Carbon Steel Wheels
A 25 (1993)	A 504 – Wrought Carbon Steel Wheels
A 26 (1966)	A 551 – Steel Tires
A 28 (1925)	A 83 – Discontinued 1967; Replaced by A 192 – Seamless Carbon Steel Boiler Tubes for High-Pressure Service
A 30 (1964)	No Replacement
A 32 (1927)	A 107 – Discontinued 1968; Replaced by A 575 – Steel Bars, Carbon, Merchant Quality, M-Grades, and A 576 – Steel Bars, Carbon, Hot-Wrought, Special Quality A 108 – Steel Bars, Carbon, Cold Finished, Standard Quality
A 33 (1937)	E 30 – Discontinued 1995; No Replacement
A 35 (1937)	No Replacement
A 37 (1936)	No Replacement
A 38 (1924)	A 83 – Discontinued 1967; Replaced by A 192 – Seamless Carbon Steel Boiler Tubes for High-Pressure Service
A 39 (1920)	A 84 – Discontinued 1972; No Replacement
A 40 (1920)	A 84 – Discontinued 1972; No Replacement
A 41 (1956)	No Replacement
A 42 (1972)	No Replacement
A 43 (1992)	No Replacement
A 44 (1955)	A 377 – Index of Specifications for Ductile-Iron Pressure Pipe
A 45 (1943)	No Replacement
A 46 (1943)	No Replacement
A 47M (1999)	A 47/A 47M – Specification for Ferritic Malleable Iron Castings
A 50 (1937)	A 183 – Carbon Steel Track Bolts and Nuts
A 51 (1937)	A 183 – Carbon Steel Track Bolts and Nuts
A 52 (1925)	A 83 – Discontinued 1967; Replaced by A 192 – Seamless Carbon Steel Boiler Tubes for High-Pressure Service
A 54 (1927)	A 107 – Discontinued 1968; Replaced by A 575 – Steel Bars, Carbon, Merchant Quality, M-Grades, and A 576 – Steel Bars, Carbon, Hot-Wrought, Special Quality A 108 – Steel Bars, Carbon, Cold Finished, Standard Quality
A 55 (1937)	E 30 – Discontinued 1995; No Replacement
A 56 (1972)	No Replacement
A 57 (1966)	A 504 – Wrought Carbon Steel Wheels
A 58 (1943)	A 689 – Carbon and Alloy Steel Bars for Springs
A 59 (1966)	A 689 – Carbon and Alloy Steel Bars for Springs
A 60 (1966)	A 552 – Discontinued 1974; Replaced by A 689 – Carbon and Alloy Steel Bars for Springs

Discontinued	Replaced By
A 61 (1969)	A 616 – Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
A 62 (1949)	No Replacement
A 63 (1941)	A 237 – Discontinued 1975; Replaced by A 668 – Steel Forgings, Carbon and Alloy, for General Industrial Use A 238 – Discontinued 1989; Replaced by A 730 – Forgings, Carbon and Alloy Steel, for Railway Use
A 64 (1937)	E 30 – Discontinued 1995; No Replacement
A 68 (1975)	A 689 – Carbon and Alloy Steel Bars for Springs
A 69 (1927)	No Replacement
A 70 (1947)	A 285 – Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength
A 71 (1937)	No Replacement
A 72 (1972)	No Replacement
A 73 (1972)	No Replacement
A 75 (1921)	A 47 – Ferritic Malleable Iron Castings
A 76 (1981)	A 183 – Carbon Steel Track Bolts and Nuts
A 77 (1935)	No Replacement
A 78 (1947)	A 283 – Low and Intermediate Tensile Strength Carbon Steel Plates
A 79 (1921)	A 84 – Discontinued 1972; No Replacement
A 80 (1927)	A 107 – Discontinued 1968; Replaced by A 575 – Steel Bars, Carbon, Merchant Quality, M-Grades, and A 576 – Steel Bars, Carbon, Hot-Wrought, Special Quality A 108 – Steel Bars, Carbon, Cold Finished, Standard Quality
A 81 (1972)	No Replacement
A 83 (1967)	A 192 – Seamless Carbon Steel Boiler Tubes for High-Pressure Service
A 84 (1972)	No Replacement
A 85 (1953)	No Replacement
A 86 (1963)	No Replacement
A 87 (1947)	A 27 – Steel Castings, Carbon, for General Application
A 88 (1933)	A 48 – Gray Iron Castings [Metric]
A 89 (1947)	A 285 – Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength
A 91 (1940)	No Replacement
A 92 (1937)	No Replacement
A 93 (1965)	A 525 – Discontinued 1994; Replaced by A 653 – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, and A 924 – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A 94 (1966)	No Replacement
A 95 (1957)	A 216 – Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
A 96 (1965)	A 193 – Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
A 97 (1935)	No Replacement
A 98 (1992)	No Replacement
A 103 (1939)	E 32 – Practices for Sampling Ferroalloys and Steel Additives for Determination of Chemical Composition
A 104 (1939)	E 31 – Discontinued 1995; No Replacement
A 107 (1968)	A 575 – Steel Bars, Carbon, Merchant Quality, M-Grades A 576 – Steel Bars, Carbon, Hot-Wrought, Special Quality
A 109M (1998)	A 109/A 109M
A 110 (1936)	A 90 – Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
A 112 (1990)	No Replacement
A 113 (1979)	No Replacement
A 114 (1940)	No Replacement
A 115 (1937)	No Replacement
A 117 (1956)	A 392 – Zinc-Coated Steel Chain-Link Fence Fabric
A 118 (1933)	No Replacement
A 119 (1943)	E 44 – Discontinued; Redesignated A 919 – Terminology Relating to Heat Treatment of Metals
A 120 (1987)	A 53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
A 122 (1963)	A 475 – Zinc-Coated Steel Wire Strand
A 124 (1940)	No Replacement
A 127	Redesignated A 340 – Terminology of Symbols and Definitions Relating to Magnetic Testing
A 129 (1969)	No Replacement
A 130 (1937)	E 30 – Discontinued 1995; No Replacement

Discontinued	Replaced By
A 133 (1941)	A 237 – Discontinued 1975; Replaced by A 668 – Steel Forgings, Carbon and Alloy, for General Industrial Use A 238 – Discontinued 1989; Replaced by A 730 – Forgings, Carbon and Alloy Steel, for Railway Use
A 136 (1945)	No Replacement
A 137 (1943)	No Replacement
A 138 (1945)	No Replacement
A 140 (1935)	No Replacement
A 141 (1967)	A 502 – Steel Structural Rivets
A 142 (1977)	A 716 – Ductile Iron Culvert Pipe
A 145 (1940)	A 132 – Ferromolybdenum
A 147 (1984)	No Replacement
A 149 (1940)	A 212 – Discontinued 1967; Replaced by A 515 – Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service, and A 516 – Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
A 150 (1940)	A 212 – Discontinued 1967; Replaced by A 515 – Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service, and A 516 – Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
A 151 (1938)	No Replacement
A 152 (1972)	No Replacement
A 154 (1936)	A 180 – Discontinued 1937; Replaced by A 27 – Steel Castings, Carbon, for General Application
A 155 (1978)	A 671 – Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures A 672 – Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures A 691 – Carbon and Alloy Steel Pipe, Electric Fusion-Welded for High-Pressure Service at High Temperatures
A 156 (1936)	A 146 – Molybdenum Oxide Products
A 157 (1953)	A 217 – Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts Suitable for High-Temperature Service A 351 – Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
A 158 (1953)	A 335 – Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
A 160 (1969)	A 617 – Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
A 161 (1999)	A 192 – Seamless Carbon Steel Boiler Tubes for High Pressure Service A 209 – Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes
A 162 (1973)	No Replacement
A 163 (1972)	No Replacement
A 164 (1981)	B 663 – Silver-Tungsten Carbide Electrical Contact Material
A 165 (1988)	B 766 – Electrodeposited Coatings of Cadmium
A 166 (1968)	B 456 – Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
A 168 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 169 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 170 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 171 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 172 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 173 (1954)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application

Discontinued	Replaced By
A 174 (1940)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 175 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 177 (1989)	A 666 – Annealed or Cold-Worked Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar
A 180 (1937)	A 27 – Steel Castings, Carbon, for General Application
A 186 (1966)	A 504 – Wrought Carbon Steel Wheels
A 187 (1943)	No Replacement
A 188 (1943)	No Replacement
A 189 (1972)	No Replacement
A 190 (1962)	No Replacement
A 191 (1942)	A 239 – Test Method for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles by the Preece Test (Copper Sulfate Dip)
A 195 (1966)	A 502 – Steel Structural Rivets
A 196 (1962)	No Replacement
A 197M (1998)	A 197/A 197M
A 198 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 199/A 199M (1995)	A 200 – Seamless Intermediate Alloy-Steel Still Tubes for Refinery Service
A 200 (1999)	A 213 – Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
A 201 (1967)	A 515 – Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service A 516 – Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
A 205 (1967)	A 233 – Discontinued 1970; No Replacement A 251 – Discontinued 1970; No Replacement
A 206 (1953)	A 335 – Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
A 207 (1972)	No Replacement
A 208 (1941)	A 239 – Test Method for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles by the Preece Test (Copper Sulfate Dip)
A 211 (1993)	No Replacement
A 212 (1967)	A 515 – Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service A 516 – Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
A 215 (1947)	A 27 – Steel Castings, Carbon, for General Application
A 218 (1963)	A 475 – Zinc-Coated Steel Wire Strand
A 219 (1972)	B 487 – Test Method for Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section B 499 – Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals B 504 – Test Method for Measurement of Thickness of Metallic Coatings by the Coulometric Method B 529 – Discontinued 1979; Replaced by B 244 – Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments B 530 – Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Electrodeposited Nickel Coatings on Magnetic and Nonmagnetic Substrates
A 220M (1999)	A 220/A 220M
A 221 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 222 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application

Discontinued	Replaced By
A 223 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 224 (1969)	G 4 – Guide for Conducting Corrosion Coupon Tests in Field Applications
A 226/A 226M (1997)	No Replacement
A 233 (1970)	No Replacement
A 235 (1975)	A 668 – Steel Forgings, Carbon and Alloy, for General Industrial Use
A 236 (1981)	No Replacement
A 237 (1975)	A 668 – Steel Forgings, Carbon and Alloy, for General Industrial Use
A 238 (1989)	A 730 – Forgings, Carbon and Alloy Steel, for Railway Use
A 241 (1979)	A 67 – Steel Tie Plates, Low-Carbon and High-Carbon Hot-Worked
A 243 (1975)	A 668 – Steel Forgings, Carbon and Alloy, for General Industrial Use
A 244 (1947)	A 504 – Wrought Carbon Steel Wheels
A 245 (1972)	A 570 – Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality A 611 – Structural Steel (SS), Sheet, Carbon, Cold-Rolled
A 246 (1958)	A 245 – Discontinued 1972; Replaced by A 570 – Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality A 611 – Structural Steel (SS), Sheet, Carbon, Cold-Rolled
A 248 (1972)	A 273 & A 274 – Discontinued 1975; Replaced by A 711 – Steel Forging Stock
A 251 (1970)	No Replacement
A 253 (1962)	No Replacement
A 256 (1990)	No Replacement
A 257 (1945)	A 34 – Practice for Sampling and Procurement Testing of Magnetic Materials
A 258 (1945)	A 34 – Practice for Sampling and Procurement Testing of Magnetic Materials
A 259 (1945)	A 34 – Practice for Sampling and Procurement Testing of Magnetic Materials
A 260 (1966)	No Replacement
A 261 (1959)	No Replacement
A 267 (1954)	No Replacement
A 271 (1999)	A 213 – Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
A 272 (1945)	E 109 – Discontinued 1981; Replaced by E 709 – Guide for Magnetic Particle Examination
A 273 (1975)	A 711 – Steel Forging Stock
A 274 (1975)	A 711 – Steel Forging Stock
A 277 (1952)	A 338 – Malleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service at Temperatures up to 650°F (345°C)
A 279 (1945)	G 31 – Practice for Laboratory Immersion Corrosion Testing of Metals
A 280 (1953)	A 335 – Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
A 281 (1947)	A 27 – Steel Castings, Carbon, for General Application
A 282 (1945)	A 148 – Steel Castings, High Strength, for Structural Purposes
A 284/A 284M (1992)	A 283 – Low and Intermediate Tensile Strength Carbon Steel Plates
A 286 (1960)	A 434 – Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered
A 287 (1955)	No Replacement
A 292 (1968)	A 469 – Vacuum-Treated Steel Forgings for Generator Rotors
A 293 (1984)	A 470 – Vacuum-Treated Carbon and Alloy Steel Forgings for Turbine Rotors and Shafts
A 294 (1988)	A 471 – Vacuum-Treated Alloy Steel Forgings for Turbine Rotor Disks and Wheels
A 296 (1980)	A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service
A 298 (1970)	No Replacement
A 300 (1975)	No Replacement
A 301 (1956)	A 387 – Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
A 303 (1970)	A 570 – Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
A 305 (1968)	A 615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement A 616 – Rail-Steel Deformed and Plain Bars for Concrete Reinforcement A 617 – Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
A 306 (1975)	A 663 – Steel Bars, Carbon, Merchant Quality, Mechanical Properties A 675 – Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
A 310 (1949)	Redesignated A 345 – Flat-Rolled Electrical Steels for Magnetic Applications

Discontinued	Replaced By
A 315 (1952)	A 335 – Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
A 316 (1969)	No Replacement
A 317 (1975)	E 381 – Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings
A 318 (1976)	A 370 – Test Methods and Definitions for Mechanical Testing of Steel Products
A 326 (1990)	No Replacement
A 329 (1965)	A 551 – Steel Tires
A 330 (1954)	A 370 – Test Methods and Definitions for Mechanical Testing of Steel Products
A 332 (1965)	A 689 – Carbon and Alloy Steel Bars for Springs
A 337 (1955)	A 392 – Zinc-Coated Steel Chain-Link Fence Fabric
A 339 (1965)	A 536 – Ductile Iron Castings
A 344 (1977)	A 370 – Test Methods and Definitions for Mechanical Testing of Steel Products A 712 – Test Method for Electrical Resistivity of Soft Magnetic Alloys A 717 – Test Method for Surface Insulation Resistivity of Single-Strip Specimens A 718 – Discontinued 1996; No Replacement A 719 – Test Method for Lamination Factor of Magnetic Materials A 720 – Test Method for Ductility of Nonoriented Electrical Steel
A 346 (1998)	No Replacement
A 347 (1996)	No Replacement
A 349 (1984)	No Replacement
A 357 (1973)	A 387 – Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
A 359 (1954)	A 370 – Test Methods and Definitions for Mechanical Testing of Steel Products
A 360/A 360M (1993)	No Replacement
A 361/A 361M (1995)	No Replacement
A 362 (1977)	No Replacement
A 364 (1959)	A 434 – Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered
A 365 (1968)	A 619 – Discontinued 1997; No Replacement A 620 – Drawing Steel (DS) Sheet, Carbon, Cold-Rolled
A 366/A 366M (2000)	A 1008 – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 371 (1969)	No Replacement
A 373 (1966)	Combined with A 36 – Carbon Structural Steel
A 374 (1971)	A 606 – Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance A 607 – Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled
A 375 (1971)	A 606 – Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance A 607 – Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled
A 378 (1955)	A 345 – Flat-Rolled Electrical Steels for Magnetic Applications
A 379 (1955)	A 345 – Flat-Rolled Electrical Steels for Magnetic Applications
A 382 (1971)	No Replacement
A 383 (1996)	No Replacement
A 386 (1984)	A 123 – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 393 (1974)	A 262 – Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
A 395 (1988)	A 395/A 395M – Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
A 396 (1965)	A 536 – Ductile Iron Castings
A 397 (1958)	No Replacement
A 398 (1969)	No Replacement
A 399 (1969)	No Replacement
A 402 (1958)	No Replacement
A 404 (1974)	No Replacement
A 405 (1995)	No Replacement
A 406 (1965)	No Replacement
A 407M (1989)	No Replacement
A 408 (1968)	A 615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 410 (1976)	No Replacement

Discontinued	Replaced By
A 412 (1989)	No Replacement
A 415 (1970)	A 569 – Steel, Carbon (0.15 Maximum, Percent) Hot-Rolled Sheet and Strip Commercial Quality
A 417M (1989)	No Replacement
A 419 (1971)	No Replacement
A 422 (1994)	No Replacement
A 425 (1970)	A 569 – Steel, Carbon (0.15 Maximum, Percent) Hot-Rolled Sheet and Strip Commercial Quality
A 429 (1976)	A 276 – Stainless Steel Bars and Shapes
A 430/A 430M (1995)	A 312 – Seamless and Welded Austenitic Stainless Steel Pipes
A 431 (1968)	A 615 – Deformed and Plain Billet Steel Bars for Concrete Reinforcement
A 432 (1968)	A 615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 433 (1972)	No Replacement
A 438-80 (1997)	No Replacement
A 440 (1979)	No Replacement
A 441/A 441M (1989)	A 572/A 572M – High-Strength Low-Alloy Columbium-Vanadium Structural Steel
A 442/A 442M (1991)	No Replacement
A 443 (1966)	Combined with A 370 – Test Methods and Definitions for Mechanical Testing of Steel Products
A 444/A 444M (1995)	A 929/A 929M – Steel Sheet Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
A 445 (1974)	A 395 – Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
A 446/A 446M (1994)	A 653/A 653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A 924/A 924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A 448 (1976)	No Replacement
A 452 (1995)	No Replacement
A 454 (1980)	No Replacement
A 457 (1990)	No Replacement
A 458 (1991)	No Replacement
A 461 (1971)	A 564 – Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes A 637 – Discontinued; Redesignated B 637 – Precipitation-Hardening Nickel Alloy Bars, Forgings, and Forging Stock for High-Temperature Service A 638 – Precipitation Hardening Iron Base Superalloy Bars, Forgings, and Forging Stock for High-Temperature Service A 639 – Discontinued; Redesignated B 639 – Precipitation Hardening Cobalt-Containing Alloys (UNS R30155 and UNS R30816) Rod, Bar, Forgings, and Forging Stock for High-Temperature Service
A 462	E 165 – Test Method for Liquid Penetrant Examination
A 464 (1968)	A 376 – Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service
A 465 (1975)	No Replacement
A 468 (1969)	A 6 – General Requirements for Rolled Structural Steel Bars, Plates, Shapes,and Sheet Piling A 341 – Test Method for Direct Current Magnetic Properties of Materials Using D-C Permeameters and the Ballistic Test Methods
A 476 (2000)	A 476/A 476M-00 – Ductile Iron Castings for Paper Mill Dryer Rolls
A 476M (2000)	A 476/A 476M-00 – Ductile Iron Castings for Paper Mill Dryer Rolls
A 477 (1991)	No Replacement
A 486/A 486M (1989)	No Replacement
A 502 (1999)	F 1470 – Guide for Fastener Sampling for Specified Mechanical Properties and Performance Inspection
A 509 (1983)	A 788 – General Requirements for Steel Forgings
A 518 M (1999)	A 518/A 518 M – Standard Specification for Corrosion-Resistant High-Silicon Iron Castings
A 520 (2000)	No Replacement
A 525/A 525M (1994)	A 653/A 653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A 924/A 924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A 526/A 526M (1994)	A 653/A 653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A 924/A 924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A 527/A 527M (1994)	A 653/A 653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A 924/A 924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A 528/A 528M (1994)	A 653/A 653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A 924/A 924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

Discontinued	Replaced By
A 535 (1999)	No Replacement
A 538/A 538M (1989)	No Replacement
A 544 (1991)	No Replacement
A 545 (1991)	No Replacement
A 546 (1991)	No Replacement
A 547 (1991)	No Replacement
A 548 (1991)	No Replacement
A 549 (1991)	No Replacement
A 552 (1974)	A 689 – Carbon and Alloy Steel Bars for Springs
A 557/A 557M (1995)	A 178 – Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes
A 558 (1969)	No Replacement
A 559 (1969)	No Replacement
A 566 (1984)	No Replacement
A 567/A 567M (1987)	No Replacement
A 568M (1991)	A 568/A 568M – General Requirements for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled
A 569/A 569M (2000)	A 1011/A 1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 570/A 570M (2000)	A 1011/A 1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 583	No Replacement
A 584 (2002)	No Replacement
A 585 (2002)	A 121 – Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
A 590 (1984)	No Replacement
A 593 (1976)	No Replacement
A 594 (1986)	No Replacement
A 599 (1992)	A 599/A 599M-99 – Tin Mill Products, Electrolytic Tin-Coated, Cold-Rolled Sheet
A 605/A 605M (1989)	No Replacement
A 607 (2000)	A 1011/A 1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 611 (2000)	A 1008 – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 613 (1984)	No Replacement
A 614 (1987)	No Replacement
A 615M (1993)	A 615/A 615M – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 616/A 616M (1999)	A 996/A 996M – Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
A 617/A 617M (1999)	A 996/A 996M – Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
A 619/A 619M (1997)	No Replacement
A 620/A 620M (2000)	A 1008 – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 621/A 621M (1997)	No Replacement
A 622/A 622M (2000)	A 1011/A 1011M – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 624M (1995)	A 624/A 624M – Tin Mill Products, Electrolytic Tin Plate, Single Reduced
A 625M (1992)	A 625/A 625M – Tin Mill Products, Black Plate, Single Reduced
A 626M (1995)	A 626/A 626M – Tin Mill Products, Electrolytic Tin Plate, Double Reduced
A 628 (1982)	No Replacement
A 631 (1993)	A 583 – Cast Steel Wheels for Railway Service
A 634 (1978)	No Replacement
A 635M (1991)	A 635/A 635M – Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled
A 637	Redesignated B 637 – Precipitation-Hardening Nickel Alloy Bars, Forgings, and Forging Stock for High-Temperature Service
A 639	Redesignated B 639 – Precipitation Hardening Cobalt-Containing Alloys (UNS R30155 and UNS R30816) Rod, Bar, Forgings, and Forging Stock for High-Temperature Service
A 641M (1997)	A 641/A 641M – Zinc-Coated (Galvanized) Carbon Steel Wire
A 642/A 642M (1994)	A 653/A 653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A 924/A 924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

