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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 book. 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 book 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 book, 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.

For instance, 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 give 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 book 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 hard 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 book. 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, DIN 17211 steel name 34 CrAlMo 5 is low on C, Cr, and Mo; 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 steel name 34 CrAlMo 5 is the closest match DIN 17211 alloy for this group. So excluding it would be a disservice to the user, since it belongs 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
DIN 17211:1987	34 CrAlMo 5	1.8507	---	0.30-0.37	0.50-0.80	0.40	0.025	0.030	1.00-1.30	---	0.15-0.25	Al 0.80-1.20
ISO 683-10:1987	41 CrAlMo 74	---	---	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 book.

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 276-00	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, there would be no data remaining, 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 book, there were many instances where they could 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 book. In these cases, the closest match comparison decisions were made at the discretion of the editor.

Organization

This book will typically be used when a specific steel standard or grade is known and a comparative steel is sought. One of the main variables in selecting a specific grade of steel is its intended application (use) or product form, which usually narrows the selection to a family of steels. Therefore, the chapters in this book 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 chapter list, at first glance, looks rather straightforward, there were many difficult decisions regarding the steel comparisons within these chapters. For example, internationally the terms "pipe" and "tube" have different definitions. 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*."

Definitions of Steel Terms

Finding definitions for carbon steel, alloy steel, and stainless steel turned out to be a very complex task and resulted in numerous changes throughout the writing of this book from one chapter to another.

ASTM A 941-00 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 Europe/UK, 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 941-00, A 902-99, and F 1789-01.

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

1. Carbon Steels
2. Alloy Steels
3. Stainless Steels

ASTM A 941-00 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.

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, or hardness, etc.? Once having selected a primary criteria, say tensile strength, should there be a secondary criteria 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 is 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 book 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 book 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 book 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 sub-category 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 book 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 book.

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-99	1005	---	G10050	0.06	0.35	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1005	---	G10050	0.06	0.35	---	0.030	0.050	---	---	---	---
EN 10016-2:1994	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 10016-4:1994	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-99	1006	---	G10060	0.08	0.25-0.40	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1006	---	G10060	0.08	0.25-0.40	---	0.030	0.050	---	---	---	---
EN 10016-2:1994	C7D	1.0313	---	0.05-0.09	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.08	Cu 0.30
EN 10016-4:1994	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-99	1008	---	G10080	0.10	0.30-0.50	---	0.040	0.050	---	---	---	---
ASTM A 108-99	1008	---	G10080	0.10	0.30-0.50	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1008	---	G10080	0.10	0.30-0.50	---	0.040	0.050	---	---	---	---
SAE J403 Aug95	1008	---	G10080	0.10	0.30-0.50	---	0.030	0.050	---	---	---	---
EN 10016-2:1994	C9D	1.0304	---	0.10	0.60	0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1994	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-99	1010	---	G10100	0.08-0.13	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 108-99	1010	---	G10100	0.08-0.13	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1010	---	G10100	0.08-0.13	0.30-0.60	---	0.040	0.050	---	---	---	---
SAE J403 Aug95	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 10016-2:1994	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 10016-4:1994	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-99	1012	---	G10120	0.10-0.15	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1012	---	G10120	0.10-0.15	0.30-0.60	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	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	---	---	---	Cu 0.30; Ni+Cr 0.35
EN 10016-2:1994	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 10016-4:1994	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

2.3 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-99	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 (1996)	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
SAE J404 APR94	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 4105:1979	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	0.40-0.70	---	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-99	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 (1996)	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 APR94	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
JIS G 4105:1979	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	25 CrMo 4	---	---	0.22-0.29	0.60-0.90	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	0.40	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	0.15-0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
	25 CrMoS 4	---	---	0.22-0.29	0.60-0.90	0.15-0.40	0.035	0.020-0.040	0.90-1.20	---	0.15-0.30	---

2.4 Non-Comparable Carbon and Alloy Steels for General Use

ASTM A 29/A 29M-99 Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished												
Grade	1008	1011	1012	1013	1330	1335	1340	1345	1513	1518	1524	1525
UNS Number	G10080	G10110	G10120	G10130	G13300	G13350	G13400	G13450	G15300	G15180	G15240	G15250
Grade	1526	1527	1547	1548	1551	1552	1561	1566	1572	4012	4023	4024
UNS Number	G15260	G15270	G15470	G15480	G15510	G15520	G15610	G15660	G15720	G40120	G40230	G40240
Grade	4027	4028	4032	4037	4042	4047	4135	4142	4147	4161	4419	4422
UNS Number	G40270	G40280	G43320	G40370	G40420	G40470	G41350	G41420	G41470	G41670	G44190	G44220
Grade	4427	4615	4620	4621	4626	4715	4718	4720	4815	4817	4820	5015
UNS Number	G44270	G46150	G46200	G46210	G46260	G47150	G47180	G47200	G48150	G48170	G48200	G50150
Grade	5046	5115	5147	5150	5155	5160	6118	8115	8615	8617	8622	8625
UNS Number	G50460	G51150	G51470	G51500	G51550	G51600	G61180	G81150	G86150	G86170	G86220	G86250
Grade	8627	8630	8637	8642	8645	8650	8655	8660	8720	8740	8822	9254
UNS Number	G86270	G86300	G86370	G86420	G86450	G86500	G86550	G86600	G87200	G87400	G88200	G92540
Grade	9255	9259	9260	81B45	94B17	94B30	---	---	---	---	---	---
UNS Number	G92550	G92590	G92600	G81451	G94171	G94301	---	---	---	---	---	---
ASTM A 322-91 (1996) 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 576-90 (1995) 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
SAE J403 AUG95 Chemical Compositions of SAE Carbon Steels (Hot Rolled and Cold Finished Bars Only)												
Grade	1572	---	---	---	---	---	---	---	---	---	---	---
UNS Number	G15720	---	---	---	---	---	---	---	---	---	---	---
Grade	1524	1526	1527	1548	1552	1566	---	---	---	---	---	---
UNS Number	G15240	G15260	G15270	G15480	G15520	G15660	---	---	---	---	---	---