Discontinued	Replaced By
A 643 (1982)	No Replacement
A 647 (1982)	No Replacement
A 650M-88 (1988)	A 650/A 650M – Tin Mill Products, Black Plate, Double Reduced
A 651 (1987)	No Replacement
A 652 (1984)	No Replacement
A 654 (1984)	No Replacement
A 655 (1984)	No Replacement
A 658/A 658M (1989)	No Replacement
A 661	Not Yet Assigned
A 665/A 665M (1998)	A 876/A 876M – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types [Metric]
A 667M (1987)	A 667/A 667M – Centrifugally Cast Dual Metal (Gray and White Cast Iron) Cylinders
A 669 (1984)	A 789 – Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service
A 670	Redesignated B 670 – Precipitation-Hardening Nickel Alloy (UNS N07718) Plate, Sheet, and Strip for High-Temperature Service
A 676 (1990)	No Replacement
A 677M (2000)	A 677/A 677M – Nonoriented Electrical Steel, Fully Processed Types
A 680/A 680M (1986)	A 684/A 684M – Steel, Strip, High-Carbon, Cold-Rolled
A 682M (1998)	A 682/A 682M – General Requirements for Steel, Strip, High-Carbon, Cold-Rolled, Spring Quality
A 683M (1999)	A 683/A 683M – Nonoriented Electrical Steel, Semiprocessed Types
A 685 (1986)	A 681 – Tool Steels Alloy
A 687 (1999)	No Replacement
A 695 (2002)	No Replacement
A 698 (1992)	A 698/A 698M – Test Method for Magnetic Shield Efficiency in Attenuating Alternating Magnetic Fields
A 692 (1995)	A 209 – Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes
A 699 (1986)	No Replacement
A 708 (1989)	No Replacement
A 715 (2000)	A 1011/A 1011M - Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 718 (1996)	No Replacement
A 722 (1995)	A 722/A 722M – Uncoated High-Strength Steel Bar for Prestressing Concrete
A 725/A 725M (1988)	A 876/A 876M – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types [Metric]
A 726M (1998)	A 726 – Cold-Rolled Magnetic Lamination Quality Steel, Semiprocessed Types
A 728	Not Yet Assigned
A 731/A 731M (1995)	A 268 – Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
A 749M (1991)	A 749/A 749M – General Requirements for Steel, Strip, Carbon and High-Strength, Low-Alloy, Hot-Rolled
A 766/A 766M (1991)	No Replacement
A 776	Not Yet Assigned
A 777 (1995)	No Replacement
A 783 (1987)	No Replacement
A 784 (1988)	No Replacement
A 785 (1988)	No Replacement
A 791/A 791M (1995)	A 268 – Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
A 792M (1994)	A 792/A 792M – Steel Sheet, 55 Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
A 797 (1990)	No Replacement
A 806/A 806M (1995)	A 929/A 929M – Steel Sheet Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
A 812/A 812M (1997)	No Replacement
A 816/A 816M (1994)	A 653/A 653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A 924/A 924Ma – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A 819 (1995)	A 929/A 929M – Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
A 825 (1991)	No Replacement
A 828	Not Yet Assigned
A 829 (1992)	A 829/A 829M – Alloy Structural Steel Plates
A 830 (1992)	A 830/A 830M – Plates, Carbon Steel, Structural Quality, Furnished to Chemical Composition Requirements
A 831 (1994)	No Replacement
A 840 (2000)	A 840/A 840M – Fully Processed Magnetic Lamination Steel
A 843 (1988)	A 876/A 876M – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types [Metric]

Discontinued	Replaced By
A 850 (1991)	No Replacement
A 851 (1996)	No Replacement
A 863 (1991)	No Replacement
A 864/A 864M (1997)	No Replacement
A 868	Not Yet Assigned
A 869	Not Yet Assigned
A 870	Not Yet Assigned
A 873/A 873M (1997)	No Replacement
A 874M (1999)	A 874/A 874M – Feritic Ductile Iron Castings Suitable for Low-Temperature Service
A 876M (1998)	A 876/A 876M – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types
A 890 (1989)	A 890/A 890M – Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Application
A 906 (1993)	A 906/A 906M – Grade 80 and Grade 100 Alloy Steel Chain Slings for Overhead Lifting
A 907/A 907M (1996)	A1018/A1018M – Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability
A 916 (1995)	A 929/A 929M – Steel Sheet Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
A 919 (1999)	A 941 – Terminology Relating to Steel, Stainless Steel, Related Alloys and Ferroalloys
A 929	Redesignated A 929/A 929M – Steel Sheet Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
A 935/A 935M (1997)	A1018/A1018M – Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability
A 936/A 936M (1997)	A1018/A1018M – Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability
A 948	Not listed
A 949	Redesignated A 949/A 949M – Spray-Formed Seamless Ferritic/Austenitic Stainless Steel Pipe
A 963/A 963M (2000)	A 1008 – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 969/A 969M (2000)	A 1008 – Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

Appendix

3

JIS STEEL AND RELATED STANDARDS

Designation	Title
G 3101:2004	Rolled steels for general structure
G 3103:1987	Carbon steel and molybdenum alloy steel plates for boilers and other pressure vessels
G 3104:1987	Steel bars for rivet
G 3105:1987	Steel bars for chains
G 3106:2004	Rolled steels for welded structure
G 3108:1987	Rolled carbon steel for cold-finished steel bars
G 3109:1994	Steel bars for prestressed concrete
G 3111:1987	Rerolled carbon steel
G 3112:1987	Steel bars for concrete reinforcement
G 3113:1990	Hot-rolled steel plates, sheets and strip for automobile structural uses
G 3114:2004	Hot-rolled atmospheric corrosion resisting steels for welded structure
G 3115:2000	Steel plates for pressure vessels for intermediate temperature service
G 3116:2000	Steel sheets, plates and strip for gas cylinders
G 3117:1987	Rerolled steel bars for concrete reinforcement
G 3118:2000	Carbon steel plates for pressure vessels for intermediate and moderate temperature service
G 3119:1987	Manganese-molybdenum alloy and manganese-molybdenum-nickel alloy steel plates for boilers and other pressure vessels
G 3120:1987	Manganese-molybdenum and manganese-molybdenum-nickel alloy steel plates quenched and tempered for pressure vessels
G 3123:1987	Cold finished carbon and alloy steel bars
G 3124:2004	High strength steel plates for pressure vessel for intermediate and moderate temperature service
G 3125:2004	Superior atmospheric corrosion resisting rolled steels
G 3126:2004	Carbon steel plates for pressure vessels for low temperature service
G 3127:2000	Nickel steel plates for pressure vessels for low temperature service
G 3128:1999	High yield strength steel plates for welded structure
G 3129:1995	High tensile strength steel for tower structural purposes
G 3131:1996	Hot-rolled mild steel plates, sheets and strip
G 3132:1990	Hot-rolled carbon steel strip for pipes and tubes
G 3133:2004	Decarburized steel sheets and strip for porcelain enamelling
G 3134:1990	Hot rolled high strength steel sheets with improved formability for automobile structural uses
G 3135:1986	Cold rolled high strength steel sheets with improved formability for automobile structural uses
G 3136:1994	Rolled steels for building structure
G 3137:1994	Small size-deformed steel bars for prestressed concrete
G 3138:1996	Rolled bars for building structure
G 3141:1996	Cold-reduced carbon steel sheets and strip
G 3191:2002	Shape, dimensions, weight and tolerance for hot rolled steel bar and bar-in-coil
G 3192:2000	Dimensions, mass and permissible variations of hot rolled steel sections
G 3193:1990	Dimensions, mass and permissible variations of hot rolled steel plates, sheets and strip
G 3194:1998	Dimensions, mass and permissible variations of hot rolled flat steel
G 3199:1992	Specification for through-thickness characteristics of steel plate and wide flat
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 3302:1998	Hot-dip zinc-coated steel sheets and coils
G 3303:2002	Tinplate and blackplate
G 3311:1998	Cold rolled special steel strip
G 3312:1994	Prepainted hot-dip zinc-coated steel sheets and coils
G 3313:1998	Electrolytic zinc-coated steel sheets and coils

Designation	Title
G 3314:1995	Hot-dip aluminium-coated steel sheets and coils
G 3315:2002	Chromium plated tin free steel
G 3316:1987	Shapes and dimensions of corrugated steel sheets
G 3317:1994	Hot-dip zinc-5% aluminium alloy-coated steel sheets and coils
G 3318:1994	Prepainted hot-dip zinc-5% aluminium alloy-coated steel sheets and coils
G 3320:1999	Coated stainless steel sheets
G 3321:1998	Hot-dip 55% aluminium-zinc alloy-coated steel sheets and coils
G 3322:1998	Prepainted hot-dip 55% aluminium-zinc alloy-coated steel sheets and coils
G 3350:1987	Light gauge steels for general structure
G 3351:1987	Expanded metals
G 3352:2003	Steel decks
G 3353:1990	Welded light gauge H steels for general structures
G 3429:1988	Seamless steel tubes for high pressure gas cylinder
G 3441:1988	Alloy steel tubes for machine purposes
G 3442:2004	Galvanized steel pipes for ordinary piping
G 3443:2004	Coated steel pipes for water service
G 3444:1994	Carbon steel tubes for general structural purposes
G 3445:1988	Carbon steel tubes for machine structural purposes
G 3446:1994	Stainless steel pipes for machine and structural purposes
G 3447:2004	Stainless steel sanitary pipes
G 3448:2004	Light gauge stainless steel tubes for ordinary piping
G 3451:1987	Fittings of coated steel pipes for water service
G 3452:2004	Carbon steel pipes for ordinary piping
G 3454:1988	Carbon steel pipes for pressure service
G 3455:1988	Carbon steel pipes for high pressure service
G 3456:2004	Carbon steel pipes for high temperature service
G 3457:1988	Arc welded carbon steel pipes
G 3458:1988	Alloy steel pipes
G 3459:2004	Stainless steel pipes
G 3460:1988	Steel pipes for low temperature service
G 3461:1988	Carbon steel boiler and heat exchanger tubes
G 3462:2004	Alloy steel boiler and heat exchanger tubes
G 3463:1994	Stainless steel boiler and heat exchanger tubes
G 3464:1988	Steel heat exchanger tubes for low temperature service
G 3465:1988	Seamless steel tubes for drilling
G 3466:1988	Carbon steel square pipes for general structural purposes
G 3467:1988	Steel tubes for fired heaters
G 3468:2004	Large diameter welded stainless steel pipes
G 3469:2002	Polyethylene coated steel pipes
G 3471:1977	Corrugated steel pipes and sections
G 3472:1988	Electric resistance welded carbon steel tubes for automobile structural purposes
G 3473:1988	Carbon steel tubes for cylinder barrels
G 3474:1995	High tensile strength steel tubes for tower structural purposes
G 3475:1996	Carbon steel tubes for building structure
G 3491:1993	Asphalt protective coatings for steel water pipe
G 3492:1993	Coal-tar enamel protective coatings for steel water pipe
G 3502:2004	Piano wire rods
G 3503:1980	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 3507:1991	Carbon steel wire rods for cold heading and cold forging
G 3508:1991	Boron steel wire rods for cold heading and cold forging
G 3509-1:2003	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

Designation	Title
G 3521:1991	Hard drawn steel wires
G 3522:1991	Piano wires
G 3523:1980	Core wires for covered electrode
G 3525:1998	Wire ropes
G 3532:2000	Low carbon steel wires
G 3533:1993	Barbed wires
G 3535:1998	Wire ropes for aircraft control
G 3536:1999	Uncoated stress-relieved steel wires and strands for prestressed concrete
G 3537:1994	Zinc-coated steel wire strands
G 3538:1994	Hard drawn steel wire for prestressed concrete
G 3539:1991	Carbon steel wires for cold heading and cold forging
G 3540:1995	Wire ropes for mechanical control
G 3542:1993	Precoated color zinc-coated steel wires
G 3543:1999	Polyvinyl chloride coated color steel wires
G 3544:1993	Hot-dip aluminium-coated steel wires
G 3545:1991	Boron steel wires for cold heading and cold forging
G 3546:2000	Wire ropes with profile wires
G 3547:1993	Zinc-coated low carbon steel wires
G 3548:1994	Zinc-coated steel wires
G 3549:2000	Wire ropes for structure
G 3550:2003	Stainless steel wire ropes for structure
G 3551:2000	Welded steel wire and bar fabrics
G 3552:2002	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 cloths
G 3560:1994	Oil tempered wire for mechanical springs
G 3561:1994	Oil tempered wire for valve springs
G 3601:2002	Stainless-clad steels
G 3602:2004	Nickel and nickel alloy clad steels
G 3603:1992	Titanium clad steels
G 3604:2004	Copper and copper alloy clad steels
G 4051:1979	Carbon steels for machine structural use
G 4052:2003	Structural steels with specified hardenability bands
G 4053:2003	Low-alloyed steels for machine structural use
G 4107:1994	Alloy steel bolting materials for high temperature service
G 4108:1994	Alloy steel bars for special application bolting materials
G 4109:2003	Chromium-molybdenum alloy steel plates for boilers and pressure vessels
G 4110:2004	High strength chromium-molybdenum and chromium-molybdenum-vanadium alloy steel plates for pressure vessels under high-temperature service
G 4202:1979	Aluminium chromium molybdenum steels
G 4303:1998	Stainless steel bars
G 4304:1999	Hot rolled stainless steel plates, sheets and strip
G 4305:1999	Cold rolled stainless steel plates, sheets and strip
G 4308:1998	Stainless steel wire rods
G 4309:1999	Stainless steel wires
G 4310:1999	Method of mass calculation for stainless steel plates and sheets, and heat-resisting steel plates and sheets
G 4311:1991	Heat-resisting steel bars
G 4312:1991	Heat-resisting steel plates and sheets
G 4313:1996	Cold rolled stainless steel strip for springs
G 4314:1994	Stainless steel wires for springs
G 4315:2000	Stainless steel wires for cold heading and cold forging
G 4316:1991	Stainless steel wire rods for welding
G 4317:1999	Hot rolled stainless steel equal leg angles
G 4318:1998	Cold finished stainless steel bars

Designation	Title
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 4401:2000	Carbon tool steels
G 4403:2000	High speed tool steels
G 4404:2000	Alloy tool steels
G 4410:1984	Hollow drill steels
G 4801:1984	Spring steels
G 4802:1999	Cold-rolled steel strips for springs
G 4804:1999	Free cutting carbon steel
G 4805:1999	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 4903:1991	Seamless nickel-chromium-iron alloy pipes
G 4904:1991	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 5131:1991	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 5504:1992	Heavy-walled ferritic spheroidal graphite iron castings for low temperature service
G 5510:1999	Austenitic iron castings
G 5511:1991	Low thermal expansive fe-alloy castings
G 5525:2000	Cast-iron drainage pipes and fittings
G 5526:1998	Ductile iron pipes
G 5527:1998	Ductile iron fittings
G 5528:1984	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 7101:2000	Structural steels with improved atmospheric corrosion resistance
G 7102:2000	Continuously hot-rolled steel sheet of structural quality with improved atmospheric corrosion resistance
G 7103:2000	Steel for the reinforcement of concrete – Part 1: Plain bars
G 7104:2000	Steel for the reinforcement of concrete – Part 2: Ribbed bars
G 7105:2000	Heat-treatable steels, alloy steels and free-cutting steels – Part 18: Bright products of unalloyed and low alloy steels
G 7121:2000	Cold-reduced electrolytic tinplate
G 7122:2000	Cold-reduced electrolytic chromium/chromium oxide-coated steel
G 7123:2000	Cold-reduced blackplate in coil form for the production of tinplate or electrolytic chromium/chromium oxide-coated steel
G 7124:2000	Continuous hot-dip aluminium/silicon-coated cold-reduced carbon steel sheet of commercial and drawing qualities
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)

Designation	Title
G 7219:2003	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 1: Unalloyed steels with specified room temperature properties (ISO specifications)
G 7220:2003	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 2: Unalloyed and alloyed steels with specified elevated temperature properties (ISO specifications)
G 7221:2003	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 3: Unalloyed and alloyed steels with specified low temperature properties (ISO specifications)
G 7222:2003	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 4: Austenitic stainless steels (ISO specifications)
G 7223:2003	Welded steel tubes for pressure purposes – Technical delivery conditions – Part 1: Unalloyed steel tubes with specified room temperature properties (ISO specifications)
G 7224:2003	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 specifications)
G 7225:2003	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 specifications)
G 7226:2003	Welded steel tubes for pressure purposes – Technical delivery conditions – Part 6: Longitudinally welded austenitic stainless steel tubes (ISO specifications)
G 7301:1998	Steel wire ropes for general purposes – Characteristics
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 7501:2000	Direct-hardening unalloyed and low-alloyed wrought steel in form of different black products
G 7502:2000	Wrought nitriding steels
G 7503:2000	Wrought case-hardening steels
G 7601:2000	Heat-resisting steels and alloys
G 7602:2000	Stainless steels for springs – Part 1: Wire
G 7603:2000	Valve steels for internal combustion engines
G 7604:2000	Nickel and nickel alloys bars
G 7605:2001	Nickel and nickel alloy plate, sheet and strip
G 7701:2000	Tool steels
G 7751:2000	Hot rolled steels for quenched and tempered springs
G 7821:2000	Cast carbon steels for general engineering purposes

Appendix 4

JIS DISCONTINUED STEEL AND RELATED STANDARDS

Designation	Date Whitdrawn/Replaced by
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: G4801
JIS G 0406:1950	Withdrawn in: 1959-12-01 Replaced by: G4801
JIS G 0501:1952	Withdrawn in: 1955-02-12 Replaced by: G3421;G3422;G3423
JIS G 0502:1952	Withdrawn in: 1955-02-12 Replaced by: G3436;G3437;G3438
JIS G 0704:1977	Withdrawn in: 1980-03-01
JIS G 1202:1975	Withdrawn in: 1995-07-01 Replaced by: G1253
JIS G 1203:1977	Withdrawn in: 1986-06-01 Replaced by: Z2611
JIS G 1230:1969	Withdrawn in: 1982-09-01 Replaced by: G1257
JIS G 1231:1969	Withdrawn in: 1981-03-01 Replaced by: G1236;G1237
JIS G 1251:1976	---
JIS G 1252:1975	---
JIS G 1254:1976	Withdrawn in: 1986-06-01 Replaced by: G1256
JIS G 1255:1977	Withdrawn in: 1986-06-01 Replaced by: G1256
JIS G 1315:1974	Withdrawn in: 1983-11-01
JIS G 1511:1976	Withdrawn in: 1986-02-01 Replaced by: G1601
JIS G 1512:1976	Withdrawn in: 1986-02-01 Replaced by: G1601
JIS G 1513:1976	Withdrawn in: 1986-02-01 Replaced by: G1601
JIS G 1514:1976	Withdrawn in: 1986-02-01 Replaced by: G1601
JIS G 1515:1976	Withdrawn in: 1986-02-01 Replaced by: G1601
JIS G 1516:1976	Withdrawn in: 1986-02-01 Replaced by: G1601
JIS G 1517:1975	Withdrawn in: 1985-03-01
JIS G 1518:1976	Withdrawn in: 1986-02-01 Replaced by: G1602
JIS G 1519:1975	Withdrawn in: 1986-02-01 Replaced by: G1602
JIS G 1520:1976	Withdrawn in: 1986-02-01 Replaced by: G1602
JIS G 1521:1975	Withdrawn in: 1986-02-01 Replaced by: G1602
JIS G 1522:1975	Withdrawn in: 1986-02-01 Replaced by: G1603
JIS G 1523:1975	Withdrawn in: 1986-02-01 Replaced by: G1603
JIS G 1524:1976	Withdrawn in: 1986-02-01 Replaced by: G1603
JIS G 1525:1975	Withdrawn in: 1986-02-01 Replaced by: G1603
JIS G 1526:1976	Withdrawn in: 1986-02-01 Replaced by: G1603
JIS G 1527:1976	Withdrawn in: 1986-02-01 Replaced by: G1601
JIS G 1528:1968	Withdrawn in: 1986-02-01 Replaced by: G1604
JIS G 1529:1975	Withdrawn in: 1985-03-01
JIS G 1530:1975	Withdrawn in: 1986-02-01 Replaced by: G1603
JIS G 1531:1975	Withdrawn in: 1986-02-01 Replaced by: G1602
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: G2201;G2202
JIS G 2204:1950	Withdrawn in: 1953-11-07 Replaced by: G2201;G2202
JIS G 2205:1953	Withdrawn in: 1953-11-07 Replaced by: G2201;G2202
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: G4051
JIS G 3107:1952	Withdrawn in: 1956-04-18 Replaced by: G3111
JIS G 3110:1953	Withdrawn in: 1965-03-01 Replaced by: G3112
JIS G 3115-1:1995 Part 1	Withdrawn in: 2000-06-20 Replaced by: JIS G 3115:2000
JIS G 3121:1951	Withdrawn in: 1955-02-12 Replaced by: G3123
JIS G 3122:1952	Withdrawn in: 1955-02-12 Replaced by: G3123
JIS G 3211:1977	Withdrawn in: 1982-07-01 Replaced by: G3202;G3203;G3204;G3205
JIS G 3212:1977	Withdrawn in: 1982-07-01 Replaced by: G3202;G3203;G3204;G3205
JIS G 3213:1977	Withdrawn in: 1982-07-01 Replaced by: G3202;G3203;G3204;G3205
JIS G 3301:1965	Withdrawn in: 1967-07-01 Replaced by: G3131
JIS G 3304:1950	Withdrawn in: 1956-07-17 Replaced by: G3301
JIS G 3305:1953	Withdrawn in: 1956-07-17 Replaced by: G3310
JIS G 3306:1954	Withdrawn in: 1956-07-17 Replaced by: G3310
JIS G 3307:1965	Withdrawn in: 1967-07-01 Replaced by: G3131
JIS G 3308:1957	Withdrawn in: 1969-08-06 Replaced by: G3141
JIS G 3309:1950	Withdrawn in: 1953-05-08
JIS G 3310:1965	Withdrawn in: 1969-08-06 Replaced by: G3141
JIS G 3391:1953	Withdrawn in: 1988-10-01

Designation	Date Whitdrawn/Replaced by
JIS G 3421:1951	Withdrawn in: 1955-02-12 Replaced by: G3432;G3433;G3434;G3435;G3436
JIS G 3422:1951	Withdrawn in: 1955-02-12 Replaced by: G3433
JIS G 3423:1951	Withdrawn in: 1955-02-12 Replaced by: G3435
JIS G 3424:1951	Withdrawn in: 1955-02-12 Replaced by: G3436
JIS G 3425:1951	Withdrawn in: 1955-02-12 Replaced by: G3437
JIS G 3426:1951	Withdrawn in: 1955-02-12 Replaced by: G3438
JIS G 3427:1951	Withdrawn in: 1955-02-12 Replaced by: G3432
JIS G 3428:1950	Withdrawn in: 1956-04-18 Replaced by: G3440
JIS G 3430:1952	Withdrawn in: 1957-10-30 Replaced by: G3443
JIS G 3431:1952	Withdrawn in: 1957-10-30 Replaced by: G3443
JIS G 3432:1958	Withdrawn in: 1962-03-01 Replaced by: G3452
JIS G 3433:1958	Withdrawn in: 1962-03-01 Replaced by: G3454;G3456
JIS G 3434:1958	Withdrawn in: 1962-03-01 Replaced by: G3455
JIS G 3435:1958	Withdrawn in: 1962-03-01 Replaced by: G3458;G3459
JIS G 3436:1958	Withdrawn in: 1962-03-01 Replaced by: G3461;G3462;G3463
JIS G 3437:1965	Withdrawn in: 1968-05-01
JIS G 3438:1958	Withdrawn in: 1962-03-01 Replaced by: G3459;G3461;G3462;G3463
JIS G 3439:1988	Withdrawn in: 1996-01-01
JIS G 3440:1956	Withdrawn in: 1961-02-01 Replaced by: G3444;G3445
JIS G 3501:1953	Withdrawn in: 1956-08-21 Replaced by: G3505;G3506
JIS G 3524:1953	Withdrawn in: 1957-10-30 Replaced by: Z3211
JIS G 3526:1962	Withdrawn in: 1980-03-01
JIS G 3527:1951	Withdrawn in: 1954-01-30 Replaced by: G3532
JIS G 3528:1951	Withdrawn in: 1954-01-30 Replaced by: G3533
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: Z3201
JIS G 3534:1988	Withdrawn in: 1994-06-01
JIS G 3541:1988	Withdrawn in: 1992-02-01
JIS G 3565:1988	Withdrawn in: 1994-06-01
JIS G 3566:1988	Withdrawn in: 1994-06-01 Replaced by: G3561
JIS G 3567:1988	Withdrawn in: 1994-06-01 Replaced by: G3560
JIS G 3568:1989	Withdrawn in: 1994-06-01 Replaced by: G3560
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: G3102;G4102;G4103;G4104;G4105
JIS G 4301:1955	Withdrawn in: 1959-12-01 Replaced by: G4303;G4304;G4305;G4306;G4307;G4308;G4309
JIS G 4302:1954	Withdrawn in: 1964-09-01 Replaced by: G4311;G4312
JIS G 4306:1988	Withdrawn in: 1991-11-01 Replaced by: G4304
JIS G 4307:1987	Withdrawn in: 1991-11-01 Replaced by: G4305
JIS G 4402:1953	Withdrawn in: 1956-04-18 Replaced by: G4404
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: G4404
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: G5702;G5703;G5704
JIS G 5702:1988	Withdrawn in: 2000-02-20 Replaced by: JIS G 5705:2000
JIS G 5703:1988	Withdrawn in: 2000-02-20 Replaced by: JIS G 5705:2000
JIS G 5704:1988	Withdrawn in: 2000-02-20 Replaced by: JIS G 5705:2000
JIS G 9071:1976	Withdrawn in: 1992-02-01
JIS G 9072:1976	Withdrawn in: 1992-02-01

Appendix 5

CEN CURRENT STEEL STANDARDS

Designation	Title
EN ISO 683-17:1999	Heat-Treated Steels, Alloy Steels and Free-Cutting Steels – Ball and Roller Bearing Steels
EN ISO 1127:1996	Stainless Steel Tubes – Dimensions, Tolerances and Conventional Masses per Unit Length
EN ISO 4066:1999	Construction Drawings – Bar Scheduling
EN ISO 4957:1999	Tool Steels
EN ISO 7153-1:2000	Surgical Instruments. Metallic Materials – Part 1: Stainless Steel
EN ISO 11960:2001	Petroleum and Natural Gas Industries – Steel Pipes for Use as Casing or Tubing for Wells
EN 502:1999	Roofing Products from Metal Sheet – Specification for Fully Supported Products of Stainless Steel Sheet
EN 505:1999	Roofing Products from Metal Sheet – Specification for Fully Supported Roofing Products of Steel Sheet
EN 508-1:2000	Roofing Products from Metal Sheet v Specification for Self-Supporting Products of Steel, Aluminum or Stainless Steel Sheet – Part 1: 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 – Test Methods – Part 2: To-and-Fro Bending Test
EN 524-4:1997	Steel Strip Sheaths for Prestressing Tendons – Test Methods – Part 2: Determination of Lateral Load Resistance
EN 524-5:1997	Steel Strip Sheaths for Prestressing Tendons – Test Methods – Part 2: Determination of Tensile Load Resistance
EN 524-6:1997	Steel Strip Sheaths for Prestressing Tendons – Test Methods – Part 2: Determination of Leaktightness (Determination of Water Loss)
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 1123-2:1999	Pipes and Fittings of Longitudinally Welded Hot-Dip Galvanized Steel Pipes with Spigot and Socket for Waste Water Systems – Part 2: Dimensions
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 1124-2:1999	Pipes and Fittings of Longitudinally Welded Stainless Steel Pipes with Spigot and Socket for Waste Water Systems – Part 2: System S. Dimensions
EN 1124-3:1999	Pipes and Fittings of Longitudinally Welded Stainless Steel Pipes with Spigot and Socket for Waste Water Systems – Part 3: System X; Dimensions
EN 1370:1996	Founding. Surface Roughness Inspection by Visual Tactile Comparators
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 1559-2:2000	Founding. Technical Conditions of Delivery – Part 2: Additional Requirements for Steel Castings
EN 1677-1:2000	Components for Slings – Safety – Part 1: Safety. Forged Steel Components, Grade 8
EN 1677-2:2000	Components for Slings – Safety – Part 2: Forged Steel Lifting Hooks with Latch, Grade 8
EN 10016-1:1994	Non-Alloy Steel Rods for Drawing and/or Cold Rolling – Part 1: General Requirements
EN 10016-2:1994	Non-Alloy Steel Rods for Drawing and/or Cold Rolling – Part 2: Specific Requirements for General Purpose Rod
EN 10016-3:1994	Non-Alloy Steel Rods for Drawing and/or Cold Rolling – Part 3: Specific Requirements for Rimmed and Rimmed Substitute Low Carbon Steel Rod
EN 10016-4:1994	Non-Alloy Steel Rods for Drawing and/or Cold Rolling – Part 4: Specific Requirements for Rod for Special Applications
EN 10024:1995	Hot Rolled Taper Flange I Sections – Tolerances On Shape and Dimensions
EN 10025:1990	Iron and Steel Products, Structural Steels, Non Alloy Steel, Hot Rolled Products, Quality Classes, Designation, Specification, Chemical Composition, Mechanical Property, Mechanical Test, Inspection, Marking
EN 10028-1:2000	Flat Products Made of Steels for Pressure Purposes – Part 1: General Requirements
EN 10028-2:2003	Flat products Made of Steels for Pressure Purposes – Part 2: Non-Alloy and Alloy Steels with Specified Elevated Temperature Properties
EN 10028-3:2003	Flat Products Made of Steels for Pressure Purposes – Part 3: Weldable Fine Grain Steels, Normalized
EN 10028-4:2003	Flat Products Made of Steels for Pressure Purposes – Part 4: Nickel alloy Steels with Specified Low Temperature Properties
EN 10028-5:2003	Flat Products Made of Steels for Pressure Purposes – Part 5: Weldable Fine Grain Steels, Thermomechanically Rolled
EN 10028-6:2003	Flat Products Made of Steels for Pressure Purposes – Part 6: Weldable Fine Grain Steels, Quenched and Tempered
EN 10028-7:2000	Flat Products Made of Steels for Pressure Purposes – Part 7: Stainless Steels
EN 10029:1991	Hot Rolled Steel Plates 3 mm Thick or Above – Tolerances on Dimensions, Shape and Mass
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 10051:1991	Continuously Hot-Rolled Uncoated Plate, Sheet and 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

Designation	Title
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 10079:1992	Definition of Steel Products
EN 10083-1:1991	Quenched and Tempered Steels – Part 1: Technical Delivery Conditions for Special Steels
EN 10083-2:1991	Quenched and Tempered Steels – Part 2: Technical Delivery Conditions for Unalloyed Quality Steels
EN 10083-3:1995	Quenched and Tempered Steels – Part 3: Technical Delivery Conditions for Boron Steels
EN 10084:1998	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 10088-1:1995	Stainless Steels – Part 1: List of Stainless Steels
EN 10088-2:1995	Stainless Steels – Part 2: Technical Delivery Conditions for Sheet/Plate and Strip for General Purposes
EN 10088-3:1995	Stainless Steels – Part 3: Technical Delivery Conditions for Semi-Finished Products, Bars, Rods and Sections for General Purposes
EN 10090:1998	Valve Steels and Alloys for Internal Combustion Engines
EN 10095:1999	Heat Resisting Steels and Nickel Alloys
EN 10106:1995	Cold Rolled Non-Oriented Electrical Steel Sheet and Strip Delivered in the Fully Processed State
EN 10107:1995	Grain-Oriented Electrical Steel Sheet and Strip Delivered in the Fully Processed State
EN 10111:1998	Continuously Hot-Rolled Low Carbon Steel Sheet and Strip for Cold Forming – Technical Delivery Conditions
EN 10113-1:1993	Hot-Rolled Products in Weldable Fine Grain Structural Steels – Part 1: General Delivery Conditions
EN 10113-2:1993	Hot-Rolled Products in Weldable Fine Grain Structural Steels – Part 2: Delivery Conditions for Normalized/Normalized Rolled Steels
EN 10113-3:1993	Hot-Rolled Products in Weldable Fine Grain Structural Steels – Part 3: Delivery Conditions for Thermomechanical Rolled Steels
EN 10120:1996	Steel Sheet and Strip for Welded Gas Cylinders
EN 10126:1995	Cold Rolled Electrical Non-Alloyed Steel Sheet and Strip Delivered in the Semi-Processed State
EN 10130:1998	Cold-Rolled Low-Carbon Steel Flat Products for Cold Forming – Technical Delivery Conditions
EN 10131:1991	Cold-Rolled Uncoated 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
EN 10137-1:1995	Plates and Wide Flats Made of High Yield Strength Structural Steels in the Quenched and Tempered or Precipitation Hardened Conditions – Part 1: General Delivery Conditions
EN 10137-2:1995	Plates and Wide Flats Made of High Yield Strength Structural Steels in the Quenched and Tempered or Precipitation Hardened Conditions – Part 2: Delivery Conditions for Quenched and Tempered Steels
EN 10137-3:1995	Plates and Wide Flats Made of High Yield Strength Structural Steels in the Quenched and Tempered or Precipitation Hardened Conditions – Part 3: Delivery Conditions for Precipitation Hardened Steels
EN 10139:1997	Cold Rolled Uncoated Mild Steel Narrow Strip for Cold Forming – Technical Delivery Conditions
EN 10140:1996	Cold Rolled Narrow Steel Strip – Tolerances On Dimensions and Shape
EN 10142:2000	Continuously Hot-Dip Zinc Coated Low Carbon Steels Strip and Sheet for Cold Forming – Technical Delivery Conditions
EN 10143:1993	Continuously Hot-Dip Metal Coated Steel Sheet and Strip – Tolerances On Dimensions and Shape
EN 10147:2000	Continuously Hot-Dip Zinc Coated Structural Steels Strip and Sheet – Technical Delivery Conditions
EN 10149-1:1995	Specification for Hot-Rolled Flat Products Made of High Yield Strength Steels for Cold Forming – Part 1: General Delivery Conditions
EN 10149-2:1995	Specification for Hot-Rolled Flat Products Made of High Yield Strength Steels for Cold Forming – Part 2: Delivery Conditions for Thermomechanically Rolled Steels
EN 10149-3:1995	Specification for Hot-Rolled Flat Products Made of High Yield Strength Steels for Cold Forming – Part 3: Delivery Conditions for Normalized or Normalized Rolled Steels
EN 10152:2003	Electrolytically Zinc Coated Cold Rolled Steel Flat Products for Cold Forming – Technical Delivery Conditions
EN 10154:2002	Continuously Hot-Dip Aluminium-Silicon (AS) Coated Steel Strip and Sheet – Technical Delivery Conditions
EN 10155:1993	Structural Steels with Improved Atmospheric Corrosion Resistance – Technical Delivery Conditions
EN 10160:1999	Ultrasonic Testing of Steel Flat Product of Thickness Equal or Greater Than 6 Mm (Reflection Method)
EN 10163-1:1991	Specification for Delivery Requirements for Surface Condition of Hot Rolled Steel Plates, Wide Flats and Sections – Part 1: General Requirements

Designation	Title
EN 10163-2:1991	Specification for Delivery Requirements for Surface Condition of Hot Rolled Steel Plates, Wide Flats and Sections – Part 2: Plates and Wide Flats
EN 10163-3:1991	Specification for Delivery Requirements for Surface Condition of Hot Rolled Steel Plates, Wide Flats and Sections – Part 3: Sections
EN 10164:1993	Steel Products with Improved Deformation Properties Perpendicular To the Surface of the Product – Technical Delivery Conditions
EN 10165:1995	Cold Rolled Electrical Alloyed Steel Sheet and Strip Delivered in the Semi-Processed State
EN 10169-1:1997	Continuously Organic Coated (Coil Coated) Steel Flat Products – Part 1: General Information (Definitions, Materials, Tolerances, Test Methods)
EN 10202:2001	Cold Reduced Tinmill Products – Electrolytic Tinplate and Electrolytic Chromium/Chromium Oxide Coated Steel
EN 10204:1991	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 10207:1992	Steels for Simple Pressure Vessels – Technical Delivery Requirements for Plates, Strips and Bars
EN 10208-1:1997	Steel Pipes for Pipelines for Combustible Fluids – Technical Delivery Conditions – Part 1: Pipes of Requirement Class A
EN 10208-2:1996	Steel Pipes for Pipelines for Combustible Fluids – Technical Delivery Conditions – Part 2: Pipes of Requirement Class B
EN 10209:1996	Cold Rolled Low Carbon Steel Flat Products for Vitreous Enamelling – Technical Delivery Conditions
EN 10210-1:1994	Hot Finished Structural Hollow Sections of Non-Alloy and Fine Grain Structural Steels – Part 1: Technical Delivery Requirements
EN 10210-2:1997	Hot Finished Structural Hollow Sections of Non-Alloy and Fine Grain Structural Steels – Part 2: Tolerances, Dimensions and Sectional Properties
EN 10213-1:1995	Technical Delivery Conditions for Steel Castings for Pressure Purposes – Part 1: General
EN 10213-2:1995	Technical Delivery Conditions for Steel Castings for Pressure Purposes – Part 2: Steel Grades for Use at Room Temperature and at Elevated Temperature
EN 10213-3:1995	Technical Delivery Conditions for Steel Castings for Pressure Purposes – Part 3: Steels for Use at Low Temperatures
EN 10213-4:1995	Technical Delivery Conditions for Steel Castings for Pressure Purposes – Part 4: Austenitic and Austenitic-Ferritic Steel Grades
EN 10214:1995	Continuously Hot-Dip Zinc-Aluminium (ZA) Coated Steel Strip and Sheet – Technical Delivery Conditions
EN 10215:1995	Continuously Hot-Dip Zinc-Aluminium (AZ) Coated Steel Strip and Sheet – Technical Delivery Conditions
EN 10218-1:1994	Steel Wire and Wire Products – General – Part 1: Test Methods
EN 10218-2:1997	Steel Wire and Wire Products – General – Part 2: Wire Dimensions and Tolerances
EN 10219-1:1997	Cold Formed Welded Structural Sections of Non-Alloy and Fine Grain Steels – Part 1: Technical Delivery Requirements
EN 10219-2:1997	Cold Formed Welded Structural 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 10222-1:2002	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
EN 10222-5:1999	Steel Forgings for Pressure Purposes – Part 5: Martensitic, Austenitic and Austenitic-Ferritic Stainless Steels
EN 10223-1:1997	Steel Wire and Wire Products for Fences – Part 1: Zinc and Zinc Alloy Coated Steel Barbed Wire
EN 10223-2:1997	Steel Wire and Wire Products for Fences – Part 2: Hexagonal Steel Wire Netting for Agricultural, Insulation and Fencing Purposes
EN 10223-3:1997	Steel Wire and Wire Products for Fences – Part 3: Hexagonal Steel Wire Netting for Engineering Purposes
EN 10223-4:1998	Steel Wire and Wire Products for Fences – Part 4: Steel Wire Welded Mesh Fencing
EN 10223-5:1998	Steel Wire and Wire Products for Fences – Part 5: Steel Wire Woven Hinged Joint and Knotted Mesh Fencing
EN 10223-6:1998	Steel Wire and Wire Products for Fences – Part 6: Steel Wire Chain Link Fencing
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 10238:1996	Automatically Blast Cleaned and Automatically 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

Designation	Title
EN 10243-2:1999	Steel Die Forgings. Tolerances On Dimensions – Part 2: Upset Forgings Made On Horizontal Forging Machines
EN 10244-1:2001	Steel Wire and Wire Products – Non-Ferrous Metallic Coatings On Steel Wire – Part 1: General Principles
EN 10244-2:2001	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 10245-1:2001	Steel Wire and Wire Products – Organic Coatings On Steel Wire – Part 1: General Rules
EN 10245-2:2001	Steel Wire and Wire Products – Organic Coatings On Steel Wire – Part 1: PVC Finished Wire
EN 10245-3:2001	Steel Wire and Wire Products – Organic Coatings On Steel Wire – Part 1: PE Coated Wire
EN 10246-1:1996	Non-Destructive Testing of Steel Tubes – Part 1: Automatic Electromagnetic Testing of Seamless and Welded (Except Submerged Arc Welded) Ferromagnetic Steel Tubes for Verification of Hydraulic Leak-Tightness
EN 10246-2:2000	Non-Destructive Testing of Steel Tubes – Part 2: Automatic Eddy Current Testing of Seamless and Welded (Except Submerged Arc Welded) Austenitic and Austenitic-Ferritic Steel Tubes for Verification of Hydraulic Leak-Tightness
EN 10246-3:1999	Non-Destructive Testing of Steel Tubes – Part 3: Automatic Eddy Current Testing of Seamless and Welded (Except Submerged Arc-Welded) Steel Tubes for the Detection of Imperfections
EN 10246-4:1999	Non-Destructive Testing of Steel Tubes – Part 4: Automatic Full Peripheral Magnetic Transducer/Flux Leakage Testing of Seamless Ferromagnetic Steel Tubes for the Detection of Transverse Imperfections
EN 10246-5:1999	Non-Destructive Testing of Steel Tubes – Part 5: Automatic Full Peripheral Magnetic Transducer/Flux Leakage Testing of Seamless and Welded (Except Submerged Arc-Welded) Ferromagnetic Steel Tubes for the Detection of Longitudinal Imperfections
EN 10246-6:1999	Non-Destructive Testing of Steel Tubes – Part 6: Automatic Full Peripheral Ultrasonic Testing of Seamless Steel Tubes for the Detection of Transverse Imperfections
EN 10246-7:1996	Non-Destructive Testing of Steel Tubes – Part 7: Automatic Full Peripheral Ultrasonic Testing of Seamless and Welded (Except Submerged Arc Welded) Steel Tubes for the Detection of Longitudinal Imperfections
EN 10246-8:1999	Non-Destructive Testing of Steel Tubes – Part 8: Automatic Ultrasonic Testing of the Weld Seam of Electric Welded Steel Tubes for the Detection of Longitudinal Imperfections
EN 10246-9:2000	Non-Destructive Testing of Steel Tubes – Part 9: Automatic Ultrasonic Testing of the Weld Seam of Submerged Arc Welded Steel Tubes for the Detection of Longitudinal and/or Transverse Imperfections
EN 10246-10:2000	Non-Destructive Testing of Steel Tubes – Part 10: Radiographic Testing of the Weld Seam of Automatic Fusion Arc Welded Steel Tubes for the Detection of Imperfections
EN 10246-11:2000	Non-Destructive Testing of Steel Tubes – Part 11: Liquid Penetrant Testing of Seamless and Welded Steel Tubes for the Detection of Surface Imperfections
EN 10246-12:2000	Non-Destructive Testing of Steel Tubes – Part 12: Magnetic Particle Inspection of Seamless and Welded Ferromagnetic Steel Tubes for the Detection of Surface Imperfections
EN 10246-13:2000	Non-Destructive Testing of Steel Tubes – Part 13: Automatic Full Peripheral Ultrasonic Thickness Testing for Seamless and Welded (Except Submerged Arc Welded) Steel Tubes
EN 10246-14:1999	Non-Destructive Testing of Steel Tubes – Part 14: Automatic Ultrasonic Testing of Seamless and Welded (Except Submerged Arc-Welded) Steel Tubes for the Detection of Laminar Imperfections
EN 10246-15:2000	Non-Destructive Testing of Steel Tubes – Part 15: Automatic Ultrasonic Testing of Strip/Plate Used in the Manufacture of Welded Steel Tubes for the Detection of Laminar Imperfections
EN 10246-16:2000	Non-Destructive Testing of Steel Tubes – Part 16: Automatic Ultrasonic Testing of the Area Adjacent To the Weld Seam of Welded Steel Tubes for the Detection of Laminar Imperfections
EN 10246-17:2000	Non-Destructive Testing of Steel Tubes – Part 17: Ultrasonic Testing of Tube Ends of Seamless and Welded Steel Tubes for the Detection of Laminar Imperfections
EN 10246-18:2000	Non-Destructive Testing of Steel Tubes – Part 18: Magnetic Particle Inspection of Tube Ends of Seamless and Welded Ferromagnetic Steel Tubes for the Detection of Laminar Imperfections
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 Steel Die Forgings for General Engineering Purposes – Part 1: General Requirements
EN 10250-2:1999	Open Steel Die Forgings for General Engineering Purposes – Part 2: Non-Alloy Quality and Special Steels
EN 10250-3:1999	Open Steel Die Forgings for General Engineering Purposes – Part 3: Alloy Special Steels
EN 10250-4:1999	Open Steel Die 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 10254:1999	Steel Closed Die Forgings – General Technical Delivery Conditions

Designation	Title
EN 10256:2000	Non-Destructive Testing On Steel Tubes – Qualification and Competence of Level 1 and Level 2 Non-Destructive Testing Personnel
EN 10257-1:1998	Zinc or Zinc Alloy Coated Non-Alloy Steel Wire for Armouring Either Power Cables or Telecommunication Cables – Part 1: Land Cables
EN 10257-2:1998	Zinc or Zinc Alloy Coated Non-Alloy Steel Wire for Armouring Either Power Cables or Telecommunication Cables – Part 2: Submarine Cables
EN 10258:1997	Cold-Rolled Stainless Steel Narrow Strip and Cut Lengths – Part 1: Tolerances On Dimensions and Shape
EN 10259:1997	Cold-Rolled Stainless and Heat Resisting Steel Wide Strip and Plate/Sheet – Tolerances On Dimensions and Shape
EN 10267:1998	Ferritic-Pearlitic Steels for Precipitation Hardening from Hot-Working Temperatures
EN 10268:1998	Cold-Rolled Flat Products Made of High Yield Strength Micro-Alloyed Steels for Cold Forming – General Delivery Conditions
EN 10269:1999	Steels and Nickel Alloys for Fasteners with Specified Elevated and/or Low Temperature Properties
EN 10270-1:2001	Steel Wire for Mechanical Springs – Part 1: Patented Cold Drawn Unalloyed Spring Steel Wire
EN 10270-2:2001	Steel Wire for Mechanical Springs – Part 2: Oil Hardened and Tempered Spring Steel Wire
EN 10270-3:2001	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 10272:2000	Stainless Steel Bars for Pressure Purposes
EN 10273:2000	Hot Rolled Weldable Steel Bars for Pressure Purposes with Specified Elevated Temperature Properties
EN 10277-1:1999	Bright Steel Products – Part 1: Technical Delivery Conditions. General
EN 10277-2:1999	Bright Steel Products – Part 2: Technical Delivery Conditions. Steels for General Engineering Purposes
EN 10277-3:1999	Bright Steel Products – Part 3: Technical Delivery Conditions. Free Cutting Steels
EN 10277-4:1999	Bright Steel Products – Part 4: Technical Delivery Conditions. Case-Hardening Steels
EN 10277-5:1999	Bright Steel Products – Part 5: Technical Delivery Conditions. 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, Dimension and Mass
EN 10283:1998	Corrosion Resistant Steel Castings
EN 10292:2000	Continuously Hot-Dip Coated Strip and Sheet of Steels with Higher Yield Strength for Cold Forming – Technical Delivery Conditions
EN 10303:2001	Thin Magnetic Steel Sheet and Strip for Use at Medium Frequencies
EN 12007-3:2000	Gas Supply Systems – Pipelines for Maximum Operating Pressure Up To and Including 16 Bar – Part 3: Specific Functional Recommendations for Steel
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 12454:1998	Founding – Visual Examination of Surface Discontinuities – Steel Sand Castings
EN 10142:1990	Continuously Hot-Dip Zinc Coated Low Carbon Steel Sheet and Strip for Cold Forming – Technical Delivery Conditions
EN 10147:1991	Continuously Hot-Dip Zinc Coated Structural Steel Sheet and Strip – Technical Delivery Conditions
EN 10202:2001	Cold Reduced Tinmill Products – Electrolytic Tinplate and Electrolytic Chromium/Chromium Oxide Coated Steel