3.1 Carbon Steel Structural Steel Plates

3.1A Mechanical Properties of Carbon Steel Structural Steel Plates

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength		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	---	16	---
					16 < t ≤ 40	---	175	---				
ASTM A 283/A 283M-00	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	---	---	---

3.1 Carbon Steel Structural Steel Plates

3.1A Mechanical Properties of Carbon Steel 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		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3101:1995	SS330	---	---	HR	≤ 16	---	205	---	330-430	---	21	---
					16 < t ≤ 40	---	195	---			26	
					> 40	---	175	---			28	
ASTM A 570/A 570M-98	30	---	K02502	HR	0.65 ≤ t < 1.6	0.025 ≤ t < 0.064	205	30	340 min	49 min	21	---
					1.6 ≤ t < 2.5	0.064 ≤ t < 0.097					24	
					2.5 ≤ t < 6.0	0.097 ≤ t < 0.230					25	
ISO 630:1995	E 235 A	---	---	AR	≤ 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	
					100 < t ≤ 150	---	195	---			20	
					150 < t ≤ 200	---	185	---			19	
	E 235 B	---	---	AR	≤ 16	---	235	---	340-470	---	24	---
					16 < t ≤ 25	---	225	---				
	E 235 B NF	---	---	AR	≤ 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	---			20	
					150 < t ≤ 200	---	185	---			19	
	E 235 C	---	---	AR	≤ 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	---			20	
					150 < t ≤ 200	---	185	---			19	

NOTE: This section continued on next page.

3.1 Carbon Steel Structural Steel Plates

3.1B Chemical Composition of Carbon Steel 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-00	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 570/A 570M-98	30	---	K02502	≤ 6.0	≤ 0.229	0.25	0.90	report value	0.035	0.04	---	---	---	Al report value
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-00	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	---	---	---	---

3.2 Alloy Steel 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		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
CSA G40.21:1998	260WT (38WT)	---	---	---	≤ 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				
ASTM A 572/A 572M-00	42 [290]	---	---	---	≤ 150	≤ 6	290	42	415 min	60 min	24	---
ASTM A 656/A 656M-00	50 [345]	---	---	HR	≤ 50	≤ 2	345	50	415 min	60 min	23	---
ASTM A 633/A 633M-00	A	---	K01802	N	≤ 65	≤ 2.5	290	42	430-570	63-83	23	---
					65 < t ≤ 100	2.5 < t ≤ 4						
ASTM A 709/A 709M-00	50 [345]	---	---	---	≤ 100	≤ 4	345	50	450 min	65 min	21	---
ASTM A 572/A 572M-00	50 [345]	---	---	---	≤ 100	≤ 4	345	50	450 min	65 min	21	---
EN 10113-3:1993	S355M	1.8823	---	TMCP	t ≤ 16	---	355	---	450-610	---	22	see standard
					16 < t ≤ 40	---	345	---				
					40 < t ≤ 63	---	335	---				
	S355ML	1.8834	---	TMCP	t ≤ 16	---	355	---	450-610	---	22	see standard
					16 < t ≤ 40	---	345	---				
					40 < t ≤ 63	---	335	---				
CSA G40.21:1998	300WT (44WT)	---	---	---	≤ 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				

3.2 Alloy Steel 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		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10113-2:1993	S355N	1.0545	---	N	t ≤ 16	---	355	---	470-630	---	22	see standard
					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
					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-00	---	---	K11510	---	t ≤ 20	t ≤ ¾	345	50	480 min	70 min	21	---
					20 < t ≤ 40	¾ < t ≤ 1½	315	46	460 min	67 min		
					40 < t ≤ 100	1½ < t ≤ 4	290	42	435 min	63min		
CSA G40.21:1998	350WT (50WT)	---	---	---	≤ 65	≤ 2½	350	50	480-650	70-95	22	---
					65 < t ≤ 150	2½ < t ≤ 6	320	46				
ASTM A 572/A 572M-00	55 [380]	---	---	---	≤ 50	≤ 2	380	55	485 min	70 min	20	---
ASTM A 656/A 656M-00	60 [415]	---	---	HR	≤ 40	≤ 1½	415	60	485 min	70 min	20	---
ASTM A 588/A 588M-00	A B C K	---	K11430 K12043 K11538 ---	---	t ≤ 100	t ≤ 4	345	50	485 min	70 min	21	---
					100 < t ≤ 125	4 < t ≤ 5	315	46	460 min	67 min		
					125 < t ≤ 200	5 < t ≤ 8	290	42	435 min	63 min		
ASTM A 633/A 633M-00	C	---	K12000	N	≤ 65	≤ 2.5	345	50	485-620	70-90	23	---
					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	---
					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
					16 < t ≤ 40	---	400	---				
					40 < t ≤ 63	---	390	---				
	S420ML	1.8836	---	TMCP	t ≤ 16	---	420	---	500-660	---	19	see standard
					16 < t ≤ 40	---	400	---				
					40 < t ≤ 63	---	390	---				