Appendix 6

CEN STANDARDS WITH SUPERSEDED FORMER NATIONAL STANDARDS

Chapter 2: Carbon and Alloy Steels for General Use	
Current CEN Standard	**Former National Standards Superseded by CEN Standards**
EN 10083–1:1991+A1:1996 Quenched and Tempered Steels – Part 1: Technical Delivery Conditions for Special Steels EN 10083–2:1991+A1:1996 Quenched and Tempered Steels – Part 2: Technical Delivery Conditions for Unalloyed Quality Steels	Supersedes: BSI BS 970-1:1983 Wrought Steels for Mechanical and Allied Engineering Purposes – Part 1: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels
EN 10084:1998 Case Hardening Steels – Technical Delivery Conditions	Supersedes: BSI BS 970-1:1996 Wrought Steels for Mechanical and Allied engineering Purposes – Part 1: General Inspection And Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels
EN 10016-1:1995 Non-Alloy Steel Rod for Drawing or Cold Rolling – Part 1: General Requirements EN 10016-2:1995 Non-Alloy Steel Rod for Drawing or Cold Rolling; – Part 2: Specific Requirements for General Purpose Rod	Supersedes: DIN 17140-1:1983 Wire Rod for Cold Drawing – Technical Delivery Conditions for Basic Steel and Unalloyed Quality Steels
EN 10016-2:1995 Non-Alloy Steel Rod for Drawing and/or Cold Rolling – Part 2: Specific Requirements for General Purposes Rod.	Supersedes: AFNOR NF A35-051:1982 Fil Machine en Acier Non Allié Destiné au Tréfilage et au Laminage à Froid – Nuances
EN 10083-1:1991 Quenched And Tempered Steels – Part 1: Technical Delivery Conditions For Specials Steels.	Supersedes: AFNOR NF EN 10083-1:1991 Aciers pour Trempe et Revenu – Partie 1: Conditions Techniques de Livraison des Aciers Spéciaux
EN 10083-2:1991 Quenched And Tempered Steels – Part 2: Technical Delivery Conditions For Unalloyed Quality Steels.	Supersedes: AFNOR NF EN 10083-2:1991 Aciers pour Trempe et Revenu – Partie 2: Conditions Techniques de Livraison des Aciers de Qualité Non Alliés AFNOR NF A33-101:1982 Aciers au Carbone de Qualité Aptes au Forgeage et aux Traitements Thermiques – Demi Produits, Barres et Fil Machine
EN 10084:1998 Case Hardening Steels – Technical Delivery Conditions	Supersedes: AFNOR NF A35-551:1986 Aciers de Construction Non Alliés et Alliés Spéciaux pour Cémentation – Nuances - Demi-Produits, Barres et Fils Machine

Chapter 3: Structural Steel Plates	
Current CEN Standards	**Former National Standards Superseded by CEN Standards**
EN 10025:1993 Hot Rolled Products of Non-Alloy Structural Steels – Technical Delivery Conditions	Supersedes: BSI BS 4360:1986 Weldable Structural Steels (Withdrawn)
EN 10113 Hot-Rolled Products in Weldable Fine Grain Structural Steels EN 10113-1:1993 General Delivery Conditions EN 10113-2:1993 Delivery Conditions for Normalized/Normalized Rolled Steels EN 10113-3:1993 Delivery Conditions for Thermomechanical Rolled Steels EN 10155:1993 Structural Steels with Improved Atmospheric Corrosion Resistance – Technical Delivery Conditions	Supersedes: BSI BS 4360:1990 Weldable Structural Steels (Withdrawn)
EN 10137 Plates and Wide Flats Made of High Yield Strength Structural Steels in the Quenched and Tempered or Precipitation Hardened Conditions EN 10137-1:1996 General Delivery Conditions EN 10137-2:1996 Delivery Conditions for Quenched and Tempered Steels EN 10137-3:1996 Delivery Conditions for Precipitation Hardened Steels	Supersedes: BSI BS 7613:1994 Hot Rolled Quenched and Tempered Weldable Structural Steel Plates (Withdrawn)
EN 10025:1993 Hot Rolled Products of Non-Alloy Structural Steels - Technical Delivery Conditions	Supersedes: DIN 17100:1980 Steels for General Structural Purposes; Quality Standard (Withdrawn)
EN 10113 Hot Rolled Products Made from Weldable, Fine Grain Structural Steel; EN 10113-1:1993 General Technical Delivery Conditions EN 10113-2:1993 Delivery Conditions for Normalized/Normalized Rolled Steels EN 10028 Flat Products Made from Steel for Pressure Purposes EN 10028-1:2000 General Requirements EN 10028-3:2003 Weldable Fine Grain Steels, Normalized	Supersedes : DIN 17102:1983 Weldable Normalized Fine Grain Structural Steels; Technical Delivery Conditions for Plate, Strip, Wide Flats, Sections and Bars (Withdrawn)
EN 10113 Hot-Rolled Products in Weldable Fine Grain Structural Steels EN 10113-2:1993 Delivery Conditions for Normalized/Normalized Rolled Steels.	Supersedes : AFNOR NF A 35-504:1984 Poutrelles et Profils en Aciers à Haute Limite d'Élasticité pour Constructions Soudées – Nuances et Qualités AFNOR NF A 36-201:1984 Tôles en Aciers à Haute Limite d'Élasticité pour Constructions Soudées – Nuances et Qualités

Chapter 3: Structural Steel Plates (Continued)	
Current CEN Standards	**Former National Standards Superseded by CEN Standards**
EN 10137 Plates and Wide Flats Made of High Yield Strength Structural Steels in the Quenched and Tempered or Precipitation Hardened Conditions EN 10137-2:1996 Delivery Conditions for Quenched and Tempered Steels EN 10137-3:1996 Delivery Conditions for Precipitation Hardened Steels	Supersedes: AFNOR NF A 36-204:1992 Produits Sidérurgiques – Tôles en Aciers à Haute Limite d'Élasticité Livrées à l'État Traité pour Construction Soudée – Nuances et Qualité
EN 10155 :1993 Structural Steels With Improved Atmospheric Corrosion Resistance – Technical Delivery Conditions	Supersedes : AFNOR NF A35-502 :1984 Aciers de Construction à Résistance Améliorée à la Corrosion Atmosphérique – Tôles Minces Moyennes et Fortes, Larges Plats, Laminés Marchands et Poutrelles

Chapter 4: Pressure Vessel Steel Plates	
Current CEN Standard	**Former National Standards Superseded by CEN Standards**
EN 10028 Flat Products Made of Steels for Pressure Purposes. EN 10028-2 :2003 Non-Alloy and Alloy Steels with Specified Elevated Temperature Properties EN 10028-3 :2003 Weldable Fine Grain Steels, Normalized	Supersedes : BSI BS 1501 Steels for Pressure Purposes. BSI BS 1501-1 :1980 Carbon and Carbon Manganese Steels : Plates (Withdrawn) BSI BS 1501-2 :1988 Alloy Steels : Plates (Withdrawn)
EN 10028-4 :1995 Flat Products Made of Steels for Pressure Purposes – Part 4 : Nickel Alloy Steels with Specified Low Temperature Properties	Supersedes : BSI BS 1501-2 :1988 Steels for Pressure Purposes – Part 2 : Specification for Alloy Steels : Plates (Withdrawn)
EN 10028-1 :2000 Flat Products Made of Steels for Pressure Purposes – Part 1 : General Requirements	Supersedes : BSI BS 1501-1 :1980 Steels For Pressure Purposes – Part 1 : Specification for Carbon and Carbon Manganese Steels : Plates (Withdrawn) BSI BS 1501-2 :1988 Steels for Pressure Purposes – Part 2 : Specification for Alloy Steels : Plates (Withdrawn)
EN 10028-7 :2000 Flat Products Made of Steels for Pressure Purposes – Part 7 : Stainless Steels	Supersedes : BSI BS 1501-3 :1990 Amd 5 Steels for Pressure Purposes – Part 3 : Specification for Corrosion- and Heat-Resisting Steels : Plates, Sheet and Strip (Withdrawn)
EN 10028 Flat Products Made from Steel for Pressure Purposes; EN 10028-1 :2000 General requirements EN 10028-2 :2003 Unalloyed and Alloy Steels with Elevated Temperature Properties	Supersedes : DIN 17155 :1983 Weldable Normalized Fine Grain Structural Steels; Technical Delivery Conditions for Plate Strip, Wide Flats, Sections and Bars
EN 10028 :1993 Flat Products Made from Steel for Pressure Purposes EN 10028-1 : 2000 General requirements EN 10028-3 :2003 Weldable, Normalized, Fine Grain Steels EN 10113 :1993 Hot Rolled Products Made from Weldable, Fine Grain Structural Steel EN 10113-1 :1993 General Technical Delivery Conditions EN 10113-2 :1993 Technical Delivery Conditions for Normalized Rolled Steel	Supersedes : DIN 17102 :1983 Creep Resistant Steel Plate and Strip; Technical Delivery Conditions
EN 10028-4 :2003 Flat Products Made of Steels for Pressure Purposes – Part 4 : Nickel-Alloy Steels with Specified Low Temperature Properties EN 10028-1 :2000 Flat Products Made of Steel for Pressure Purposes – Part 1 : General Requirements	Partially Supersedes : DIN 17280 :1985 Steels With Low Temperature Toughness; Technical Delivery Conditions for Plate. Sheet, Strip, Wide Flats,Sections,Bars and Forgings

Chapter 4: Pressure Vessel Steel Plates (Continued)	
Current CEN Standard	**Former National Standards Superseded by CEN Standards**
EN 10028-7:2000 Flat Products Made of Steels for Pressure – Part 7: Purposes Stainless Steels	Supersedes: DIN 17441:1997 Technical Delivery Conditions for Stainless Steel Cold-Rolled Strip, Slit Strip and Plate Cut Therefrom for Pressure Purposes Partially Supersedes: DIN 17440:1996 Technical Delivery Conditions for Stainless Steel Plate, Hot Rolled Strip, and Bars for Pressure Purposes DIN 17460:1992 High-Temperature Austenitic Steel Plate and Sheet, Cold and Hot Rolled Strip, Bars and Forgings; Technical Delivery Conditions
EN 10028-2:2003 Flat Products Made of Steels for Pressure Purposes – Part 2: Non-Alloy and Alloy Steels with Specified Elevated Temperature Properties.	Supersedes: AFNOR NF A36-205:1982 Iron and steel products: steel plates for boilers and pressure vessels; carbon and carbon manganese steels, grades and qualities AFNOR NF A36-206:1983 Iron and steel products: steel plates for boilers and pressure vessels; Mo, Mn-Mo and Cr-Mo alloy steels, grades and qualities
EN 10028-3:2003 Flat Products Made of Steels for Pressure Purposes – Part 3: Weldable Fine Grain Steels, Normalized.	Supersedes: AFNOR NF A36-207:1982 Iron and steel products: high yield strength steel plates for pressure vessels; grades and qualities (July)
EN 10028-4:2003 Flat Products Made of Steels for Pressure Purposes – Part 4: Nickel Alloy Steels with Specified Low Temperature Properties.	Supersedes: AFNOR NF A36-208:1982 Tôles en Aciers au Nickel pour Appareils à Pression à Basse Température
EN 10028-7:2000 Flat Products Made of Steels for Pressure Purposes – Part 7: Stainless Steels	Partially Supersedes: AFNOR NF A36-209:1990 Austenitic and Austenic-Ferritic Stainless Steels Plates for Boilers and Pressure Vessels

Chapter 5: Steel Tubes and Pipes	
Current CEN Standard	**Former National Standards Superseded by CEN Standards**
EN 10208-1:1997 Steel Pipes for Pipe Lines for Combustible Fluids – Technical Delivery Conditions – Part 1: Pipes of Requirement Class A	Supersedes: DIN 1626:1984 Welded Circular Unalloyed Steel Tubes Subject to Special Requirements DIN 1629:1984 Seamless Circular Unalloyed Steel Tubes Subject to Special Requirements
EN 10216-1:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 1: Non-Alloy Steel Tubes with Specified Room Temperature Properties	Supersedes: AFNOR NF A49-111:1978 Plain end seamless tubes of commercial quality for general purposes at mean pressure AFNOR NF A49-112:1987 Plain end seamless hot rolled tubes with specified room temperature properties and with special delivery conditions – Dimensions – Technical delivery conditions BSI BS 3059-1:1987 Steel Boiler and Superheater Tubes – Part 1: Specification for Low Tensile Carbon Steel Tubes Without Specified Elevated Temperature Properties BSI BS 3601:1987 Carbon Steel Pipes and Tubes with Specified Room Temperature Properties for Pressure Purposes DIN 1626:1984 Welded Circular Unalloyed Steel Tubes Subject to Special Requirements DIN 1629:1984 Seamless Circular Unalloyed Steel Tubes Subject to Special Requirements
EN 10216-2:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 2: Non-Alloy and Alloy Steel Tubes with Specified Elevated Temperature Properties	Supersedes: AFNOR NF A 49-210:1985 Steel Tubes: Seamless Cold Drawn Tubes for Fluid Piping – Dimensions – Technical Delivery Conditions AFNOR NF A 49-211:1989 Steel Tubes; Seamless Plain-End Tubes in Unalloyed Steels for Fluid Piping at Elevated Temperatures – Dimensions – Technical Delivery Conditions AFNOR NF A 49-213:1990 Seamless Unalloyed and Mo and Cr-Mo Alloyed Steel Tubes for Use at High Temperatures – Dimensions (With Normal Tolerances) – Technical Delivery Conditions AFNOR NF A 49-215:1981 Seamless Tubes for Ferritic Non-Alloy and Alloy Steel Heat Exchangers – Dimensions – Technical Delivery Conditions AFNOR NF A 49-219:1990 Non-Alloy and Mo and Cr-Mo Alloy Steel Seamless Tubes for Furnaces – Dimensions – Technical Delivery Conditions BSI BS 3059-2:1990 Steel Boiler and Superheater Tubes Part 2: Carbon, Alloy and Austenitic Stainless Steel Tubes with Specified Elevated Temperature Properties BSI BS 3602-1:1987 Steel Pipes and Tubes for Pressure Purposes Carbon and Carbon Manganese Steel with Specified Elevated Temperature Properties: Seamless, Electric Resistance Welded and Induction Welded Tubes (Withdrawn) BSI BS 3606:1992 Steel Tubes for Heat Exchangers (Withdrawn)

Chapter 5: Steel Tubes and Pipes (continued)	
Current CEN Standard	**Former National Standards Superseded by CEN Standards**
EN 10216-2:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 2: Non-Alloy and Alloy Steel Tubes with Specified Elevated Temperature Properties	Supersedes: BSI BS 3604-1:1990 Steel Pipes and Tubes for Pressure Purposes: Ferritic Alloy Steel with Specified Elevated Temperature Properties – Part 1: Specification for Seamless and Electric Resistance Welded Tubes (Withdrawn) DIN 17175:1979 Seamless Tubes of Heat-resistant Steels
EN 10216-3:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 3: Alloy Fine Grain Steel Tubes	Supersedes: DIN 17179:1986 Seamless Circular Fine Grain Steel Tubes Subject to Special Requirements – Technical Delivery Conditions
EN 10216-4:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 4: Non-alloy and Alloy Steel Tubes with Specified Low Temperature Properties	Supersedes: AFNOR NF A 49-230:1985 Steel Tubes: Plain End Seamless Tubes for Pressure Vessels and Piping Systems Used at Low Temperatures – Dimensions – Technical Delivery Conditions BSI BS 3603:1991 Carbon and Alloy Steel Pipes and Tubes with Specified Low Temperature Properties for Pressure Purpose (Withdrawn) DIN 17173:1985 Seamless Circular Tubes Made from Steels with Low Temperature Toughness
EN 10217-1:2002 Welded Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 1: Non-Alloy Steel Tubes with Specified Room Temperature Properties	Supersedes: AFNOR NF A 49-142:1987 Longitudinally Pressure Welded Plain Ended and Hot Finished Tubes. Diameters from 13,5 to 168,3 mm With Specified Room Temperature Properties and with Special Delivery Conditions – Dimensions – Technical Delivery Conditions BSI BS 3059-1:1987 Steel Boiler and Superheater Tubes – Part 1: Specification for Low Tensile Carbon Steel Tubes Without Specified Elevated Temperature Properties BSI BS 3601:1987 Carbon Steel Pipes and Tubes with Specified Room Temperature Properties for Pressure Purposes DIN 1626:1984 Welded Circular Unalloyed Steel Tubes Subject to Special Requirements DIN 1628:1984 High Performance Welded Circular Unalloyed Steel Tubes – Technical Delivery Conditions DIN 1629:1984 Seamless Circular Unalloyed Steel Tubes Subject to Special Requirements
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	Supersedes: AFNOR NF A 49-241:1986 Steel Tubes - Longitudinally Pressure Welded Plain End Tubes in Non-Alloyed Steel Grades for Fluid Piping Up to 425°C – Diameters from 21.3 mm to 168.3 mm – Dimensions – Technical Delivery Conditions AFNOR NF A 49-242:1985 Longitudinally Pressure Welded Tubes D Inferior or Equal to 168.3 mm in Non-Alloyed and Low Alloyed Steels Used at Medium Elevated Temperatures – Dimensions – Technical Delivery Conditions

Chapter 5: Steel Tubes and Pipes (continued)	
Current CEN Standard	**Former National Standards Superseded by CEN Standards**
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	Supersedes: AFNOR NF A 49-243:1985 Longitudinally Ppressure Welded Tubes D Inferior or Equal to 168.3 mm in Non-Alloyed and Ferritic Alloyed Steels, Used at Elevated Temperatures – Dimensions – Technical Delivery Conditions AFNOR NF A 49-245:1986 Longitudinally Pressure Welded Tubes from Non-Alloy and Ferritic Alloy Steels for Heat Exchangers in Diameters from 15.9 mm and 76.1 mm Inclusive – Dimensions – Technical Delivery Conditions AFNOR NF A 49-252:1982 Welded Non-Alloy Steel Tubes of Diameters 168.3 mm to 1220 mm Used at Averagely Elevated Temperatures – Dimensions – Technical Delivery Conditions AFNOR NF A 49-253:1982 Longitudinally Fusion Welded Non-Alloy Steel and Ferritic Alloy Steel Tubes for Use at Elevated Temperatures – Dimensions – Technical Delivery Conditions BSI BS 3059-2:1990 Steel Boiler and Superheater Tubes Part 2: Carbon, Alloy and Austenitic Stainless Steel Tubes with Specified Elevated Temperature Properties BSI BS 3602-1:1987 Steel Pipes and Tubes for Pressure Purposes Carbon and Carbon Manganese Steel with Specified Elevated Temperature Properties – Part 1: Seamless, Electric Resistance Welded and Induction Welded Tubes (Withdrawn) BSI BS 3604-1:1990 Steel Pipes and Tubes for Pressure Purposes: Ferritic Alloy Steel with Specified Elevated Temperature Properties – Part 1: Specification for Seamless and Electric Resistance Welded Tubes (Withdrawn) BSI BS 3606:1992 Steel Tubes for Heat Exchangers (Withdrawn) DIN 17177:1979 Electric Pressure-Welded Steel Tubes for Elevated Temperatures
EN 10217-3:2002 Welded Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 3: Alloy Fine Grain Steel Tubes	Supersedes: BSI BS 3602-2:1991 Steel Pipes and Tubes for Pressure Purposes: Carbon and Carbon Manganese Steel with Specified Elevated Temperature Properties – Part 2: Specification for Longitudinally Arc Welded Tubes (Withdrawn) DIN 17178:1986 Welded Circular Fine Grain Steel Tubes Subject to Special requirements – Technical Delivery Conditions
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	Supersedes: AFNOR NF A 49-240:1983 Steel Tubes: Plain Ended Steel Tubes Longitudinally Welded Without Fusion for Pressure Vessels and Piping Systems at Low Temperatures – Dimensions – Technical Delivery Conditions BSI BS 3603:1991 Carbon and Alloy Steel Pipes and Tubes with Specified Low Temperature Properties for Pressure Purpose (Withdrawn) DIN 17174:1985 Welded Circular Tubes of Heat-Resistant Steels

Chapter 5: Steel Tubes and Pipes (continued)	
Current CEN Standard	**Former National Standards Superseded by CEN Standards**
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 Temperatures Properties	Supersedes: AFNOR NF A 49-252:1982 Welded Non-Alloy Steel Tubes of Diameters 168.3 mm to 1220 mm Used at Averagely Elevated Temperatures – Dimensions – Technical Delivery Conditions
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 Temperatures Properties	Supersedes: AFNOR NF A 49-253:1982 Longitudinally Fusion Welded Non-Aalloy Steel and Ferritic Alloy Steel Tubes for Use at Elevated Temperatures – Dimensions – Technical Delivery Conditions BSI BS 3602-2:1991 Steel Pipes and Tubes for Pressure Purposes: Carbon and Carbon Manganese Steel with Specified Elevated Temperature Properties – Part 2: Specification for Longitudinally Arc Welded Tubes (Withdrawn)
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	Supersedes: DIN 17174:1985 Welded Circular Tubes of Hear-Resistant Steels
EN 10224:2002 Non-Alloy Steel Tubes and Fittings for the Conveyance of Aqueous Liquids Including Water for Human Consumption – Technical Delivery Conditions	Supersedes: AFNOR NF A 49-150:1985 Steel Tubes. Welded Tubes Intended to be Coated or Protected for Use in Water Piping Systems – Dimensions – Technical Delivery Conditions. DIN 1626:1984 Welded Circular Unalloyed Steel Tubes Subject to Special Requirements DIN 1628:1984 High Performance Welded Circular Unalloyed Steel Tubes – Technical Delivery Conditions DIN 1629:1984 Seamless Circular Unalloyed Steel Tubes Subject to Special Requirements
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	Supersedes: AFNOR NF A 49-341:1975 Precision Welded Tubes for Mechanical Application – Dimensions – Technical Delivery Conditions AFNOR NF A 49-343:1980 Longitudinally Welded D Inferior or Equal to 168.3 mm for Engineering Use – Dimensions – Technical Delivery Conditions BSI BS 6323-2:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 2: Specific Requirements for Hot Finished Welded Steel Tubes BSI BS 6323-5:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 5: Specific Requirements for Electric Resistance Welded and Induction Welded Steel Tubes (Withdrawn) BSI BS 6323-7:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 7: Specific Requirements for Submerged Arc Welded Steel Tubes DIN 1626:1984 Welded Circular Unalloyed Steel Tubes Subject to Special Requirements DIN 1628:1984 High Performance Welded Circular Unalloyed Steel Tubes – Technical Delivery Conditions

Chapter 5: Steel Tubes and Pipes (continued)	
Current CEN Standard	**Former National Standards Superseded by CEN Standards**
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	Supersedes: AFNOR NF A 49-311:1974 Seamless Tubes for Mechanical Application – Dimensions – Technical Delivery Conditions
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	Supersedes: BSI BS 6323-3:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 3: Specific Requirements for Hot Finished Seamless Steel Tubes (Withdrawn) DIN 1626:1984 Welded Circular Unalloyed Steel Tubes Subject to Special Requirements DIN 1629:1984 Seamless Circular Unalloyed Steel Tubes Subject to Special Requirements DIN 17204:1990 Seamless Circular Tubes Made from Steels for Quenching and Tempering – Technical Delivery Conditions
EN 10305-1:2002 Steel Tubes for Precision Applications – Technical Delivery Conditions – Part 1: Seamless Cold Drawn Tubes	Supersedes: AFNOR NF A 49-310:1994 Seamless Precision Tubes for Mechanical Application – Dimensions – Technical Delivery Conditions AFNOR NF A 49-323:1978 Steel Tubes: Jacks for Hydraulic Transmissions; Cold Rolled or Drawn Seamless Tubes, Type – Ready for Use – Dimensions – Technical Delivery Conditions BSI BS 6323-4:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 4: Specific Requirements for Cold Finished Seamless Steel Tubes (Withdrawn) DIN 2391-2:1994 Seamless Precision Steel Tubes
EN 10305-2:2002 Steel Tubes for Precision Applications – Technical Delivery Conditions – Part 2: Welded Cold Drawn Tubes	Supersedes: BSI BS 6323-6:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 6: Specific Requirements for Cold Finished Electric Resistance Welded and Induction Welded Steel Tubes (Withdrawn) DIN 2393-2:1994 Welded Precision Steel Tubes
EN 10305-3:2002 Steel Tubes for Precision Applications – Technical Delivery Conditions – Part 3: Welded Cold Sized Tubes	Supersedes: BSI BS 6323-5:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 5 : Specific Requirements for Electric Resistance Welded and Induction Welded Steel Tubes (Withdrawn) BSI BS 6323-6:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 6: Specific Requirements for Cold Finished Electric Resistance Welded and Induction Welded Steel Tubes (Withdrawn) DIN 2394-2:1994 Welded and Sized Precision Steel Tubes – Technical Delivery Conditions

Chapter 5: Steel Tubes and Pipes (continued)	
Current CEN Standard	**Former National Standards Superseded by CEN Standards**
EN 10305-4:2003 Steel Tubes for Precision Applications - Technical Delivery Conditions - Part 4: Seamless Cold Drawn Tubes for Hydraulic and Pneumatic Power Systems	BSI BS 6323-4:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 4: Specific Requirements for Cold Finished Seamless Steel Tubes (Withdrawn)
EN 10305-5:2003 Steel Tubes for Precision Applications – Technical Delivery Conditions – Part 5: Welded and Cold Sized Square and Rectangular Tubes	Supersedes: BSI BS 6323-5:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 5: Specific Requirements for Electric Resistance Welded and Induction Welded Steel Tubes (Withdrawn)
EN 10305-6:2003 Steel Tubes for Precision Applications - Technical Delivery Conditions - Part 6: Welded Cold Drawn Tubes for Hydraulic and Pneumatic Power Systems	Supersedes: BSI BS 6323-6:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 6: Specific Requirements for Cold Finished Electric Resistance Welded and Induction Welded Steel Tubes (Withdrawn)

Chapter 6: Steel Forgings	
Current CEN Standard	**Former National Standards Superseded by CEN Standards**
EN 10222 Steel Forgings for Pressure Purposes EN 10222-1:1998 General Requirements for Open Die Forgings EN 10222-3:1999 Nickel Steels with Specified Low-Temperature EN 10222-4:1999 Weldable Fine-Grain Steels with High Proof Strength EN 10222-2:2000 Ferritic and Martensitic Steels with Specified Elevated Temperature Properties EN 10222-5:2000 Martensitic, Austenitic and Austenitic-Ferritic Stainless Steels	Supersedes: BSI BS 1503:1989 Amd 3 Steel Forgings for Pressure Purposes (Withdrawn)
EN 10250 Corr 1 Open Die Steel Forgings for General Eengineering Purposes EN 10250-2:2000 Non-Alloy Quality and Special Steels	Supersedes: BSI BS 29:1976 Carbon Steel Forgings Above 150 mm Ruling Section (Withdrawn)
EN 10250 Open Die Steel Forgings for General Engineering Purposes EN 10250-3:2000 Alloy Special Steels	Supersedes: BSI BS 4670:1971 Alloy Steel Forgings (Withdrawn)
EN 10250: Open Die Steel Forgings for General Engineering Purposes EN 10250-4: 2000 Stainless Steels	Partially Supersedes: BSI BS 970-1:1996 Wrought Steels for Mechanical and Allied engineering Purposes – Part 1: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels
EN 10222-1:1998 Steel Forgings for Pressure Purposes – Part 1: General Requirements for Open Die Forgings	Supersedes: DIN 17103:1989 Weldable Fine Grain Structural Steel Forgings – Technical Delivery Conditions (Withdrawn) DIN 17243:1987 Weldable Heat Resisting Steel Forgings and Rolled or Forged Steel Bars – Technical Delivery Conditions (Withdrawn) Partially Supersedes: DIN 17280:1985 Steels with Low Temperature Toughness – Technical Delivery Conditions for Plate, Sheet, Strip, Wide Flats, Sections, Bars and Forgings (Withdrawn) DIN 17440:1996 Stainless Steels – Technical Delivery Conditions for Plates, Hot Rolled Strip and Bars for Pressure Purposes, Drawn Wire and Forgings (Withdrawn) DIN 17100:1980 Steels for General Structural Purposes – Quality Standard (Withdrawn)
EN 10222 Steel Forgings for Pressure Purposes EN 10222-1:1998 General Requirements for Open Die Forgings EN 10222-2:2000 Ferritic and Martensitic Steels with Specified Elevated Temperature Properties (Includes Corrigendum AC: 2000) EN 10273:2000 Hot Rolled Weldable Steel Bars for Pressure Purposes with Specified Elevated Temperature	Supersedes: DIN 17243:1987 Weldable Heat Resisting Steel Forgings and Rolled or Forged Steel Bars – Technical Delivery Conditions (Withdrawn)

Chapter 6: Steel Forgings (Continued)	
Current CEN Standard	**Former National Standards Superseded by CEN Standards**
EN 10250 Open Die Steel Forgings for General engineering Purposes EN 10250-1:1999 General EN 10250-2:2000 Non-Alloy Quality and Special Steels	Supersedes: DIN 17100:1980 Steels for General Structural Purposes – Quality Standard (Withdrawn) Partially Supersedes: DIN 17440:1996 Stainless Steels – Technical Delivery Conditions for Plates, Hot Rolled Strip and Bars for Pressure Purposes, Drawn Wire and Forgings (Withdrawn)
EN 10250 Open Die Steel Forgings for General engineering Purposes EN 10250-1:1999 General Requirements for Open Die Forgings EN 10250-2:2000 Non-Alloy Quality and Special Steels	Supersedes: DIN 17100:1980 Steels for General Structural Purposes; Quality Standard (Withdrawn)
EN 10250 Open Die Steel Forgings for General engineering Purposes EN 10250-1:1999 General Requirements for Open Die Forgings EN 10250-4:2000 Stainless Steels	Partially Supersedes: DIN 17440:1996 Stainless Steels – Technical Delivery Conditions for Plates, Hot Rolled Strip and Bars for Pressure Purposes, Drawn Wire and Forgings (Withdrawn)
EN 10222 Steel Forgings for Pressure Purposes EN 10222-1:1998 General Requirements for Open Die Forgings EN 10222-3:1999 Nickel Steels with Specified Low Temperature Properties. EN 10222-4:1999 Weldable Fine Grain Steels with High Proof Strength EN 10222-2:2000 Ferritic and Martensitic Steels with Specified Elevated Temperature Properties EN 10222-5:2000 Martensitic, Austenitic and Austenitic-Ferritic Stainless Steels	Supersedes: AFNOR NF A36-601:1980 Pièces Forgées en Acier Soudable pour Chaudières et Appareils à Pression - Aciers au Carbone et Carbone-Manganèse – Nuances et Qualités (Withdrawn) AFNOR NF A36-602:1988 Pièces Forgées en Acier Soudable pour Chaudières et Appareils à Pression – Aciers Alliés au Mo, au Mn-Mo et au Cr-Mo - Nuances et Qualités (Withdrawn) AFNOR NF A36-603:1988 Pièces Forgées en Acier Soudable pour Chaudières et Appareils à Pression - Aciers Alliés à Haute Limite d'Élasticité - Nuances et Qualités (Withdrawn) AFNOR NF A36-607:1984 Pièces Obtenues par Forgeage Libre ou Estampage en Aciers Inoxydables Austénitiques pour Chaudières et Appareils à Pression – Nuances et Qualités (Withdrawn)
EN 10250 Open Die Steel Forgings for General engineering Purposes EN 10250-1:1999 General Requirements	Supersedes: AFNOR NF A36-612:1982 Pièces Forgées d'Usage Général – Aciers Non Alliés (Withdrawn) AFNOR NF A36-613:1986 Pièces Forgées d'Usage Général – Aciers Inoxydables (Withdrawn)
EN 10250 Open Die Steel Forgings for General engineering Purposes EN 10250-2:2000 Non-Alloy Quality and Special Steels	Supersedes: AFNOR NF A36-612:1982 Pièces Forgées d'Usage Général – Aciers Non Alliés (Withdrawn)
EN 10250 Open Die Steel Forging for General engineering Purposes EN 10250-4:2000 Stainless Steels	Supersedes: AFNOR NF A36-613:1986 Pièces Forgées d'Usage Général – Aciers Inoxydables (Withdrawn)

Chapter 7: Steel Castings	
Current CEN Standard	**Former National Standards Superseded by CEN Standards**
EN 10213 Steel Castings for Pressure Purposes EN 10213-1:1996 General EN 10213-2:1996 Steel Grades for Use at Room Temperature and at Elevated Temperature EN 10213-3:1996 Steels for Use at Low Temperatures EN 10213-4:1996 Austenitic and Austenitic-Ferritic Steel Grades	Supersedes: BSI BS 1504:1976 Steel Castings for Pressure Purposes (Withdrawn)
EN 10213: Steel Castings for Pressure Purposes EN 10213-1:1996 General EN 10213-2:1996 Steel Grades for Use at Room Temperature and at Elevated Temperature	Supersedes: DIN 17245:1987 Ferritic Steel Castings with Elevated Temperature Properties – Technical Delivery Conditions (Withdrawn)
EN 10213 Steel Castings for Pressure Purposes EN 10213-1:1996 General EN 10213-3:1996 Steels for Use at Low Temperatures	Supersedes: DIN 17182:1992 General Purpose Steel Castings with enhanced Weldability and Higher Toughness – Technical Delivery Conditions (Withdrawn)
EN 10213 Steel Castings for Pressure Purposes EN 10213-1:1996 General EN 10213-4:1996 Austenitic and Austenitic-Ferritic Steel Grades	Supersedes: DIN 17445:1984 Stainless Steel Castings – Technical Delivery Conditions (Withdrawn)
EN 10283:1999 Corrosion resistant steel castings	Supersedes: DIN 17445:1984 Stainless Steel Castings – Technical Delivery Conditions
EN 10213 Steel Castings for Pressure Purposes EN 10213-1:1996 General EN 10213-2:1996 Steel Grades for Use at Room Temperature and at Elevated Temperature EN 10213-3:1996 Steels for Use at Low Temperatures EN 10213-4:1996 Austenitic and Austenitic-Ferritic Steel Grades	Supersedes: AFNOR NF A32-055:1985 Produits de Fonderie – Aciers Moulés Soudables pour Chaudières et Appareils à Pression (Withdrawn)

Chapter 8: Wrought Stainless Steels and Heat-Resisting Steels	
Current CEN Standards	**Former National Standards Superseded by CEN Standards**
EN 10088-2:1995 Stainless Steels – Part 1: Technical Delivery Conditions for Sheet/Plate and Strip for General Purpose EN 10088-3:1995 Stainless Steels – Part 3: Technical Delivery Conditions for Semi-Finished Products, Bars, Rods and Sections for General Purposes	Partially Supersedes: BSI BS 970-1:1991 Wrought Steels for Mechanical and Allied engineering Purposes – Part 1: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels (Withdrawn)
EN 10095:1999 Heat Resisting Steels and Nickel Alloys	Supersedes: BSI BS 1449-2:1983 Amd 4 Steel Plate, Sheet and Strip – Part 2: Stainless and Heat-Resisting Steel Plate, Sheet and Strip AMD 9648 (Withdrawn) BSI BS 970-1:1996 Wrought Steels for Mechanical and Allied engineering Purposes – Part 1: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels
EN 10088-2:1995 Stainless Steels – Part 2: Technical Delivery Conditions for Sheet/Plate and Strip for General Purpose	Partially Supersedes: DIN 17440:1985 Stainless Steels – Technical Delivery Conditions for Plate and Sheet, Hot Rolled Strip, Wire Rod, Drawn Wire, Steel Bars, Forgings and Semi-Finished Products DIN 17441:1985 Stainless Steels – Technical Delivery Conditions for Cold Rolled Strip and Slit Strip and for Plate And Sheet Cut Therefrom
EN 10088-3:1995 Stainless Steels – Part 3: Technical Delivery Conditions for General Purpose Semi-Finished Products, Bars, Rod and Sections	Partially Supersedes: DIN 17440:1985 Stainless Steels – Technical Delivery Conditions for Plate and Sheet, Hot Rolled Strip, Wire Rod, Drawn Wire, Steel Bars, Forgings and Semi-Finished Products
EN 10088-2:1995 Stainless Steels – Part 2: Technical Delivery Conditions for Sheet/Plate and Strip for General Purposes	Supersedes: AFNOR NF A35-573:1990 Produits Sidérurgiques – Aciers Inoxydables d'Usage Général - Tôles, Larges Bandes et Feuillards
EN 10088-3:1995 Stainless Steels – Part 3: Technical Delivery Conditions for Semi-Finished Products, Bars, Rods, and Sections for General Purposes	Supersedes: AFNOR NF A35-574:1990 Produits Sidérurgiques – Aciers Inoxydables d'Usage Général - Demi-Produits, Barres et Fil Machine

Chapter 9: Steels for Special Use	
Current CEN Standard	**Former National Standards Superseded by CEN Standards**
EN 10087:1999 Free Cutting Steels-Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods	Partially Supersedes: BSI BS 970-1:1996 Wrought Steels for Mechanical and Allied Engineering Purposes – Part 1: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels
EN 10095:1999 Heat Resisting Steels and Nickel Alloys	Supersedes: BSI BS 1449-2:1983 Steel Plate, Sheet and Strip – Part 2: Specification for Stainless and Heat-Resisting Steel Plate, Sheet and Strip (Withdrawn) Partially Supersedes: BSI BS 970-1:1991 Wrought Steels for Mechanical and Allied Engineering Purposes – Part 1: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels
EN 10277 Bright Steel Products. Technical Delivery Conditions EN 10277-1:1999 General EN 10277-2:1999 Steels for General Engineering Purposes EN 10277-3:1999 Free-Cutting Steels EN 10277-4:1999 Case-Hardening Steels EN 10277-5:1999 Steels for Quenching and Tempering EN 10278:1999 Dimensions and Tolerances of Bright Steel Products	Supersedes: BSI BS 970-3:1991 Wrought Steel for Mechanical and Allied Engineering Purposes – Part 3: Bright Bars for General Engineering Purposes;
EN 10132-4: 2000 Cold Rolled Narrow Steel Strip for Heat Treatment-Technical Delivery Conditions – Part 4: Spring Steels and Other Applications EN 10132-1:2000 Cold Rolled Narrow Steel Strip for Heat Treatment. Technical Delivery Conditions – Part 1: General	Supersedes: BSI BS 5770:1981 Steel Strip Intended for the Manufacture of Springs BSI BS 5770-1:1981 Hot Rolled Steel and Low Alloy Steel (Withdrawn) BSI BS 5770-2:1981 Amd 1 Cold Rolled Carbon and Low Alloy Steel (Withdrawn) BSI BS 5770-3:1981 Pre-Hardened and Tempered Carbon Steel (Withdrawn)
EN ISO 4957:2000 Tool Steels	Supersedes: BSI BS 4659:1989 Tool and Die Steels
EN 10087:1999 Free-Cutting Steels; Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods	Partially Supersedes: DIN 1651:1988 Free-Cutting Steels – Part 2: 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 10132-1:2000 Cold-Rolled Narrow Steel Strip for Heat Treatment - Technical Delivery Conditions – Part 1: General	Supersedes: DIN 17222:1979 Cold Rolled Steel Strips for Springs – Technical Conditions of Delivery
EN ISO 4957:2000 Tool Steels	Supersedes: DIN 17350:1980 Tool Steel

Chapter 9: Steels for Special Use (Continued)	
Current CEN Standard	**Former National Standards Superseded by CEN Standards**
EN ISO 683-17:1999 Heat-Treated Steels, Alloy Steels and Free-Cutting Steels – Part 17: Ball and Roller Bearing Steels	Supersedes: DIN 17230:1980 Ball and Roller Bearing Steels – Technical Conditions of Delivery
EN 10087:1999 Free-Cutting Steels. Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods.	Supersedes: AFNOR NF A35-561:1992 Produits Sidérurgiques-Barres, Fil Machine en Acier de Décolletage d'Usage Général-Conditions Techniques de Livraison AFNOR NF A35-562:1986 Barres et Fils Machine en Aciers de Décolletage Spéciaux pour Traitement Thermique
EN 10277-3:1999 Bright Steel Products – Technical Delivery Conditions -Part 3: Free-Cutting Steels.	Supersedes: AFNOR NF A37-401:1993 Produits en Acier Transformés à Froid-Barres Étirées et Ronds Écroutés-Galètes-Caractéristiques Mécaniques
EN ISO 683-17:1999 Heat-Treated Steels, Alloy Steels and Free-Cutting Steels – Part 17: Ball and Roller Bearing Steels	Supersedes: AFNOR NF A 35-565: 1999 Aciers pour Traitement Thermique, Aciers Alliés et Aciers pour Décolletage. Partie 17:Aciers pour Roulements
EN ISO 4957:2000 Tool Steels	Supersedes: AFNOR NF A35-590:1992 Aciers Outils

Appendix

7

FORMER NATIONAL STANDARDS SUPERSEDED BY CEN STANDARDS

Chapter 2: Carbon and Alloy Steels for General Use	
Former National Standards Superseded by EN Standards	**Current Standards**
BSI BS 970-1:1983 Specification for Wrought Steels for Mechanical and Allied Engineering Purposes – Part 1: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels	Superseded by: EN 10083-1:1991+A1:1996 Quenched and Tempered Steels – Part 1: Technical Delivery Conditions for Special Steels EN 10083-2:1991+A1:1996 Quenched and Tempered Steels – Part 2: Technical Delivery Conditions for Unalloyed Quality Steels
BSI BS 970-1:1991 Specification for Wrought Steels for Mechanical and Allied Engineering Purposes – Part 1: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels	Superseded by: BS 970-1:1996 Wrought Steels for Mechanical and Allied Engineering Purposes. General Inspection And Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels EN 10083-3:1995 Quenched and Tempered Steels – Part 3: Technical Delivery Conditions for Boron Steels EN 10088:1995 Stainless Steels EN 10088-1:1995 List of Stainless Steels EN 10088-3:1995 Technical Delivery Conditions for Semi-Finished Products, Bars, Rods and Sections for General Purposes
BSI BS 970-1:1996 Specification for Wrought Steels for Mechanical and Allied Engineering Purposes – Part 1: General Inspection And Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels	Superseded by: EN 10084:1998 Case Hardening Steels – Technical Delivery Conditions EN 10085:2001 Nitriding Steel – Technical Delivery Conditions EN 10087:1999 Free Cutting Steels – Technical Delivery Conditions for Semi-Finished Products, Hot Rolled Bars and Rods EN 10095:1999 Heat Resisting Steels and Nickel Alloys EN 10250-4:2000 Open Die Steel Forgings for General Stainless Steels Engineering Purposes – Part 4: Stainless Steels-Supersedes Table
DIN 17140-1:1983 Wire Rod for Cold Drawing – Technical Delivery Conditions for Basic Steel and Unalloyed Quality Steels	Superseded by: EN 10016-1:1995 Non-Alloy Steel Rod for Drawing or Cold Rolling Steels – Part 1: General Requirements EN 10016-2:1995 Non-Alloy Steel Rod for Drawing or Cold Rolling Steels – Part 2: Specific Requirements for General Purpose Rod
DIN 17211:1987 Nitriding Steels; Technical Delivery Conditions	Superseded by: EN 10085:2001 Nitriding Steels – Technical Delivery Conditions
AFNOR NF A35-051:1982 Fil Machine en Acier Non Allié Destiné au Tréfilage et au Laminage à Froid-Nuances	Superseded by: EN 10016-2:1995 Non-Alloy Steel Rod for Drawing and/or Cold Rolling - Part 2: Specific Requirements for General Purpose Rod
AFNOR NF EN 10083-1:1991 Aciers Pour Trempe et Revenu– Partie 1:Conditions Techniques de Livraison des Aciers Spéciaux	Superseded by: EN 10083-1:1991 Quenched and Tempered Steels – Part 1: Technical Delivery Conditions for Special Steels
AFNOR NF EN 10083-2:1991 Aciers pour Trempe et Revenu – Partie 2:Conditions Techniques de Livraison des Aciers de Qualité Non Alliés AFNOR NF A33-101:1982 Aciers au Carbone de Qualité Aptes au Forgeage et aux Traitements Thermiques – Demi Produits, Barres et Fil Machine	Superseded by: EN 10083-2:1991 Quenched and Tempered Steels – Part 2: Technical Delivery Conditions for Unalloyed Quality Steels

Chapter 2: Carbon and Alloy Steels for General Use (Continued)	
Former National Standards Superseded by EN Standards	**Current Standards**
AFNOR NF A35-551:1986 Aciers de Construction Non Alliés et Alliés Spéciaux pour Cémentation–Nuances-Demi-Produits, Barres et Fils Machine	Superseded by: EN 10084:1998 Case Hardening Steels – Technical Delivery Conditions