3.2 Alloy Steel 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 G40.21:1998	260WT (38WT)	---	---	---	---	0.20	0.80-1.50	0.15-0.40	0.03	0.04	---	---	---	Grain refining elements 0.10
ASTM A 572/A 572M-00	42 [290] Type 1	---	---	≤ 150	≤ 6	0.21	1.35	0.15-0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
	42 [290] Type 2	---	---	≤ 150	≤ 6	0.21	1.35	0.15-0.40	0.04	0.05	---	---	---	V 0.01-0.15
	42 [290] Type 3	---	---	≤ 150	≤ 6	0.21	1.35	0.15-0.40	0.04	0.05	---	---	---	Cb 0.005-0.05; V 0.01-0.15; Cb + V 0.02-0.15
	42 [290] Type 4	---	---	≤ 150	≤ 6	0.21	1.35	0.15-0.40	0.04	0.05	---	---	---	V 0.01-0.15; N 0.015
	42 [290] Type 5	---	---	≤ 150	≤ 6	0.21	1.35	0.15-0.40	0.04	0.05	---	---	---	Ti 0.006-0.04; N 0.003-0.015; V 0.06
ASTM A 656/A 656M-00	50 [345] Type 3	---	---	---	---	0.18	1.65	0.60	0.025	0.035	---	---	---	V 0.08; N 0.020; Cb 0.008-0.15
	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-00	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-00	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
				40 < t ≤ 100	1½ < t ≤ 4	0.23	1.35	0.15-0.40	0.04	0.05	---	---	---	
ASTM A 572/A 572M-00	50 [345] Type 1	---	---	≤ 100	≤ 4	0.23	1.35	0.15-0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
	50 [345] Type 2	---	---	≤ 100	≤ 4	0.23	1.35	0.15-0.40	0.04	0.05	---	---	---	V 0.01-0.15
	50 [345] Type 3	---	---	≤ 100	≤ 4	0.23	1.35	0.15-0.40	0.04	0.05	---	---	---	Cb 0.005-0.05; V 0.01-0.15; Cb + V 0.02-0.15
	50 [345] Type 4	---	---	≤ 100	≤ 4	0.23	1.35	0.15-0.40	0.04	0.05	---	---	---	V 0.01-0.15; N 0.015
	50 [345] Type 5	---	---	≤ 100	≤ 4	0.23	1.35	0.15-0.40	0.04	0.05	---	---	---	Ti 0.006-0.04; N 0.003-0.015; V 0.06

NOTE: This section continued on next page.

3.3 Atmospheric Corrosion Resisting Structural Steel Plates

3.3A Mechanical Properties of Atmospheric Corrosion Resisting 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		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
JIS G 3125:1987	SPA-C	---	---	CR	---	---	315	---	450	---	26	---
ISO 4952:1981	Gr. Fe 355 W Quality 2B	---	---	Flat: AR or N Long: AR	t < 16	---	355	---	470	---	20	27 J at 20°C
					16 < t ≤ 35	---	345	---				
					35 < t ≤ 50	---	335	---				
					50 < t ≤ 70	---	325	---				
	Gr. Fe 355 W Quality 2C	---	---	Flat: AR or N Long: AR or N	t < 16	---	355	---	470	---	20	27 J at 0°C
					16 < t ≤ 35	---	345	---				
					35 < t ≤ 50	---	335	---				
					50 < t ≤ 70	---	325	---				
	Gr. Fe 355 W Quality 2D	---	---	Flat: N Long: AR or N	t < 16	---	355	---	470	---	22	27 J at -20°C
					16 < t ≤ 35	---	345	---				
					35 < t ≤ 50	---	335	---				
					50 < t ≤ 70	---	325	---				
ASTM A 606-98	Type 2 and Type 4	---	---	HR	---	---	340	50	480 min	70 min	22	---
				HR, A or N	---	---	310	45	450 min	65 min	22	---
				CR	---	---	310	45	450 min	65 min	22	---
ISO 4952:1981	Gr. Fe 355 W Quality 1A	---	---	Flat: AR Long: AR	t < 12	---	355	---	480	---	20	27 J at -20°C
	Gr. Fe 355 W Quality 1D	---	---	Flat: N Long: AR or N	t < 12	---	355	---	480	---	20	27 J at -20°C
CSA G40.21:1998	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	
JIS G 3125:1987	SPA-H	---	---	HR	≤ 6.0	---	345	---	480 min	---	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	