Chapter 3: Structural Steel Plates	
Former National Standards	**Current Standards**
BSI BS 4360:1986 Specification for Weldable Structural Steels (Withdrawn)	Partially Superseded by: EN 10025:1993 Hot Rolled Products of Non-Alloy Structural Steels – Technical Delivery Conditions
BSI BS 4360:1990 Weldable Structural Steels (Withdrawn)	Superseded by: BS 7613:1994 Hot Rolled Quenched and Tempered Weldable Structural Steel Plates (Withdrawn) BS 7668:1994 Weldable Structural Steels. Hot Finished Structural Hollow Sections in Weather Resistant Steels EN 10113 Hot-Rolled Products in Weldable Fine Grain Structural Steels EN 10113-1:1993 General Delivery Conditions EN 10113-2:1993 Delivery Conditions for Normalized/Normalized Rolled Steels EN 10113-3:1993 Delivery Conditions for Thermomechanical Rolled Steels EN 10155:1993 Structural Steels with Improved Atmospheric Corrosion Resistance – Technical Delivery Conditions EN 10029:1991 Tolerances on Dimensions, Shape and Mass for Hot Rolled Steel Plates 3 mm Thick or Above EN 10210-1:1994 Hot Finished Structural Hollow Sections of Non-Alloy and Fine Grain Structural Steels – Part 1: Technical Delivery Requirements
BSI BS 7613:1994 Hot Rolled Quenched and Tempered Weldable Structural Steel Plates (Withdrawn)	Superseded by: EN 10137 Plates and Wide Flats Made of High Yield Strength Structural Steels in the Quenched and Tempered or Precipitation Hardened Conditions EN 10137-1:1996 General Delivery Conditions EN 10137-2:1996 Delivery Conditions for Quenched and Tempered Steels EN 10137-3:1996 Delivery Conditions for Precipitation Hardened Steels
DIN 17100:1980 Steels for General Structural Purposes; Quality Standard	Partially Superseded by: EN 10025:1993 Hot Rolled Products of Non-Alloy Structural Steels– Technical Delivery Conditions
DIN 17102:1983 Weldable Normalized Fine Grain Structural Steels; Technical Delivery Conditions for Plate, Strip, Wide Flats, Sections And Bars (Withdrawn)	Superseded by: EN 10113 Hot Rolled Products Made from Weldable, Fine Grain Structural Steel; EN 10113-1:1993 General Technical Delivery Conditions EN 10113-2:1993 Delivery Conditions for Normalized/Normalized Rolled Steels EN 10028 Flat Products Made from Steel for Pressure Purposes EN 10028-1:2000 General Requirements EN 10028-3:2003 Weldable Fine Grain Steels, Normalized

Chapter 3: Structural Steel Plates (Continued)	
Former National Standards	**Current Standards**
AFNOR NF A 35-504:1984 Poutrelles et Profils en Aciers à Haute Limite d'Élasticité pour Constructions Soudées Nuances et Qualités AFNOR NF A 36-201:1984 Tôles en Aciers à Haute Limite D'Élasticité pour Constructions Soudées-Nuances et Qualités	Superseded by: EN 10113 Hot-Rolled Products in Weldable Fine Grain Structural Steels EN 10113-2:1993 Delivery Conditions for Normalized/Normalized Rolled Steels.
AFNOR NF A 36-204:1992 Produits Sidérurgiques – Tôles en Aciers à Haute Limite d'Élasticité Livrées à l'État Traité pour Construction Soudée – Nuances et Qualité	Superseded by: EN 10137 Plates and Wide Flats Made of High Yield Strength Structural Steels in the Quenched and Tempered or Precipitation Hardened Conditions EN 10137-2:1995 Delivery Conditions for Quenched and Tempered Steels EN 10137-3:1995 Delivery Conditions for Precipitation Hardened Steels
AFNOR NF A35-502:1984 Aciers de Construction à Résistance Améliorée à la Corrosion Atmosphérique – Tôles Minces Moyennes et Fortes, Larges Plats, Laminés Marchands et Poutrelles	Superseded by: EN 10155:1993 Structural Steels with Improved Atmospheric Corrosion Resistance – Technical Delivery Conditions

Chapter 4: Pressure Vessel Steel Plates	
Former National Standards Superseded by EN Standards	**Current Standards**
BSI BS 1501-1:1980 Specification for Carbon and Carbon Manganese Steels – Part 1: Plates (Withdrawn)	Superseded by: EN 10028 Flat Products Made of Steels for Pressure Purposes. EN 10028-2:2003 Non-Alloy and Alloy Steels with Specified Elevated Temperature Properties EN 10028-3:2003 Weldable Fine Grain Steels, Normalized EN 10029:1991 Tolerances on Dimensions, Shape and Mass for Hot Rolled Steel Plates 3 Mm Thick or Above
BSI BS 1501-2:1988 Steels for Pressure Purposes – Part 2: Specification for Alloy Steels: Plates (Withdrawn)	Superseded by: EN 10028 Flat Products Made of Steels for Pressure Purposes. EN 10028-2:2003 Non- Alloy and Alloy Steels with Specified Elevated Temperature Properties EN 10028-3:2003 Weldable Fine Grain Steels, Normalized. EN 10028-4:2003 Nickel Alloy Steel with Specified Low Temperature Properties EN 10029:1991 Tolerances on Dimensions, Shape and Mass for Hot Rolled Steel Plates 3 Mm Thick or Above
BSI BS 1501-1:1980 Steels for Pressure Purposes – Part 1: Specification for Carbon and Carbon Manganese Steels: Plates (Withdrawn) BSI BS 1501-2:1988 Steels for Pressure Purposes – Part 2: Specification for Alloy Steels: Plates (Withdrawn)	Superseded by: EN 10028-1:2000 Flat Products Made of Steels for Pressure Purposes – Part 1: General Requirements
BSI BS 1501-3:1990 Amd 5 Steels for Pressure Purposes – Part 3: Specification for Corrosion- and Heat-Resisting Steels: Plates, Sheet and Strip (Withdrawn)	Superseded by: EN 10028-7:2000 Flat Products Made of Steels for Pressure Purposes – Part 7: Stainless Steels Partially Superseded by: EN 10029:1991 Tolerances on Dimensions, Shape And Mass for Hot Rolled Steel Plates 3 Mm Thick or Above EN 10048:1997 Hot Rolled Narrow Steel Strip – Tolerances on Dimensions and Shape EN 10051:1992 Continuously Hot-Rolled Uncoated Plate, Sheet and Strip of Non-Alloy and Alloy Steels – Tolerances on Dimensions and Shape EN 10258:1997 Cold-Rolled Stainless Steel Narrow Strip and Cut Lengths – Tolerances on Dimensions and Shape EN 10259:1997 Cold-Rolled Stainless and Heat Resisting Steel Wide Strip and Plate/Sheet – Tolerances on Dimensions and Shape
DIN 17280:1985 Steels With Low Temperature Toughness; Technical Delivery Conditions for Plate. Sheet, Strip, Wide Flats, Sections, Bars and Forgings	Partially Superseded by: EN 10028-1:2000 Flat Products Made of Steel for Pressure Purposes – Part 1: General Requirements EN 10028-4:2003 Flat Products Made of Steels for Pressure Purposes – Part 4: Nickel-Alloy Steels with Specified Low Temperature Properties
DIN 17441:1997 Technical Delivery Conditions for Stainless Steel Cold-Rolled Strip, Slit Strip and Plate Cut Therefrom for Pressure Purposes	Superseded by: EN 10028-7:2000 Flat Products Made of Steels for Pressure Purposes – Part 7: Stainless Steels

Chapter 4: Pressure Vessel Steel Plates (Continued)	
Former National Standards Superseded by EN Standards	**Current Standards**
DIN 17440:1996 Technical Delivery Conditions for Stainless Steel Plate, Hot Rolled Strip, and Bars for Pressure Purposes DIN 17460:1992 High-Temperature Austenitic Steel Plate and Sheet, Cold and Hot Rolled Strip, Bars and Forgings; Technical Delivery Conditions	Partially Superseded by: EN 10028-7:2000 Flat Products Made of Steels for Pressure Purposes – Part 7: Stainless Steels
AFNOR NF A36-205:1982 Iron and Steel Products: Steel Plates for Boilers and Pressure Vessels; Carbon and Carbon Manganese Steels, Grades and Qualities AFNOR NF A36-206:1983 Iron and Steel Products: Steel Plates for Boilers and Pressure Vessels; Mo, Mn-Mo and Cr-Mo Alloy Steels, Grades and Qualities	Superseded by: EN 10028-2:2003 Flat Products Made of Steels for Pressure Purposes – Part 2: Non-Alloy and Alloy Steels with Specified Elevated Temperature Properties.
AFNOR NF A36-207:1982 Iron and Steel Products: High Yield Strength Steel Plates for Pressure Vessels; Grades and Qualities	Superseded by: EN 10028-3:2003 Flat Products Made of Steels for Pressure Purposes – Part 3: Weldable Fine Grain Steels, Normalized.
AFNOR NF A36-208:1982 Tôles en Aciers au Nickel pour Appareils à Pression à Basse Température	Superseded by: EN 10028-4:2003 Flat Products Made of Steels for Pressure Purposes – Part 4: Nickel Alloy Steels with Specified Low Temperature Properties.

Chapter 5: Steel Tubes and Pipes	
Former National Standards Superseded by EN Standards	**Current EN Standards**
BSI BS 3059-1:1987 Steel Boiler and Superheater Tubes – Part 1: Specification for Low Tensile Carbon Steel Tubes Without Specified Elevated Temperature Properties BSI BS 3601:1987 Carbon Steel Pipes and Tubes with Specified Room Temperature Properties for Pressure Purposes	Superceded by: EN 10216-1:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 1: Non-Alloy Steel Tubes with Specified Room Temperature Properties EN 10217-1:2002 Welded Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 1: Non-Alloy Steel Tubes with Specified Room Temperature Properties
BSI BS 3059-2:1990 Steel Boiler and Superheater Tubes – Part 2: Carbon, Alloy and Austenitic Stainless Steel Tubes with Specified Elevated Temperature Properties BSI BS 3602-1:1987 Steel Pipes and Tubes for Pressure Purposes Carbon and Carbon Manganese Steel with Specified Elevated Temperature Properties: Seamless, Electric Resistance Welded and Induction Welded Tubes (Withdrawn) BSI BS 3604-1:1990 Steel Pipes and Tubes for Pressure Purposes: Ferritic Alloy Steel with Specified Elevated Temperature Properties – Part 1: Specification for Seamless and Electric Resistance Welded Tubes (Withdrawn) BSI BS 3606:1992 Steel Tubes for Heat Exchangers (Withdrawn)	Superceded by: EN 10216-2:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 2: Non-Alloy and Alloy Steel Tubes with Specified Elevated 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
BSI BS 3602-2:1991 Steel Pipes and Tubes for Pressure Purposes: Carbon and Carbon Manganese Steel with Specified Elevated Temperature Properties – Part 2: Specification for Longitudinally Arc Welded Tubes (Withdrawn)	Superceded by: EN 10217-3:2002 Welded Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 3: Alloy Fine Grain Steel Tubes 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 Temperatures Properties
BSI BS 3603:1991 Carbon and Alloy Steel Pipes and Tubes with Specified Low Temperature Properties for Pressure Purpose (Withdrawn)	Superceded by: EN 10216-4:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 4: Non-alloy and Alloy Steel Tubes with Specified Low Temperature Properties 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
BSI BS 6323-2:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 2: Specific Requirements for Hot Finished Welded Steel Tubes BSI BS 6323-7:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 7: Specific Requirements for Submerged Arc Welded Steel Tubes	Superceded by: 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
BSI BS 6323-3:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 3: Specific Requirements for Hot Finished Seamless Steel Tubes (Withdrawn)	Superceded by: 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
BSI BS 6323-4:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 4: Specific Requirements for Cold Finished Seamless Steel Tubes (Withdrawn)	Superceded by: 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

Chapter 5: Steel Tubes and Pipes (Continued)	
Former National Standards Superseded by EN Standards	**Current EN Standards**
BSI BS 6323-5:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 5. Specific Requirements for Electric Resistance Welded and Induction Welded Steel Tubes (Withdrawn)	Superceded by: 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 10305-3:2002 Steel Tubes for Precision Applications – Technical Delivery Conditions – Part 3: Welded Cold Sized Tubes EN 10305-5:2003. Steel Tubes for Precision Applications – Technical Delivery Conditions – Part 5: Welded and Cold Sized Square and Rectangular Tubes
BSI BS 6323-6:1982 Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes – Part 6: Specific Requirements for Cold Finished Electric Resistance Welded and Induction Welded Steel Tubes (Withdrawn)	Superceded by: EN 10305-2:2002 Steel Tubes for Precision Applications – Technical Delivery Conditions – Part 2: Welded Cold Drawn Tubes EN 10305-3:2003 Steel Tubes for Precision Applications – Technical Delivery Conditions – Part 3: Welded Cold Sized Tubes EN 10305-6:2003
DIN 1626:1984 Welded Circular Unalloyed Steel Tubes Subject to Special Requirements	Superceded by: EN 10208-1:1997 Steel Pipes for Pipe Lines for Combustible Fluids – Technical Delivery Conditions – Part 1: Pipes of Requirement Class A EN 10216-1:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 1: Non-Alloy Steel Tubes with Specified Room Temperature Properties 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 10224:2002 Non-Alloy Steel Tubes and Fittings for the Conveyance of Aqueous Liquids Including Water for Human Consumption – Technical Delivery Conditions 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 10297-1:2003 Seamless Circular Steel Tubes for Mechanical and General Engineering Purposes – Technical Delivery Conditions – Part 1: Non-Alloy and Alloy Steel Tubes
DIN 1628:1984 High Performance Welded Circular Unalloyed Steel Tubes – Technical Delivery Conditions	Superceded by: 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 10217-1:2002 Welded Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 1: Non-Alloy Steel Tubes with Specified Room Temperature Properties EN 10224:2002 Non-Alloy Steel Tubes and Fittings for the Conveyance of Aqueous Liquids Including Water for Human Consumption – Technical Delivery Conditions

Chapter 5: Steel Tubes and Pipes (Continued)	
Former National Standards Superseded by EN Standards	**Current EN Standards**
DIN 1629:1984 Seamless Circular Unalloyed Steel Tubes Subject to Special Requirements	Superceded by: EN 10208-1:1997 Steel Pipes for Pipe Lines for Combustible Fluids – Technical Delivery Conditions – Part 1: Pipes of Requirement Class A EN 10216-1:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 1: Non-Alloy Steel Tubes with Specified Room Temperature Properties 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 10224:2002 Non-Alloy Steel Tubes and Fittings for the Conveyance of Aqueous Liquids Including Water for Human Consumption – Technical Delivery Conditions 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
DIN 17173:1985 Seamless Circular Tubes Made from Steels with Low Temperature Toughness	Superceded by: EN 10216-4:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 4: Non-alloy and Alloy Steel Tubes with Specified Low Temperature Properties
DIN 17174:1985 Welded Circular Tubes of Hear-Resistant Steels	Superceded by: 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 10217-6:2002 Welded Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 6: Submerged Arc Welded Non-Alloy Steel Tubes with Specified Low Temperature Properties
DIN 17175:1979 Seamless Tubes of Heat-resistant Steels	Superceded by: EN 10216-2:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 2: Non-Alloy and Alloy Steel Tubes with Specified Elevated Temperature Properties
DIN 17177:1979 Electric Pressure-welded Steel Tubes for Elevated Temperatures	Superceded by: 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
DIN 17178:1986 Welded Circular Fine Grain Steel Tubes Subject to Special requirements – Technical Delivery Conditions	Superceded by: EN 10217-3:2002 Welded Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 3: Alloy Fine Grain Steel Tubes
DIN 17179:1986 Seamless Circular Fine Grain Steel Tubes Subject to Special Requirements – Technical Delivery Conditions	Superceded by: EN 10216-3:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 3: Alloy Fine Grain Steel Tubes
DIN 17204:1990 Seamless Circular Tubes Made from Steels for Quenching and Tempering – Technical Delivery Conditions	Superceded by: 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
DIN 2391-2:1994 Seamless Precision Steel Tubes	Superceded by: EN 10305-1:2002 Steel Tubes for Precision Applications – Technical Delivery Conditions – Part 1: Seamless Cold Drawn Tubes

Chapter 5: Steel Tubes and Pipes (Continued)	
Former National Standards Superseded by EN Standards	**Current EN Standards**
DIN 2393-2:1994 Welded Precision Steel Tubes	Superceded by: EN 10305-2:2003 Steel Tubes for Precision Applications – Technical Delivery Conditions – Part 2: Welded Cold Drawn Tubes
DIN 2394-2:1994 Welded and Sized Precision Steel Tubes – Technical Delivery Conditions	Superceded by: EN 10305-3:2003 Steel Tubes for Precision Applications – Technical Delivery Conditions – Part 3: Welded Cold Sized Tubes
AFNOR NF A49-111:1978 Plain End Seamless Tubes of Commercial Quality for General Purposes at Mean Pressure	Superceded by: EN 10216-1:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 1: Non-Alloy Steel Tubes with Specified Room Temperature Properties
AFNOR NF A49-112:1987 Plain End Seamless Hot Rolled Tubes with Specified Room Temperature Properties and with Special Delivery Conditions – Dimensions – Technical Delivery Conditions	Superceded by: EN 10216-1:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 1: Non-Alloy Steel Tubes with Specified Room Temperature Properties
AFNOR NF A 49-142:1987 Longitudinally Pressure Welded Plain Ended and Hot Finished Tubes. Diameters from 13,5 to 168,3 mm with Specified Room Temperature Properties and with Special Delivery Conditions – Dimensions – Technical Delivery Conditions	Superceded by: EN 10217-1:2002 Welded Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 1: Non-Alloy Steel Tubes with Specified Room Temperature Properties
AFNOR NF A 49-150:1985 Steel Tubes. Welded Tubes Intended to be Coated or Protected for use in Water Piping Systems – Dimensions – Technical Delivery Conditions.	Superceded by: EN 10224:2002 Non-Alloy Steel Tubes and Fittings for the Conveyance of Aqueous Liquids Including Water for Human Consumption – Technical Delivery Conditions
AFNOR NF A 49-210:1985 Steel Tubes: Seamless Cold Drawn Tubes for Fluid Piping – Dimensions – Technical Delivery Conditions	Superceded by: EN 10216-2:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 2: Non-Alloy and Alloy Steel Tubes with Specified Elevated Temperature Properties
AFNOR NF A 49-211:1989 Steel Tubes; Seamless Plain-End Tubes in Unalloyed Steels for Fluid Piping at Elevated Temperatures – Dimensions – Technical Delivery Conditions	Superceded by: EN 10216-2:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 2: Non-Alloy and Alloy Steel Tubes with Specified Elevated Temperature Properties
AFNOR NF A 49-213:1990 Seamless Unalloyed and Mo and Cr-Mo Alloyed Steel Tubes for Use at High Temperatures – Dimensions (with Normal Tolerances) – Technical Delivery Conditions	Superceded by: EN 10216-2:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 2: Non-Alloy and Alloy Steel Tubes with Specified Elevated Temperature Properties
AFNOR NF A 49-215:1981 Seamless Tubes for Ferritic Non-Alloy and Alloy Steel Heat Exchangers – Dimensions – Technical Delivery Conditions	Superceded by: EN 10216-2:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 2: Non-Alloy and Alloy Steel Tubes with Specified Elevated Temperature Properties
AFNOR NF A 49-219:1990 Non-Alloy and Mo and Cr-Mo Alloy Steel Seamless Tubes for Furnaces – Dimensions – Technical Delivery Conditions	Superceded by: EN 10216-2:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 2: Non-Alloy and Alloy Steel Tubes with Specified Elevated Temperature Properties
AFNOR NF A 49-230:1985 Steel Tubes: Plain end Seamless Tubes for Pressure Vessels and Piping Systems Used at Low Temperatures – Dimensions – Technical Delivery Conditions	Superceded by: EN 10216-4:2002 Seamless Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 4: Non-alloy and Alloy Steel Tubes with Specified Low Temperature Properties
AFNOR NF A 49-240:1983 Steel Tubes: Plain Ended Steel Tubes Longitudinally Welded Without Fusion for Pressure Vessels and Piping Systems at Low Temperatures – Dimensions – Technical Delivery Conditions	Superceded by: 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

Chapter 5: Steel Tubes and Pipes (Continued)	
Former National Standards Superseded by EN Standards	**Current EN Standards**
AFNOR NF A 49-241:1986 Steel Tubes - Longitudinally Pressure Welded Plain End Tubes in Non-Alloyed Steel Grades for Fluid Piping up to 425°C – Diameters From 21.3 mm to 168.3 mm – Dimensions – Technical Delivery Conditions	Superceded by: 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
AFNOR NF A 49-242:1985 Longitudinally Pressure Welded Tubes D Inferior or Equal to 168.3 mm in Non-Alloyed and Low Alloyed Steels Used at Medium Elevated Temperatures – Dimensions – Technical Delivery Conditions	Superceded by: 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
AFNOR NF A 49-243:1985 Longitudinally Pressure Welded Tubes D Inferior or Equal to 168.3 mm in Non-Alloyed and Ferritic Alloyed Steels, Used at Elevated Temperatures – Dimensions – Technical Delivery Conditions	Superceded by: 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
AFNOR NF A 49-245:1986 Longitudinally Pressure Welded Tubes from Non-Alloy and Ferritic Alloy Steels for Heat Exchangers in Diameters From 15.9 mm and 76.1 mm Inclusive – Dimensions – Technical Delivery Conditions	Superceded by: 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
AFNOR NF A 49-252:1982 Welded Non-Alloy Steel Tubes of Diameters 168.3 mm to 1220 mm Used at Averagely Elevated Temperatures – Dimensions – Technical Delivery Conditions	Superceded by: 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 10217-5:2002 Welded Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 5: Submerged Arc Welded Non-alloy and Alloy Steel Tubes with Specified Elevated Temperatures Properties
AFNOR NF A 49-253:1982 Longitudinally Fusion Welded Non-Alloy Steel and Ferritic Alloy Steel Tubes for Use at Elevated Temperatures – Dimensions – Technical Delivery Conditions	Superceded by: 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 10217-5:2002 Welded Steel Tubes for Pressure Purposes – Technical Delivery Conditions – Part 5: Submerged Arc Welded Non-alloy and Alloy Steel Tubes with Specified Elevated Temperatures Properties
AFNOR NF A 49-310:1994 Seamless Precision Tubes for Mechanical Application – Dimensions – Technical Delivery Conditions	Superceded by: EN 10305-1:2002 Steel Tubes for Precision Applications – Technical Delivery Conditions – Part 1: Seamless Cold Drawn Tubes
AFNOR NF A 49-311:1974 Seamless Tubes for Mechanical Application – Dimensions – Technical Delivery Conditions	Superceded by: 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
AFNOR NF A 49-323:1978 Steel Tubes: Jacks for Hydraulic Transmissions; Cold Rolled or Drawn Seamless Tubes, Type – Ready for Use – Dimensions – Technical Delivery Conditions	Superceded by: EN 10305-1:2002 Steel Tubes for Precision Applications – Technical Delivery Conditions – Part 1: Seamless Cold Drawn Tubes
AFNOR NF A 49-341:1975 Precision Welded Tubes for Mechanical Application – Dimensions – Technical Delivery Conditions	Superceded by: 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

Chapter 5: Steel Tubes and Pipes (Continued)	
Former National Standards Superseded by EN Standards	**Current EN Standards**
AFNOR NF A 49-343:1980 Longitudinally Welded D Inferior or Equal to 168.3 mm for Engineering Use – Dimensions – Technical Delivery Conditions	Superceded by: 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