Note: This section continued on next page

3.3 Atmospheric Corrosion Resisting Structural Steel Plates

3.3B Chemical Composition for Atmospheric Corrosion Resisting 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
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 4952:1981	Gr. Fe 355 W Quality 2B	---	---	---	---	0.19	0.50-1.50	< 0.50	< 0.040	0.050	0.40-0.80	0.65	0.30	Cu 0.20-0.55; Zr 0.15
	Gr. Fe 355 W Quality 2C	---	---	---	---	0.19	0.50-1.50	< 0.50	< 0.040	0.050	0.40-0.80	0.65	0.30	Cu 0.20-0.55; Zr 0.15; grain-refining elements
	Gr. Fe 355 W Quality 2D	---	---	---	---	0.19	0.50-1.50	< 0.50	< 0.040	0.050	0.40-0.80	0.65	0.30	Cu 0.20-0.55; Zr 0.15; grain-refining elements
ASTM A 606-98	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 4952:1981	Gr. Fe 355 W Quality 1A	---	---	---	---	0.12	< 1.00	0.20-0.75	0.06-0.15	0.050	0.30-1.25	0.65	---	Cu 0.25-0.55
	Gr. Fe 355 W Quality 1D	---	---	---	---	0.12	< 1.00	0.20-0.75	0.06-0.15	0.050	0.30-1.25	0.65	---	Cu 0.25-0.55; grain-refining elements
CSA G40.21:1998	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

4.1 Carbon Steel Pressure Vessel Plates

4.1A Mechanical Properties of Carbon Steel 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		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 515/A 515M-97	65 [450]	---	K02800	AR	≤ 50	≤ 2	240	35	450-585	65-85	23	---
				N	> 50	> 2						
ASTM A 516/A 516M-90 (2001)	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	---
				N	50 < t ≤ 200	---					> 50 mm: 23	
JIS G 3118:1987	SGV 450	---	---	AR	6 ≤ t ≤ 38	---	245	---	450-540	---	≤ 50 mm: 19 > 50 mm: 23	---
				N	38 < t ≤ 200	---						
EN 10028-5:1996	P355ML P355ML1 P355ML2	1.8821 1.8832 1.8833	---	TMCP	≤ 16	---	355	---	450-610	---	22	---
					16 < t ≤ 40	---	355	---				
					40 < t ≤ 63	---	345	---				
EN 10028-2:1992	P295GH	1.0481	---	N	≤ 16	---	295	---	460-580	---	22	27 J at 0°C
					16 < t ≤ 40	---	290	---		---	22	
					40 < t ≤ 60	---	285	---		---	22	
					60 < t ≤ 100	---	260	---		---	21	
					100 < t ≤ 150	---	235	---	440-570	---	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	---
				N	50 < t ≤ 200	---					> 50 mm: 21	
JIS G 3118:1987	SGV 480	---	---	AR	6 ≤ t ≤ 38	---	265	---	480-590	---	≤ 50 mm: 17	---
				N	38 < t ≤ 200	---					> 50 mm: 21	
ASTM A 515/A 515M-97	70 [485]	---	K03101	AR	≤ 50	≤ 2	260	38	485-620	70-90	21	---
				N	> 50	> 2						
ASTM A 516/A 516M-90 (2001)	70 [485]	---	K02700	AR	≤ 40	≤ 1.5	260	38	485-620	70-90	21	---
				N	> 40	> 1.5						

NOTE: This section continued on next page.

4.1 Carbon Steel 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-97	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-90 (2001)	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	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 3115:1990	SPV 315	---	---	6 ≤ t ≤ 100	---	0.18	1.50	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								
EN 10028-5:1996	P420M	1.8824	---	---	---	0.16	1.70	0.50	0.025	0.020	---	0.50	0.20	Nb 0.05; Ti 0.05; V 0.10; N 0.020; Al ≥ 0.020; Nb+Ti+V 0.15; Cr+Cu+Mo 0.60
	P420 ML1	1.8835	---	---	---	0.16	1.70	0.50	0.020	0.015				
	P420ML2	1.8828	---	---	---	0.16	1.70	0.50	0.020	0.015				
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 10028-2:1992	P355GH	1.0473	---	---	---	0.10-0.22	1.00-1.70	0.60	0.030	0.025	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al ≥ 0.020; Cr+Cu+Mo+Ni 0.70
ASTM A 738/A 738M-00	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 3115:1990	SPV 355	---	---	6 ≤ t ≤ 75	---	0.20	1.60	0.15-0.55	0.030	0.030	---	---	---	---
JIS G 3115-1:1995	SPV 355	---	---	75 < t ≤ 150	---	0.20	1.60	0.15-0.55	0.030	0.030	---	---	---	---
EN 10028-5:1996	P460M	1.8826	---	---	---	0.16	1.70	0.60	0.025	0.020	---	0.50	0.20	Nb 0.05; Ti 0.05; V 0.10; Al ≥ 0.020; N 0.020; Cr+Cu+Mo 0.60
	P460ML	1.8837	---	---	---	0.16	1.70	0.60	0.020	0.015				
	P460ML2	1.8831	---	---	---	0.16	1.70	0.60	0.020	0.015				