Chapter 6: Steel Forgings	
Former National Standards Superseded by EN Standards	**Current Standards**
BSI BS 29:1976 Carbon Steel Forgings Above 150 mm Ruling Section (Withdrawn)	Superseded by: EN 10250-2:2000 Corr 1 Open Die Steel Forgings for General Engineering Purposes – Part 2: Non-Alloy Quality and Special Steels CORR 11041
BSI BS 1503:1989 Amd 3 Steel Forgings for Pressure Purposes (Withdrawn)	Superseded by: EN 10222 Steel Forgings for Pressure Purposes EN 10222-1:1998 General Requirements for Open Die Forgings EN 10222-2:2000 Ferritic and Martensitic Steels with Specified Elevated Temperature Properties EN 10222-3:1999 Nickel Steels with Specified Low-Temperature EN 10222-4:1999 Weldable Fine-Grain Steels with High Proof Strength EN 10222-5:2000 Martensitic, Austenitic and Austenitic-Ferritic Stainless Steels
BSI BS 4670:1971 Alloy Steel Forgings (Withdrawn)	Superseded by: EN 10250-3:2000 Open Die Steel Forgings for General Engineering Purposes – Part 3: Alloy Special Steels
DIN 17103:1989 Weldable Fine Grain Structural Steel Forgings; Technical Delivery Conditions (Withdrawn) DIN 17243:1987 Weldable Heat Resisting Steel Forgings and Rolled or Forged Steel Bars; Technical Delivery Conditions (Withdrawn)	Superseded by: EN 10222-1:1998 Steel Forgings for Pressure Purposes – Part 1: General Requirements for Open Die Forgings
DIN 17280:1985 Steels with Low Temperature Toughness; Technical Delivery Conditions for Plate, Sheet, Strip, Wide Flats, Sections, Bars and Forgings (Withdrawn) DIN 17440:1996 Stainless Steels- Technical Delivery Conditions for Plates, Hot Rolled Strip and Bars for Pressure Purposes, Drawn Wire and Forgings (Withdrawn) DIN 17100:1980 Steels for General Structural Purposes; Quality Standard (Withdrawn)	Partially Superseded by: EN 10222-1:1998 Steel Forgings for Pressure Purposes – Part 1: General Requirements for Open Die Forgings
DIN 17243:1987 Weldable Heat Resisting Steel Forgings and Rolled or Forged Steel Bars; Technical Delivery Conditions (Withdrawn)	Superseded by: EN 10222 Steel Forgings for Pressure Purposes EN 10222-1:1998 General Requirements for Open Die Forgings EN 10222-2:2000 Ferritic and Martensitic Steels with Specified Elevated Temperature Properties (Includes Corrigendum AC: 2000) EN 10273:2000 Hot Rolled Weldable Steel Bars for Pressure Purposes with Specified Elevated Temperature
DIN 17100:1980 Steels for General Structural Purposes; Quality Standard (Withdrawn)	Superseded by: EN 10250 Open Die Steel Forgings for General Engineering Purposes EN 10250-1:1999 General EN 10250-2:2000 Non-Alloy Quality and Special Steels

Chapter 6: Steel Forgings (Continued)	
Former National Standards Superseded by EN Standards	**Current Standards**
DIN 17440:1996 Stainless Steels-Technical Delivery Conditions for Plates, Hot Rolled Strip and Bars for Pressure Purposes, Drawn Wire and Forgings (Withdrawn)	Partially Superseded by: EN 10250 Open Die Steel Forgings for General Engineering Purposes EN 10250-1:1999 General EN 10250-4:2000 Open Die Steel Forgings for General Engineering Purposes
AFNOR NF A36-601:1980 Pièces Forgées en Acier Soudable pour Chaudières et Appareils à Pression- Aciers au Carbone et Carbone-Manganèse-Nuances et Qualités (Withdrawn) AFNOR NF A36-602:1988 Pièces Forgées en Acier Soudable pour Chaudières et Appareils à Pression – Aciers Alliés au Mo, au Mn-Mo et au Cr-Mo Nuances et Qualités (Withdrawn) AFNOR NF A36-603:1988 Pièces Forgées en Acier Soudable pour Chaudières et Appareils à Pression-Aciers Alliés à Haute Limite d'Élasticité Nuances et Qualités (Withdrawn) AFNOR NF A36-607:1984 Pièces Obtenues par Forgeage Libre ou Estampage en Aciers Inoxydables Austénitiques pour Chaudières et Appareils à Pression – Nuances et Qualités (Withdrawn)	Superseded by: EN 10222 Steel Forgings for Pressure Purposes EN 10222-1:1998 General Requirements for Open Die Forgings EN 10222-3:1999 Nickel Steels with Specified Low Temperature Properties. EN 10222-4:1999 Weldable Fine Grain Steels with High Proof Strength EN 10222-2:2000 Ferritic and Martensitic Steels with Specified Elevated Temperature Properties EN 10222-5:2000 Martensitic, Austenitic and Austenitic-Ferritic Stainless Steels
AFNOR NF A36-612:1982 Pièces Forgées d'Usage Général – Aciers Non Alliés (Withdrawn) AFNOR NF A36-613:1986 Pièces Forgées d'Usage Général – Aciers Inoxydables (Withdrawn)	Superseded by: EN 10250-1:1999 Open Die Steel Forgings for General Engineering Purposes – Part 1: General Requirements
AFNOR NF A36-612:1982 Pièces Forgées d'Usage Général – Aciers Non Alliés (Withdrawn)	Superseded by: EN 10250-2:2000 Open Die Steel Forgings for General Engineering Purposes – Part 2: Non-Alloy Quality and Special Steels
AFNOR NF A36-613:1986 Pièces Forgées d'Usage Général – Aciers Inoxydables (Withdrawn)	Superseded by: EN 10250-4:2000 Open Die Steel Forgings for General Engineering Purposes – Part 4: Stainless Steels

Chapter 7: Steel Castings	
Former National Standards Superseded by EN Standards	**Current EN Standard**
BSI BS 1504:1976 Steel Castings for Pressure Purposes (Withdrawn)	Superseded by: EN 10213 Steel Castings for Pressure Purposes EN 10213-1:1996 General EN 10213-2:1996 Steel Grades for Use at Room Temperature and at Elevated Temperature EN 10213-3:1996 Steels for Use at Low Temperatures EN 10213-4:1996 Austenitic and Austenitic-Ferritic Steel Grades
DIN 17182:1992 General Purpose Steel Castings with Enhanced Weldability and Higher Toughness; Technical Delivery Conditions (Withdrawn)	Partially Superseded by: EN 10213 Steel Castings for Pressure Purposes EN 10213-1:1996 General EN 10213-3:1996 Steels for Use at Low Temperatures
DIN 17245:1987 Ferritic Steel Castings with Elevated Temperature Properties; Technical Delivery Conditions (Withdrawn)	Superseded by: EN 10213: Steel Castings for Pressure Purposes EN 10213-1:1996 General EN 10213-2:1996 Steel Grades for Use at Room Temperature and at Elevated Temperature
DIN 17445:1984 Stainless Steel Castings; Technical Delivery Conditions (Withdrawn)	Partially Superseded by: EN 10213 Steel Castings for Pressure Purposes EN 10213-1:1996 General EN 10213-4:1996 Austenitic and Austenitic-Ferritic Steel Grades
DIN 17445:1984 Stainless Steel Castings; Technical Delivery Conditions (Withdrawn)	Superseded by: EN 10213 Steel Castings for Pressure Purposes EN 10213-1:1996 General EN 10213-4:1996 Austenitic and Austenitic-Ferritic Steel Grades EN 10283:1999 Corrosion Resistant Steel Castings
DIN 17465:1993 Heat Resisting Steel Castings	Superceded by: EN 10295:2002 Heat Resistant Steel Castings.
AFNOR NF A 32-057:1981 Steel Grades and Related Alloys-Refractory Moulds	Superceded by: EN 10295:2002 Heat Resistant Steel Castings.
AFNOR NF A32-055:1985 Produits de Fonderie–Aciers Moulés Soudables pour Chaudières et Appareils à Pression (Withdrawn)	Superseded by: EN 10213 Steel Castings for Pressure Purposes EN 10213-1:1996 General EN 10213-2:1996 Steel Grades for Use at Room Temperature and at Elevated Temperature EN 10213-3:1996 Steels for Use at Low Temperatures EN 10213-4:1996 Austenitic and Austenitic-Ferritic Steel Grades

Chapter 8: Wrought Stainless Steels and Heat-Resisting Steels	
Former National Standards Superseded by EN Standards	**Current EN Standards**
BSI BS 970-1:1991 Wrought Steels for Mechanical and Allied Engineering Purposes – Part 1: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels (Withdrawn)	Partially Superseded by: BS 970-1:1996 Specification for Wrought Steels for Mechanical and Allied Engineering Purposes – Part 1: General Inspection And Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels EN 10083-3:1996 Quenched and Tempered Steels – Part 3: Technical Delivery Conditions for Boron Steels EN 10088-2:1995 Stainless Steels – Part 2: Technical Delivery Conditions for Sheet/Plate and Strip for General Purposes EN 10088-3:1995 Stainless Steels – Part 3: Technical Delivery Conditions for Semi-Finished Products, Bars, Rods and Sections for General Purposes
BSI BS 1449-2:1983 Amd 4 Steel Plate, Sheet and Strip – Part 2: Specification for Stainless and Heat-Resisting Steel Plate, Sheet and Strip AMD 9648 (Withdrawn)	Superseded by: EN 10029:1991 Specification for Tolerances on Dimensions, Shape and Mass for Hot Rolled Steel Plates 3 Mm Thick or Above EN 10048:1997 Hot Rolled Narrow Steel Strip – Tolerances on Dimensions and Shape EN 10051:1992 Specification for Continuously Hot-Rolled Uncoated Plate, Sheet and Strip of Non-Alloy and Alloy Steels – Tolerances on Dimensions and Shape EN 10095:1999 Heat Resisting Steels and Nickel Alloys EN 10258:1997 Cold-Rolled Stainless Steel Narrow Strip and Cut Lengths – Tolerances on Dimensions and Shape EN 10259:1997 Cold-Rolled Stainless and Heat Resisting Steel Wide Strip and Plate/Sheet – Tolerances on Dimensions and Shape
BSI BS 970-1:1991 Wrought Steels for Mechanical and Allied Engineering Purposes – Part 1: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels	Partially Superseded by: EN 10084:1998 Case Hardening Steels – Technical Delivery Conditions EN 10085:2001 Nitriding Steel – Technical Delivery Conditions EN 10087:1999 Free Cutting Steels – Technical Delivery Conditions for Semi-Finished Products, Hot Rolled Bars and Rods EN 10095:1999 Heat Resisting Steels and Nickel Alloys EN 10250-4:2000 Open Die Steel Forgings for General Engineering Purposes – Part 4: Stainless Steels
DIN 17440:1985 Stainless Steels; Technical Delivery Conditions for Plate and Sheet, Hot Rolled Strip, Wire Rod, Drawn Wire, Steel Bars, Forgings and Semi-Finished Products DIN 17441:1985 Stainless Steels; Technical Delivery Conditions for Cold Rolled Strip and Slit Strip and for Plate and Sheet Cut Therefrom	Superseded by: EN 10088-2:1995 Stainless Steels – Part 2: Technical Delivery Conditions for Sheet/Plate and Strip for General Purposes
DIN 17440:1985 Stainless Steels; Technical Delivery Conditions for Plate and Sheet, Hot Rolled Strip, Wire Rod, Drawn Wire, Steel Bars, Forgings and Semi-Finished Products	Partially Superseded by: EN 10088-3:1995 Stainless Steels – Part 3: Technical Delivery Conditions for Semi-Finished Products, Bars, Rods and Sections for General Purposes
DIN 17440:1985 Stainless Steels; Technical Delivery Conditions for Plate and Sheet, Hot Rolled Strip, Wire Rod, Drawn Wire, Steel Bars, Forgings and Semi-Finished Products	Partially Superseded by: EN 10250-4:2000 Open Die Steel Forgings for General Engineering Purposes – Part 4: Stainless Steels

Chapter 8: Wrought Stainless Steels and Heat-Resisting Steels (Continued)	
Former National Standards Superseded by EN Standards	**Current EN Standards**
AFNOR NF A35-573:1990 Produits Sidérurgiques- Aciers Inoxydables d'Usage Général-Tôles, Larges Bandes et Feuillards	Superseded by: EN 10088-2:1995 Stainless Steels – Part 2: Technical Delivery Conditions for Sheet/Plate and Strip for General Purposes
AFNOR NF A35-574:1990 Produits Sidérurgiques-Aciers Inoxydables d'Usage Général-Demi-Produits, Barres et Fil Machine	Superseded by: EN 10088-3:1995 Stainless Steels – Part 3: Technical Delivery Conditions for Semi-Finished Products, Bars, Rods and Sections for General Purposes

Chapter 9: Steels for Special Use	
Former National Standards Superseded by EN Standards	**Current EN Standard**
BSI BS 970-1:1991 Wrought Steels for Mechanical and Allied Engineering Purposes – Part 1: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels	Superseded by: EN 10095:1999 Heat Resisting Steels and Nickel Alloys
BSI BS 970-1:1991 Wrought Steels for Mechanical and Allied Engineering Purposes – Part 1: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels	Partially Superseded by: EN 10084:1998 Case Hardening Steels – Technical Delivery Conditions EN 10085:2001 Nitriding Steel – Technical Delivery Conditions EN 10087:1999 Free Cutting Steels-Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods EN 10250-4:2000 Open Steel Die Forgings for General Engineering Purposes – Part 4: Stainless Steels
BSI BS 970-2:1988 AMD 2:1992 Wrought Steels for Mechanical and Allied Engineering Purposes – Part 2: Requirements for Steels for the Manufacture of Hot Formed Springs (Withdrawn)	Superseded by: EN 10089:2002 Hot Rolled Steels for Quenched and Tempered Springs – Technical Delivery Conditions.
BSI BS 970-3:1991 Wrought Steel for Mechanical and Allied Engineering Purposes – Part 3: Bright Bars for General Engineering Purposes (Withdrawn)	Superseded by: EN 10277 Bright Steel Products – Technical Delivery Conditions EN 10277-1:1999 General EN 10277-2:1999 Steels for General Engineering Purposes EN 10277-3:1999 Free-Cutting Steels EN 10277-4:1999 Case-Hardening Steels EN 10277-5:1999 Steels for Quenching and Tempering EN 10278:1999 Dimensions and Tolerances of Bright Steel Products
BSI BS 1449-2:1983 Steel Plate, Sheet and Strip – Part 2: Specification for Stainless and Heat-Resisting Steel Plate, Sheet and Strip (Withdrawn)	Superseded by: EN 10095:1999 Heat Resisting Steels and Nickel Alloys EN 10029:1991 Specification for Tolerances on Dimensions, Shape and Mass for Hot Rolled Steel Plates 3 Mm Thick or Above EN 10048:1997 Hot Rolled Narrow Steel Strip – Tolerances on Dimensions and Shape EN 10051:1992 Specification for Continuously Hot-Rolled Uncoated Plate, Sheet and Strip of Non-Alloy and Alloy Steels – Tolerances on Dimensions and Shape EN 10258:1997 Cold-Rolled Stainless Steel Narrow Strip and Cut Lengths – Tolerances on Dimensions and Shape EN 10259:1997 Cold-Rolled Stainless and Heat Resisting Steel Wide Strip and Plate/Sheet – Tolerances on Dimensions and Shape
BSI BS 4659:1989 Tool and Die Steels (Withdrawn)	Superseded by: EN ISO 4957:2000 Tool Steels

Chapter 9: Steels for Special Use (Continued)	
Former National Standards Superseded by EN Standards	**Current EN Standard**
BSI BS 5770:1981 Steel Strip Intended for the Manufacture of Springs (Withdrawn) BSI BS 5770-1:1981: Hot Rolled Steel and Low Alloy Steel (Withdrawn) BSI BS 5770-2:1981 Amd 1 Cold Rolled Carbon and Low Alloy Steel (Withdrawn) BSI BS 5770-3:1981 Pre-Hardened and Tempered Carbon Steel (Withdrawn)	Superseded by: EN 10132-1:2000 Cold Rolled Narrow Steel Strip for Heat Treatment – Technical Delivery Conditions – Part 1: General EN 10132-4:2000 Cold Rolled Narrow Steel Strip for Heat Treatment – Technical Delivery Conditions – Part 4: Spring Steels and Other Applications
BSI BS 5770-4:1981 Steel Strip Intended for the Manufacture of Springs – Part 4: Martensitic and Austenitic Stainless Steel (Withdrawn)	Superseded by: EN 10151:2002 Stainless Steel Strip for Springs – Technical Delivery Conditions
DIN 1651:1988 Free-Cutting Steels – Technical Delivery Conditions	Partially Superseded by: EN 10087:1999 Free-Cutting Steels – Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods
DIN 17221:1988 Hot Rolled Steels for Springs Suitable for Quenching and Tempering – Technical Delivery Conditions	Superceded by: EN 10151:2002 Stainless Steel Strip for Springs – Technical Delivery Conditions.
DIN 17222:1979 Cold Rolled Steel Strips for Springs – Technical Conditions of Delivery	Superseded by: EN 10132-4:2000 Cold-Rolled Narrow Steel Strip for Heat-Treatment – Technical Delivery Conditions – Part 4: Spring Steels and Other Applications EN 10132-1:2000 Cold-Rolled Narrow Steel Strip for Heat Treatment – Technical Delivery Conditions – Part 1: General
DIN 17224:1982 Stainless Steel Wire and Strip for Springs; Technical Delivery Conditions	Superseded by: EN 10151:2002 Stainless Steel Strip for Springs – Technical Delivery Conditions EN 10270-3:2001 Steel Wire for Mechanical Springs – Part 3: Stainless Spring Steel Wire
DIN 17230:1980 Ball and Roller Bearing Steels– Technical Conditions of Delivery	Superseded by: EN ISO 683-17:1999 Heat-Treated Steels, Alloy Steels and Free-Cutting Steels – Part 17: Ball and Roller Bearing Steels
DIN 17350:1980 Tool Steel	Superseded by: EN ISO 4957:2000 Tool Steels
AFNOR NF A35-561:1992 Produits Sidérurgiques-Barres, Fil Machine en Acier de Décolletage d'Usage Général-Conditions Techniques de Livraison AFNOR NF A35-562:1986 Barres et Fils Machine en Aciers de Décolletage Spéciaux pour Traitement Thermique	Superseded by: EN 10087:1999 Free-Cutting Steels – Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods.
AFNOR NF A 35-565: 1999 Aciers pour Traitement Thermique, Aciers Alliés et Aciers pour Décolletage. Partie 17:Aciers pour Roulements	Superseded by: EN ISO 683-17:1999 Heat-Treated Steels, Alloy Steels and Free-Cutting Steels – Part 17: Ball and Roller Bearing Steels
AFNOR NF A35 571:1996 Special Structural Steels Suitable for the Manufacture of Suspension Components	Superseded by: EN 10089:2002 Hot Rolled Steels for Quenched and Tempered Springs – Technical Delivery Conditions.
AFNOR NF A35-590:1992 Aciers Outils	Superseded by: EN ISO 4957:2000 Tool Steels
AFNOR NF A37-401:1993 Produits en Acier Transformés à Froid-Barres Étirées et Ronds Écroutés-Galètes-Caractéristiques Mécaniques	Superseded by: EN 10277-3:1999 Bright Steel Products – Technical Delivery Conditions – Part 3: Free-Cutting Steels.

Appendix

8

ISO IRON AND STEEL PRODUCT STANDARDS

Designation	Title
ISO 404:1992	Steel and steel products -- General technical delivery requirements
ISO 630:1995	Structural steels -- Plates, wide flats, bars, sections and profiles
ISO 1052:1982	Steels for general engineering purposes
ISO 3755:1991	Cast carbon steels for general engineering purposes
ISO 4885:1996	Ferrous products -- Heat treatments -- Vocabulary
ISO 6929:1987	Steel products -- Definitions and classification
ISO 9477:1992	High strength cast steels for general engineering and structural purposes
ISO 10474:1991	Steel and steel products -- Inspection documents
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 683-15:1992	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 4954:1993	Steels for cold heading and cold extruding
ISO 4955:1994	Heat-resisting steels and alloys
ISO 5949:1983	Tool steels and bearing steels -- Micrographic method for assessing the distribution of carbides using reference photomicrographs
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/TR 11637:1997	Boron treated engineering steels for quenching and tempering
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 10144:1991	Certification scheme for steel bars and wires for the reinforcement of concrete structures
ISO 10544:1992	Cold-reduced steel wire for the reinforcement of concrete and the manufacture of welded fabric
ISO 11082:1992	Certification scheme for welded fabric for the reinforcement of concrete structures
ISO/TR 12662:1997	Certification scheme for prestressing steels
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 11692:1994	Ferritic-pearlitic engineering steels for precipitation hardening from hot-working temperatures
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 683-15:1992	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 4952:2003	Structural steels with improved atmospheric corrosion resistance
ISO 4954:1993	Steels for cold heading and cold extruding
ISO 4955:1994	Heat-resisting steels and alloys
ISO 5949:1983	Tool steels and bearing steels -- Micrographic method for assessing the distribution of carbides using reference photomicrographs
ISO 7153-1:1991	Surgical instruments -- Metallic materials -- Part 1: Stainless steel Amd 1:1999
ISO 9443:1991	Heat-treatable and alloy steels -- Surface quality classes for hot-rolled round bars and wire rods -- Technical delivery conditions

Designation	Title
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 11972:1998	Corrosion-resistant cast steels for general applications
ISO 11973:1999	Heat-resistant cast steels and alloys for general applications
ISO/TR 15510:2003	Stainless steels -- Chemical composition
ISO 683-14:2004	Heat-treatable steels, alloy steels and free-cutting steels -- Part 14: Hot-rolled steels for quenched and tempered springs
ISO 6931-1:1994	Stainless steels for springs -- Part 1: Wire
ISO 6931-2:1989	Stainless steels for springs -- Part 2: Strip
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 9442:1988	Steel -- Hot-rolled ribbed and grooved flats for spring leaves -- Tolerances and dimensions
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 4978:1983	Flat rolled steel products for welded gas cylinders
ISO 4991:1994	Steel castings for pressure purposes
ISO 6303:1981	Pressure vessel steels not included in ISO 2604, Parts 1 to 6 -- Derivation of long-time stress rupture properties
ISO/TR 7468:1981	Summary of average stress rupture properties of wrought steels for boilers and pressure vessels
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 9328-1:1991	Steel plates and strips for pressure purposes -- Technical delivery conditions -- Part 1: General requirements
ISO 9328-2:1991	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 9328-3:1991	Steel plates and strips for pressure purposes -- Technical delivery conditions -- Part 3: Nickel-alloyed steels with specified low temperature properties
ISO 9328-4:1991	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 9328-5:1991	Steel plates and strips for pressure purposes -- Technical delivery conditions -- Part 5: Austenitic steels
ISO 4957:1999	Tool steels
ISO 5949:1983	Tool steels and bearing steels -- Micrographic method for assessing the distribution of carbides using reference photomicrographs
ISO 11054:1993	Cutting tools -- Designation of high-speed steel groups
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 683-18:1996	Heat-treatable steels, alloy steels and free- cutting steels -- Part 18: Bright products of unalloyed and low alloy steels
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 3575:1996	Continuous hot-dip zinc-coated carbon steel sheet of commercial, lock-forming and drawing qualities
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 4960:1999	Cold-reduced carbon steel strip with a carbon content over 0,25 %
ISO 4995:2001	Hot-rolled steel sheet of structural quality
ISO 4996:1999	Hot-rolled steel sheet of high yield stress structural quality
ISO 4997:1999	Cold-reduced steel sheet of structural quality
ISO 4998:1996	Continuous hot-dip zinc-coated carbon steel sheet of structural quality
ISO 4999:1999	Continuous hot-dip terne (lead alloy) coated cold-reduced carbon steel sheet of commercial drawing and structural qualities
ISO 5000:1993	Continuous hot-dip aluminium/silicon-coated cold-reduced carbon steel sheet of commercial and drawing qualities