4.2 Carbon Steel Pressure Vessel Plates - With Impact Testing Below 0°C

4.2A Mechanical Properties of Carbon Steel Pressure Vessel Plates - With Impact Testing Below 0°C (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength		Elongation, min, %	Other
					t, mm	t, in.	N/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
ASTM A 662/A 662M-99	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-98	A, B, C, Cl. 1	---	---	TMCP	≤ 65	≤ 2½	345	50	485-620	70-90	22	20 J at -40°C
					> 65	> 2½	310	45	450-585	65-85		
EN 10028-3:1992	P355N P355NH P355NL1 P355NL2	1.0562 1.0565 1.0566 1.1106	---	N	≤ 16	---	355	---	490-630	---	22	see standard
					16 < t ≤ 35	---	355	---				
					35 < t ≤ 50	---	345	---				
					50 < t ≤ 70	---	325	---				
					70 < t ≤ 100	---	315	---	470-610	---	21	
					100 < t ≤ 150	---	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
					35 < t ≤ 50		345	---				
					50 < t ≤ 70		325	---				
JIS G 3126:1990	SLA 360	---	---	QT	---	---	360	---	490-610	---	6-16 mm: 20 >16 mm: 28 >20 mm: 20	see standard
JIS G 3126:1990	SLA 410	---	---	QT or TMCP	---	---	410	---	520-640	---	6-16 mm: 18 >16 mm: 26 >20 mm: 18	see standard
ASTM A 841/A 841M-98	A, B, C, Cl. 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 Steel Pressure Vessel Plates - With Impact Testing Below 0°C

4.2B Chemical Composition of Carbon Steel Pressure Vessel Plates - With Impact Testing Below 0°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 10028-3:1992	P275N	1.0486	---	---	---	0.18	0.50-1.40	0.40	0.030	0.025	0.30	0.50	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
	P275NH	1.0487	---	---	---	0.16	0.50-1.50		0.030	0.020				
	P275NL1	1.0488	---	---	---									
	P275NL2	1.1104	---	---	---				0.025	0.015				
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-99	A	---	K01701	---	---	0.14	0.90-1.35	0.15-0.40	0.035	0.035	---	---	---	---
JIS G 3126:1990	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	---	---	---	---
ASTM A 662/A 662M-99	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-98	A, Cl. 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, Cl. 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, Cl. 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 10028-3:1992	P355N P355NH	1.0562 1.0565	---	---	---	0.20	0.90-1.70	0.50	0.030	0.025	0.30	0.50	0.08	Cu 0.30; Nb 0.05; Ti 0.03; V 0.10; N 0.020; Al ≥ 0.020; Nb+Ti+V 0.12; Cr+Cu+Mo 0.45
	P355NL1	1.0566	---	---	---	0.18			0.030	0.020				
	P355NL2	1.1106	---	---	---				0.025	0.015				
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 3126:1990	SLA 360	---	---	6 ≤ t ≤ 32	---	0.18	0.80-1.60	0.15-0.55	0.030	0.025	---	---	---	---

4.4 Cr-Mo Alloy Steel Pressure Vessel Plates

4.4.4A Chemical Composition of 2¼Cr-1Mo Alloy Steel 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-99	22, Cl. 1	---	K21590	---	---	0.05-0.15	0.30-0.60	0.50	0.035	0.035	2.00-2.50	---	0.90-1.10	---
	22 L, Cl. 1	---				0.10								
EN 10028-2:1992	10 CrMo 9-10	1.7380	---	---	---	0.08-0.14	0.40-0.80	0.50	0.030	0.025	2.00-2.50	---	0.90-1.10	Cu 0.30
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-99	22, Cl. 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	---
EN 10028-2:1992	11 CrMo 9-10	1.7383	---	---	---	0.08-0.15	0.40-0.80	0.50	0.030	0.025	2.00-2.50	---	0.90-1.10	Cu 0.30
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

4.4 Cr-Mo Alloy Steel Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength		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-99	Gr. 22, Cl. 1	---	K21590	A, or NT	---	---	---	30	415-585	60-85	18	---
	Gr. 22 L, Cl. 1	---										
EN 10028-2:1992	10 CrMo 9-10	1.7380	---	NT	≤ 16	---	310	---	480-630	---	18	31 J at 20°C
					16 < t ≤ 40	---	300	---				
					40 < t ≤ 60	---	290	---				
				NT, QA or QL	60 < t ≤ 100	---	270	---	470-620	---	17	27 J at 20°C
				QL	100 < t ≤ 150	---	250	---	460-610	---		
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-99	Gr. 22, Cl. 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	---
EN 10028-2:1992	11 CrMo 9-10	1.7383	---	NT, QA or QL	≤ 60	---	310	---	520-670	---	18	31 J at 20°C
				QL	60 < t ≤ 100	---					17	27 J at 20°C
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

4.8 Austenitic Stainless Steel Pressure Vessel Plates

4.8A Chemical Composition of Austenitic Stainless Steel 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-00	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-00	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-00	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-00	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-00	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-00	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-00	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-00	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-00	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 Steel Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless Steel Pressure Vessel Plates

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Heat Treatment	Section Thickness		Yield Strength, min		Tensile Strength		% Elongation, min	Other
					t, mm	t, in.	N/mm² or MPa	ksi	N/mm² or MPa	ksi		
ASTM A 240/A 240M-00	301LN	---	S30153	---	---	---	240	35	550 min	80 min	45.0	---
EN 10028-7:2000	X2CrNi18-7	1.4318	---	CR St, AT	≤ 6	---	350	---	650-850	---	40	see standard
				HR St, AT	≤ 12	---	330	---				
				HR Pl, AT	≤ 75	---	330	---				
ASTM A 240/A 240M-00	304	---	S30400	---	---	---	205	30	515 min	75 min	40.0	---
EN 10028-7:2000	X5CrNi18-10	1.4301	---	CR St, AT	≤ 6	---	230	---	540-750	---	45	see standard
				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-00	304H	---	---	---	---	---	205	30	515 min	75 min	40.0	---
EN 10028-7:2000	X6CrNi18-10	1.4948	---	CR St, AT	≤ 6	---	230	---	530-740	---	45	see standard
				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-00	304L	---	S30403	---	---	---	170	25	485 min	70 min	40.0	---
EN 10028-7:2000	X2CrNiN18-9	1.4307	---	CR St, AT	≤ 6	---	220	---	520-670	---	45	see standard
				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
				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-00	304N	---	S30451	---	---	---	240	35	550 min	80 min	30.0	---
EN 10028-7:2000	X5CrNiN19-9	1.4315	---	CR St, AT	≤ 6	---	290	---	550-750	---	40	see standard
				HR St, AT	≤ 12	---	270	---				
				HR Pl, AT	≤ 75	---	270	---				
ASTM A 240/A 240M-00	304LN	---	S30453	---	---	---	205	30	515 min	75 min	40.0	---
EN 10028-7:2000	X2CrNiN18-10	1.4311	---	CR St, AT	≤ 6	---	290	---	550-750	---	40	see standard
				HR St, AT	≤ 12	---	270	---				
				HR Pl, AT	≤ 75	---	270	---				
ISO 9328-5:1991	X 2 CrNiN 18 10	---	---	Q	---	---	270	---	550-750	---	35	---

4.10 Non-Comparable Pressure Vessel Carbon and Alloy Steel Standards

ASTM A 202/A 202M-93 (1999) - Pressure Vessel Plates, Alloy Steel, Chromium-Manganese-Silicon												
Grade, Class, Type	A	B	---	---	---	---	---	---	---	---	---	---
UNS Number	K11742	K12542	---	---	---	---	---	---	---	---	---	---
ASTM A 225/A 225M-93 (1999) - Pressure Vessel Plates, Alloy Steel, Manganese-Vanadium-Nickel												
Grade, Class, Type	C	D	---	---	---	---	---	---	---	---	---	---
UNS Number	K12524	---	---	---	---	---	---	---	---	---	---	---
ASTM A 285/A 285M-90 (1996) - Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength												
Grade, Class, Type	A	B	C	---	---	---	---	---	---	---	---	---
UNS Number	K01700	K02200	K02801	---	---	---	---	---	---	---	---	---
ASTM A 299/A 299M-97 - Pressure Vessel Plates, Carbon Steel, Manganese-Silicon												
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K02803	---	---	---	---	---	---	---	---	---	---	---
ASTM A 387/A 387M-99 - Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum												
Grade, Class, Type	Gr. 9, Cl. 1, 2	Gr. 91, Cl. 2	Gr. 911, Cl. 2	---	---	---	---	---	---	---	---	---
UNS Number	S50400	---	---	---	---	---	---	---	---	---	---	---
ASTM A 455/A 455M-90 (1996) - Pressure Vessel Plates, Carbon Steel, High-Strength Manganese												
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K03300	---	---	---	---	---	---	---	---	---	---	---
ASTM A 516/A 516M-90 (2001) - 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	Gr. D, Cl.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	Gr. A, Cl. 1, 2, 3, 4, 4a	Gr. B, Cl. 1, 2, 3, 4, 4a	Gr. C, Cl. 1, 2, 3, 4, 4a	Gr. D, Cl. 1, 2, 3, 4, 4a	Gr. 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	Gr. B, Cl. 1, 2, 3	Gr. C, Cl. 1, 2, 3	---	---	---	---	---	---	---	---	---	---
UNS Number	K42339	K11224	---	---	---	---	---	---	---	---	---	---

5.1 Tubes for General and Structural Applications

5.1.1.A 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		
ASTM A 513-00*	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	---
BSI BS 1717: 1983	ERW C1	---	---	GKM	---	---	150	---	270	---	27	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 1	---	---	GKM & GZF	---	---	150	---	270	---	27	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 1	---	---	GBK & GZF	---	---	150	---	270	---	27	---
ASTM A 512-96*	MT 1010	---	G10100	SA	---	---	138	20	276	40	35	40-65 HRB
ASTM A 513-00*	1010	---	G10100	N	---	---	172	25	276	40	30	65 HRB max
DIN 2391-2:1994	St 30 Si	1.0211	---	GBK	---	---	---	---	280	---	30	---
	St 30 Al	1.0212	---	GBK	---	---	---	---	280	---	30	---
BSI 1717:1983	ERW C1	---	---	NKM	---	---	155	---	280	---	25	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 1	---	---	NKM & NZF	---	---	155	---	280	---	25	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 1	---	---	NBK & NZF	---	---	155	---	280	---	25	---
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	---
SAE J526 FEB 96	---	---	G10080 G10100	---	---	---	170	---	290	---	14	65 HR30T max
JIS G 3452:1997	SGP	---	---	see standard	---	---	---	---	290	---	L: 30; T: 25	---
JIS G 3472:1988	STAM 290 GA	---	---	see standard	≤ 25	---	175	---	290	---	40	---
	STAM 290 GB	---	---	see standard	---	---	175	---	290	---	33	---
DIN 1615:1984	St 33	1.0035	---	AD	≤ 25	---	175	---	290-540	---	17 L; 15 T	---
ASTM A 513-00*	1008	---	G10080	AW	---	---	207	30	290	42	15	50 HRB min
ASTM A 512-96*	MT 1015	---	G10150	SA	---	---	172	25	296	43	34	40 HRB min
DIN 2391-2:1994	St 30 Si	1.0211	---	NBK	---	---	215	---	290-420	---	30	---
	St 30 Al	1.0212	---	NBK	---	---	215	---	290-420	---	30	---