Designation	Title
ISO 5001:1999	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 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 5952:1998	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 6316:2000	Hot-rolled steel strip of structural quality
ISO 6317:2000	Hot-rolled carbon steel strip of commercial and drawing qualities
ISO 6930-1:2001	High yield strength steel plates and wide flats for cold forming -- Part 1: Delivery conditions for thermomechanically-rolled steels
ISO 6932:2001	Cold-reduced carbon steel strip with a maximum carbon content of 0,25 %
ISO 7452:2002	Hot-rolled structural steel plates -- Tolerances on dimensions and shape
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 9034:1987	Hot-rolled structural steel wide flats -- Tolerances on dimensions and shape
ISO 9328-1:1991	Steel plates and strips for pressure purposes -- Technical delivery conditions -- Part 1: General requirements
ISO 9328-2:1991	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 9328-3:1991	Steel plates and strips for pressure purposes -- Technical delivery conditions -- Part 3: Nickel-alloyed steels with specified low temperature properties
ISO 9328-4:1991	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 9328-5:1991	Steel plates and strips for pressure purposes -- Technical delivery conditions -- Part 5: Austenitic steels
ISO 9364:2001	Continuous hot-dip aluminium/zinc-coated steel sheet of commercial, lock-forming and structural qualities
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 9473:1988	Textile machinery and accessories -- Strip steel for dents of reeds
ISO 10384:2001	Hot-rolled carbon steel sheet for machinery
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 13887:1995	Cold-reduced steel sheet of higher yield strength with improved formability
ISO 13976:1998	Hot-rolled steel sheet in coils of structural quality and heavy thickness
ISO 14590:1999	Cold-reduced steel sheet of high tensile strength and low yield point with improved formability
ISO 14788:1998	Continuous hot-dip zinc-5 %/aluminium alloy coated steel sheets and coils
ISO 16160:2000	Continuously hot-rolled steel sheet products -- Dimensional and shape tolerances
ISO 16162:2000	Continuously cold-rolled steel sheet products -- Dimensional and shape tolerances
ISO 16163:2000	Continuously hot-dipped coated steel sheet products -- Dimensional and shape tolerances
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 2938:1974	Hollow steel bars for machining
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 9443:1991	Heat-treatable and alloy steels -- Surface quality classes for hot-rolled round bars and wire rods -- Technical delivery conditions
ISO 2232:1990	Round drawn wire for general purpose non-alloy steel wire ropes and for large diameter steel wire ropes -- Specifications
ISO 2408:2004	Steel wire ropes for general purposes -- Minimum requirements
ISO 2532:1974	Steel wire ropes -- Vocabulary
ISO 2701:1977	Drawn wire for general purpose non-alloy steel wire ropes -- Terms of acceptance
ISO 3108:1974	Steel wire ropes for general purposes -- Determination of actual breaking load

Designation	Title
ISO 3178:1988	Steel wire ropes for general purposes -- Terms of acceptance
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 4101:1983	Drawn steel wire for elevator ropes -- Specifications
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 6984:1990	Round non-alloy steel wires for stranded wire ropes for mine hoisting -- Specifications
ISO 7531:1987	Wire rope slings for general purposes -- Characteristics and specifications
ISO 7595:1984	Socketing procedures for wire ropes -- Molten metal socketing
ISO/TR 7596:1982	Socketing procedures for wire ropes -- Resin socketing
ISO 7900:1988	Zinc-coated steel wire for fencing
ISO 7989:1988	Zinc coatings for steel wire
ISO 8457-1:1989	Steel wire rod -- Part 1: Dimensions and tolerances
ISO 8792:1986	Wire rope slings -- Safety criteria and inspection procedures for use
ISO 8793:1986	Steel wire ropes -- Ferrule-secured eye terminations
ISO 8794:1986	Steel wire ropes -- Spliced eye terminations for slings
ISO 9975:1990	Round non-alloy steel wires for locked coil mine winding ropes -- Specifications
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 657-15:1980	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 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 559:1991	Steel tubes for water and sewage
ISO 630-2:2000	Structural steels -- Part 2: Technical delivery requirements for hot-finished hollow sections
ISO 657-14:2000	Hot-rolled steel sections -- Part 14: Hot-finished structural hollow sections -- Dimensions and sectional properties
ISO 1129:1980	Steel tubes for boilers, superheaters and heat exchangers -- Dimensions, tolerances and conventional masses per unit length
ISO 2037:1992	Stainless steel tubes for the food industry
ISO 2937:1974	Plain end seamless steel tubes for mechanical application
ISO 3183-1:1996	Petroleum and natural gas industries -- Steel pipe for pipelines -- Technical delivery conditions -- Part 1: Pipes of requirement class A
ISO 3183-2:1996	Petroleum and natural gas industries -- Steel pipe for pipelines -- Technical delivery conditions -- Part 2: Pipes of requirements class B
ISO 3183-3:1999	Petroleum and natural gas industries -- Steel pipe for pipelines -- Technical delivery conditions -- Part 3: Pipes of requirement class C, Cor 1:2000
ISO 4019:2001	Structural steels -- Cold-formed, welded, structural hollow sections -- Dimensions and sectional properties
ISO 6594:1983	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 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

Designation	Title
ISO 9305:1989	Seamless steel tubes for pressure purposes -- Full peripheral ultrasonic testing for the detection of transverse imperfections
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 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 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 10124:1994	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Ultrasonic testing for the detection of laminar imperfections
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 10543:1993	Seamless and hot-stretch-reduced welded steel tubes for pressure purposes -- Full peripheral ultrasonic thickness testing
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 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 11960:2001	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 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 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 13:1978	Grey iron pipes, special castings and grey iron parts for pressure main lines
ISO 65:1981	Carbon steel tubes suitable for screwing in accordance with ISO 7-1
ISO 1127:1992	Stainless steel tubes -- Dimensions, tolerances and conventional masses per unit length
ISO 2531:1998	Ductile iron pipes, fittings, accessories and their joints for water or gas applications
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

Designation	Title
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 4179:1985	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 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 6761:1981	Steel tubes -- Preparation of ends of tubes and fittings for welding
ISO 7598:1988	Stainless steel tubes suitable for screwing in accordance with ISO 7-1
ISO 8179-1:1995	Ductile iron pipes -- External zinc 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 8180:1985	Ductile iron pipes -- Polyethylene sleeving
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 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 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 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 10124:1994	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Ultrasonic testing for the detection of laminar imperfections
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 10543:1993	Seamless and hot-stretch-reduced welded steel tubes for pressure purposes -- Full peripheral ultrasonic thickness testing
ISO 10803:1999	Design method for ductile iron pipes
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 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

Designation	Title
ISO 12096:1996	Submerged arc-welded steel tubes for pressure purposes -- Radiographic testing of the weld seam for the detection of imperfections
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 4986:1992	Steel castings -- Magnetic particle inspection
ISO 4987:1992	Steel castings -- Penetrant inspection
ISO 4990:2003	Steel castings -- General technical delivery requirements
ISO 4991:1994	Steel castings for pressure purposes
ISO 4993:1987	Steel castings -- Radiographic inspection
ISO 7186:1996	Ductile iron products for sewage applications
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 13521:1999	Austenitic manganese steel castings
ISO 13583-1:2000	Centrifugally cast steel and alloy products -- Part 1: General testing and tolerances
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/TR 15461:1997	Steel forgings -- Testing frequency, sampling conditions and test methods for mechanical tests
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 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 2415:1987	Forged shackles for general lifting purposes -- Dee shackles and bow shackles
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.
ISO 3077:2001	Short-link chain for lifting purposes -- Grade T, (types T, DAT and DT), fine-tolerance hoist chain
ISO 3266:1984	Eyebolts for general lifting purposes
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 4309:1990	Cranes -- Wire ropes -- Code of practice for examination and discard
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 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 8539:1986	Forged steel lifting components for use with grade T(8) chain

Appendix

9

ASTM A 941-03 TERMINOLOGY RELATING TO STEEL, STAINLESS STEEL, RELATED ALLOYS, AND FERROALLOYS

Designation: A 941 – 03

An American National Standard

Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys[1]

This standard is issued under the fixed designation A 941; 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:*

E 112 Test Methods for Determining Average Grain Size[2]

3. Terminology

3.1 *Definitions of General Terms:*

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.

capped steel, *n*—a **rimmed steel** in which, during ingot solidification, the rimming action was limited by mechanical or chemical means.

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.

cast analysis—Deprecated term. Use the preferred term **heat analysis**.

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.

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**.

defect, *n*—an imperfection of sufficient magnitude to warrant rejection based on the specified requirements.

[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] *Annual Book of ASTM Standards*, Vol 03.01.

***A Summary of Changes section appears at the end of this standard.**

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direct quenching, *n—in thermomechanical processing*, **quenching** immediately following the final hot deformation.

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.

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.

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 E 112.)

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**.

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.

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 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**.

inspection, *n*—the process of measuring, examining, testing, gaging, or otherwise comparing the unit of product with the applicable requirements.

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.

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**.

manufacturer, *n*—the organization responsible for the conversion of materials into products meeting the requirements of a product specification.

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**.

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.

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.

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.

semikilled steel, *n*—an incompletely deoxidized **steel** that contained sufficient oxygen to form enough entrapped carbon monoxide during solidification to offset solidification shrinkage.

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.

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.

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 hardening, *n*—an increase in hardness and strength of a metal caused by plastic deformation at temperatures below its **recrystallization temperature**. (Syn. *work hardening*)

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.

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.

3.2 *Definitions of Terms Relating to Heat Treatment of Steels:*

Ac_{cm}, Ac_1, Ac_3, Ac_4—See **transformation temperature**.

Ae_{cm}, Ae_1, Ae_3, Ae_4—See **transformation temperature**.

age hardening, *n*—hardening by **aging**, usually after rapid cooling or **cold working**.

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**.

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: **black annealing, box annealing, bright annealing, flame annealing, full annealing, graphitization annealing, intermediate annealing, isothermal annealing, process annealing, quench annealing, recrystallization 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**.

Ar_{cm}, Ar_1, Ar_3, Ar_4—See **transformation temperature**.

artificial aging, *n*—**aging** above room temperature.

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**.

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.

black annealing, *n*—**box annealing** steel sheet, strip, or wire.

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.

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.

carbonitriding, *n*—**case hardening** in which a suitable steel object is heated above Ac_1 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**; **cyaniding**; **nitriding**; and **carbonitriding**. It is preferred that the applicable specific process name be used.

cementation, *n*—the introduction of one or more elements into the outer portion of a steel object by means of diffusion at high 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.

cyaniding, *n*—introducing carbon and nitrogen into a solid steel object by holding it above Ac_1 in contact with molten cyanide of suitable composition.

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.

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.

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.

ferritizing anneal, *n*—a **heat treatment** that produces a predominantly ferritic matrix in a steel object.

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 Ac_3 or Ac_{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 Ac_3 for hypoeutectoid steels and between Ac_1 and Ac_{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.

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 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.

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 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.

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 Ac_3 or Ac_{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 Ac_3 or Ac_{cm} throughout its section, and then the object is **quenched**.

induction heating, *n*—heating by electrical induction.

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.

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.

M_f **,** M_s—See **transformation temperature**.

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.

natural aging, *n*—spontaneous aging of a super-saturated solid solution at room temperature.

nitriding, *n*—introducing nitrogen into a solid steel object by holding it at a suitable temperature in contact with a nitrogenous environment.

normalizing, *n*—heating a steel object to a suitable temperature above the **transformation range** and then cooling it in air to a temperature substantially below the **transformation range**.

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.

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*—*for tool steels*, heating to an intermediate temperature immediately before final **austenitizing**.

preheating, *n*—heating before welding, a mechanical treatment, or some further thermal treatment.

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.

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 annealing, *n*—**annealing** an austenitic steel object by **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.

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**.

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.

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.

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.

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.

stabilizing treatment, *n*—any treatment intended to stabilize the microstructure or dimensions of a steel object.

strain aging, *n*—**aging** induced by cold working.

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.

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.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A 941 – 01) that may impact the use of this standard.

(1) Changed "columbium (niobium)" to "niobium (columbium)" in 3.1.
(2) Added a definition for microalloyed steel in 3.1.
(3) Revised the definition for heat analysis by adding a discussion section in 3.1.

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Appendix 10

ASTM E 527-83 (2003) STANDARD PRACTICE FOR NUMBERING METALS AND ALLOYS (UNS)

Designation: E 527 – 83 (Reapproved 2003)

Standard Practice for Numbering Metals and Alloys (UNS)[1]

This standard is issued under the fixed designation E 527; 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 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 4 describes the procedure for requesting number assignment to metals and alloys for which UNS numbers have not previously been assigned.

NOTE 1—UNS designations shall not 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 others are intended to portray a material in active industrial use, although the actual amount of such use will depend, among other things, upon the type of materials. (Obviously gold will not be used in the same "tonnages'' as hot-rolled steel.)

Different standardizing groups use different criteria to define the status that a material has to attain before a standard number will be assigned to it. For instance, the American Iron and Steel Institute requires for stainless steels "two or more producers with combined production of 200 tons per year for at least two years''; 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.''

While it is apparent that no hard and fast usage definition can be set up for an all-encompassing system, the UNS numbers are intended to identify metals and alloys that are in more or less 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.

1.2 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 also provides the uniformity necessary for efficient indexing, record keeping, data storage and retrieval, and cross referencing.

1.3 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 3—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.

2. Description of Numbers (or Codes) Established for Metals and Alloys

2.1 The unified numbering system (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 4—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 be widely accepted and used.

2.3 Wherever feasible, identification "numbers'' from existing systems are incorporated into the UNS numbers. For example: carbon steel, presently identified by AISI 1020 (American Iron and Steel Institute), is covered by "UNS G 10200 ''; and free cutting brass, presently identified by CDA (Copper Development Association C 36000), is covered by "UNS C 36000.'' 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

Nonferrous Metals and Alloys	
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
Ferrous Metals and Alloys	
D00001–D99999	speci ed mechanical properties steels
F00001–F99999	cast irons and cast steels
G00001–G99999	AISI and SAE carbon and alloy steels
H00001–H99999	AISI 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
Specialized Metals and Alloys	
W00001–W99999	welding ller metals, covered and tubular electrodes, classi ed by weld deposit composition (see Table 2)

TABLE 2 Secondary Division of Some Series of Numbers

E00001–E99999 Rare Earth and Rare Earth-Like Metals and Alloys	
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
F00001–F9999 Cast Irons	
K00001–K99999 Miscellaneous Steels and Ferrous Alloys	
L00001–L99999 Low-Melting Metals and Alloys	
L00001–L00999	bismuth
L01001–L01999	cadmium
L02001–L02999	cesium
L03001–L03999	gallium
L04001–L04999	indium
L05001–L05999	lead
L06001–L06999	lithium
L07001–L07999	mercury
L08001–L08999	potassium
L09001–L09999	rubidium
L10001–L10999	selenium
L11001–L11999	sodium
L12001–L12999	thallium
L13001–L13999	tin
M00001–M99999 Miscellaneous Nonferrous Metals and Alloys	
M00001–M00999	*antimony*
M01001–M01999	*arsenic*
M02001–M02999	*barium*
M03001–M03999	*calcium*

TABLE 2 *Continued*

M04001–M04999	*germanium*
M05001–M05999	*plutonium*
M06001–M06999	*strontium*
M07001–M07999	*tellurium*
M08001–M08999	*uranium*
M10001–M19999	*magnesium*
M20001–M29999	*manganese*
M30001–M39999	*silicon*
P00001–P99999 Precious Metals and Alloys	
P00001–P00999	gold
P01001–P01999	iridium
P02001–P02999	osmium
P03001–P03999	palladium
P04001–P04999	platinum
P05001–P05999	rhodium
P06001–P06999	ruthenium
P07001–P07999	silver
R00001–R99999 Reactive and Refractory Metals and Alloys	
R01001–R01999	boron
R02001–R02999	hafnium
R03001–R03999	molybdenum
R04001–R04999	niubium (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
W00001–W99999 Welding Filler Metals Classi ed by Weld Deposit Composition	
W00001–W09999	carbon steel with no signi cant 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	chromiun low alloy steels
W60000–W69999	copper base alloys
W70000–W79999	surfacing alloys
W80000–W89999	nickel base alloys
Z00001–Z99999 Zinc and Zinc 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 new 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 5—Readers are cautioned *not* to make their own assignments of numbers from such listings, as this can result in unintended and unexpected 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.

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.

[2] Request ASTM DS 56A and SAE Handbook Supplement HS 1086a, *Unified Numbering System for Metals and Alloys*, (a joint ASTM–SAE publication), PCN 05-056001-01.

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 and ASTM. 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 both SAE and ASTM details of each number assignment. ASTM and SAE 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 and ASTM number assigners, they are not listed in this recommended practice. At the request of the ASTM (or 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 ASTM or 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 *Staffs at ASTM and SAE*—Staff members at SAE and ASTM maintain duplicate 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

TABLE 3 Number Assigners and Areas of Responsibility

The Aluminum Association 818 Connecticut Ave. N.W. Washington, D.C. 20006 Attention: Office for Uni ed Numbering System for Metals Telephone: (202)862-5100	Aluminum and Aluminum Alloys UNS Number Series: A 00001–A 99999
American Iron and Steel Institute 1000 16th St., N.W. Washington, D.C. 20036 Attention: Office for Uni ed Numbering System for Metals Telephone: (202)452-7236	Carbon and Alloy Steels UNS Number Series: G 00001–G 99999 H-Steels UNS Number Series: H 00001–H 99999 Tool Steels UNS Number Series: T 00001–T 99999
American Welding Society 550 N. W. LeJeune Road P.O. Box 351040 Miami, FL 33135 Attention: Office for Uni ed Numbering System for Metals Telephone: (305)642-7090	Welding Filler Metals UNS Number Series: W 00001–W 99999
Copper Development Association 405 Lexington Ave. New York, N. Y. 10017 Attention: Office for Uni ed Numbering System for Metals Telephone: (212)953-7321	Copper and Copper Alloys UNS Number Series: C 00001–C 99999
ASTM 100 Barr Harbor Drive West Conshohocken, Pa. 19428 Attention: Office for Uni ed Numbering System for Metals Telephone: (610)832-9652	Rare Earth and Rare Earth-Like Metals and Alloys UNS Number Series: E 00001–E 99999 Low Melting Metals and Alloys UNS Number Series: L 00001–L 99999 Miscellaneous Steels and Ferrous Alloys UNS Number Series: K 00001–K 99999 Miscellaneous Nonferrous Metals and Alloys UNS Number Series: M 00001–M 99999 Cast Steels UNS Number Series: J 00001–J 99999 Heat and Corrosion Resistant (Stainless) Steels UNS Number Series: S 00001–S 99999 Zinc and Zinc Alloys UNS Number Series: Z 00001–Z 99999 Precious Metals and Alloys UNS Number Series: P 00001–P 99999 Cast Irons and Cast Steels UNS Number Series: F 00001–F 99999
Society of Automotive Engineers 400 Commonwealth Drive Warrendale, Pa. 15096 Attention: Office for Uni ed Numbering System for Metals Telephone: (412)776-4841	Nickel and Nickel Alloys UNS Number Series: N 00001–N 99999 Steels Speci ed by Mechanical Properties UNS Number Series: D 00001–D 99999 Reactive and Refractory Metals and Alloys UNS Number Series: R 00001–R 99999

when considering appeals from unfavorable rulings in the matter of UNS number assignments.

4. Procedure for Requesting Number Assignment to Metals and Alloys Not Already Covered by UNS Numbers (or Codes)

4.1 UNS numbers are assigned only to metals and alloys that have a commercial standing (as defined in Note 2).

4.2 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.

4.3 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.

4.3.1 In the case of metals or alloys that are normally identified or specified by chemical composition, the chemical composition limits must be reported.

4.3.2 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.

4.4 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.

4.5 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.

4.6 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.

4.7 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).

5. Keywords

5.1 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

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 E 527, Section 4.

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 indicate 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 A 638 (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 E 527.

FIG. 2 Sample Application Form (Reverse Side).

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This standard is subject to revision at any time by the responsible technical committee and must be reviewed every ve years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

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Appendix
11

SI QUICK REFERENCE GUIDE

SI QUICK REFERENCE GUIDE:
International System of Units (SI)
*The Modernized Metric System**

UNITS

The International System of Units (SI) is based on seven fundamental (base) units:

Base Units

Quantity	*Name*	*Symbol*
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

Quantity	*Expression*	*Name*	*Symbol*
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 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/(m^2·K)

Symbol for quotient—use one of the following forms:

Examples: m/s or $\frac{m}{s}$ or use negative exponent

Note: Use only one solidus (/) per expression and parentheses to avoid any ambiguity.

Do not use modifying terms such as electrical, alternating current, etc.

Examples: kPa (gage); MW (e); V (ac)

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 zeros 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}

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., µm, mm, km).

**Exceptions*:

In expressing area and volume, the prefixes hecto, deka, deci, and centi may by 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 m^3 *not* 6 kL
6 MPa *not* 6 kkPa

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 $mm^3 = (10^{-3}\ m)^3 = 10^{-9}\ m^3$
1 $ns^{-1} = (10^{-9}\ s)^{-1} = 10^{9}\ s^{-1}$
1 $mm^2/s = (10^{-3}\ m)^2/s = 10^{-6}\ m^2/s$

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 uniformity in tables.

Examples: 6.358 568; 85 365; 51 845 953; 88 000;
0.246 113 562; 7 258

Small Numbers. When writing numbers less than one, always put a zero before the decimal marker.

Example: 0.046

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 in the US are called Inch-Pound units (I-P units)—*not* conventional units, *not* U.S. customary units, *not* English units, and *not* Imperial 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 words or write the unit name in full.

Use plurals for spelled out words 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 compound units are 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 compound 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

Do not use modifying terms such as electrical, alternating current, etc. after the symbol.

Examples: kPa (gage); MW (e); V (ac)

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.

Multiply	*By*	*To Obtain*
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 vicosity, 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_f (torque or moment)	1.36	N·m
ft·lb_f (work)	1.36	J
ft·lb_f / lb (specific energy)	2.99	J/kg
ft·lb_f / 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
in of water (60°F)	248.8	Pa
in·lb_f (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	μm
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_f (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_f·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.

STEEL GRADE/NAME INDEX

Steel Grade/Name	Specification Designation	Page
1	ASTM A 266/A 266M-03a	272, 275
	ASTM A 333/A 333M-99	196, 198
	ASTM A 334/A 334M-99	196, 198
	ASTM A 485-03	435
	ASTM A 487/A 487M-93 (2003)	360
	ASTM A 508/A 508M-03a	273, 275
	ASTM A 537/A 537M-95 (2000)	105, 111
	ASTM A 541/A 541M-95 (1999)	273, 275
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10	ASTM A 333/A 333M-99	260
	ASTM A 487/A 487M-93 (2003)	360
10 N14-M	AFNOR NF A 32-053:1992	359
10 N19-M	AFNOR NF A 32-053:1992	359
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