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

5.1 Tubes for General and Structural Applications

5.1.1B 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
ASTM A 513-00	1008	---	G10080	0.10 max	0.50 max	---	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	---	---	---	---
BSI BS 1717:1983	ERW C1	---	---	0.13	0.60	---	0.050	0.050	---	---	---	---
BSI BS 6323-5:1982 AMD 2:1989	ERW 1	---	---	0.13	0.60	---	0.050	0.050	---	---	---	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 1	---	---	0.13	0.60	---	0.050	0.050	---	---	---	---
ASTM A 512-96	MT 1010	---	G10100	0.05-0.15	0.30-0.60	---	0.04	0.045	---	---	---	--
ASTM A 513-00	1010	---	G10100	0.08-0.13	0.30-0.60	---	0.035	0.035	---	---	---	---
DIN 2391-2:1994	St 30 Si	1.0211	---	0.10	≤ 0.55	0.30	0.025	0.025	---	---	---	---
	St 30 Al	1.0212	---	0.10	≤ 0.55	0.05	0.025	0.025	---	---	---	---
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	---	---	---	---
SAE J526 FEB 96	---	---	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 3452:1997	SGP	---	---	---	---	---	0.040	0.040	---	---	---	---
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	MT 1015	---	G10150	0.10-0.20	0.30-0.60	---	0.04	0.045	---	---	---	---

5.2 Tubes for Heat Transfer Applications

5.2.1A Mechanical Properties of Carbon Steel Tubes for Heat Transfer 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 214/A 214M-96	---	---	K01807	see standard	---	---	---	---	---	---	---	72 HRB max
ASTM A 556/A 556M-96	A2	---	K01807	---	---	---	180	26	320	47	35	72 HRB max
BSI BS 3059-1:1987	320 Seamless	---	---	see standard	---	---	195	---	320	---	25	---
	320 Welded	---	---	see standard	---	---	195	---	320	---	25	---
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	---
BSI BS 3606:1992	320	---	---	N	---	---	195	---	320-460	---	25	---
ASTM A 178/A 178M-95 (2000)*	A	---	K01200	see standard	---	---	180	26	325	47	35	---
ASTM A 179/A 179M-90*	---	---	K01200	CD+1200°F min	---	---	180	26	325	47	35	72 HRB max
ASTM A 192/A 192M-91*	---	---	K01201	HF or CF + 1200°F min	---	---	180	26	325	47	35	5.1 mm (0.200 in) 137 HB max 77 HRB max
AFNOR NF A 49-245:1986	TS 34 C	---	---	N	---	---	185	---	330-410	---	16	---
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.

5.2 Tubes for Heat Transfer Applications

5.2.1B Chemical Composition of Carbon Steel Tubes for Heat Transfer 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 214/A 214M-96	---	---	K01807	0.18	0.27-0.63	---	0.035	0.035	---	---	---	---
ASTM A 556/A 556M-96	A2	---	K01807	0.18	0.27-0.63	---	0.035	0.035	---	---	---	---
BSI BS 3059-1:1987	320 Seamless	---	---	0.16	0.30-0.70	0.10-0.35	0.040	0.040	---	---	---	---
	320 Welded	---	---	0.16	0.30-0.70	0.35	0.040	0.040	---	---	---	---
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	---	---	---	---
BSI BS 3606:1992	320	---	---	0.16	0.30-0.70	---	0.040	0.040	---	---	---	---
ASTM A 178/A 178M-95 (2000)	A	---	K01200	0.06-0.18	0.27-0.63	---	0.035	0.035	---	---	---	---
ASTM A 179/A 179M-90 (1996)	---	---	K01200	0.06-0.18	0.27-0.63	---	0.035	0.035	---	---	---	---
ASTM A 192/A 192M-91	---	---	K01201	0.06-0.18	0.27-0.63	0.25	0.035	0.035	---	---	---	---
AFNOR NF A 49-245:1986	TS 34 C	---	---	0.14	0.30-0.60	0.06-0.30	0.035	0.025	---	---	---	Cu 0.25; Sn 0.030
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

5.3 Tubes for Low Temperature Service

5.3.2A Chemical Composition of Alloy Steel Tubes 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
DIN 17173:1985	11 MnNi 5 3	1.6212	---	0.14	0.70-1.50	0.50	0.030	0.025	---	0.30-0.80	---	Al 0.020 min; Nb 0.05; V 0.05
DIN 17174:1985	11 MnNi 5 3	1.6212	---	0.14	0.70-1.50	0.50	0.030	0.025	---	0.30-0.80	---	Al 0.020 min; 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
DIN 17173:1985	13 MnNi 6 3	1.6217	---	0.18	0.85-1.65	0.50	0.030	0.025	---	0.30-0.85	---	Al 0.020 min; Nb 0.05; V 0.05
DIN 17174:1985	13 MnNi 6 3	1.6217	---	0.18	0.85-1.65	0.50	0.030	0.025	---	0.30-0.85	---	Al 0.020 min; 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
AFNOR NF A 49-215:1981	TU 17 N 2	---	---	0.23	1.60	0.40	0.045	0.045	---	0.6-0.8	---	---
AFNOR NF A 49-245:1986	TS 17 N 2	---	---	0.21	1.50	0.35	0.035	0.035	---	0.6-0.8	---	---
ASTM A 334/A 334M-99	7	---	K21903	0.19	0.90	0.13-0.32	0.025	0.025	---	2.03-2.57	---	---
AFNOR NF A 49-215:1981	TU 10 N 9	---	---	0.17	1.00	0.35	0.035	0.035	---	2.0-2.6	---	---
AFNOR NF A 49-245:1986	TS 10 N 9	---	---	0.15	0.90	0.30	0.030	0.030	---	2.0-2.6	---	---
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 3464:1988	STBL 450	---	---	0.18	0.30-0.60	0.10-0.35	0.030	0.030	---	3.20-3.80	---	---
BSI BS 3603:1991	3½% Ni, 503 LT	---	---	0.15	0.30-0.80	0.15-0.35	0.025	0.020	---	3.25-3.75	---	Al 0.020 min
DIN 17173:1985	10 Ni 14	1.5637	---	0.15	0.30-0.80	0.35	0.025	0.020	---	3.25-3.75	---	V 0.05
DIN 17174:1985	10 Ni 14	1.5637	---	0.15	0.30-0.80	0.35	0.025	0.020	---	3.25-3.75	---	V 0.05
AFNOR NF A 49-215:1981	TU 10 N 14	---	---	0.17	0.75	0.40	0.035	0.035	---	3.2-3.8	---	---
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	0.30-0.85	0.15-0.35	0.025	0.020	---	3.25-3.75	---	V 0.05
DIN 17173:1985	12 Ni 19	1.5680	---	0.15	0.30-0.80	0.35	0.025	0.020	---	4.50-5.30	---	V 0.05
DIN 17174:1985	12 Ni 19	1.5680	---	0.15	0.30-0.80	0.35	0.025	0.020	---	4.50-5.30	---	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	0.30-0.80	0.35	0.025	0.020	---	4.50-5.30	---	V 0.05

5.5 Line Pipe Steels

5.5.2A 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-2000	B - PSL 2	---	---	see standard	---	---	241-448	35-65	414-758	60-110	see standard	L: 41 J at 0°C; T: 27J at 0°C see standard
CSA Z245.1-98	241 - Category II or III	---	---	see standard	---	---	241	---	414	---	see standard	OD < 457 mm: 27 J at temp OD ≥ 457 mm: 40 J at temp see standard
ASTM A 984/A 984M-00	35	---	---	see standard	---	NPS < 8	245	35	415	60	see standard	see standard
					---	NPS ≤ 8	245-450	35-70				
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-2000	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 Z245.1-98	290 - Category II or III	---	---	see standard	---	---	290	---	414	---	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											
ASTM A 984/A 984M-00	45	---	---	see standard	---	NPS < 8	315	45	450	65	see standard	see standard
					---	NPS ≤ 8	315-500	45-72				
API 5L-2000	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 Z245.1-98	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

5.5 Line Pipe Steels

5.5.2B 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-2000	B, PSL 2 seamless	---	---	0.24	1.20	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15; CE(Pcm) 0.25 or CE(IIW) 0.43 (see standard)
	B, PSL 2 welded	---	---	0.22	1.20	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15 CE(Pcm) 0.25 or CE(IIW) 0.43 (see standard)
CSA Z245.1-98	241 - Cat 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-00	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 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; 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 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; CEV 0.40 (see standard)
API 5L-2000	X 42, PSL 2 seamless	---	---	0.24	1.30	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15 CE(Pcm) 0.25 or CE(IIW) 0.43 (see standard)
	X 42, PSL 2 welded	---	---	0.22	1.30	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15 CE(Pcm) 0.25 or CE(IIW) 0.43 (see standard)
CSA Z245.1-98	290 - Cat 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 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; 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 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; CEV 0.40 (see standard)
ASTM A 984/A 984M-00	45	---	---	0.22	---	---	0.025	0.015	---	---	---	B 0.0007; CE 0.40 (see standard)
API 5L-2000	X46, PSL 2 seamless	---	---	0.24	1.40	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15 CE(Pcm) 0.25 or CE(IIW) 0.43 (see standard)
	X46, PSL 2 welded	---	---	0.22	1.40	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15 CE(Pcm) 0.25 or CE(IIW) 0.43 (see standard)
CSA Z245.1-98	317 - Cat 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)

5.7 Non-Comparable Tubes for Heat Transfer Applications

ASTM A 213/A 213M-99 - Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes												
Grade, Class, Type	T5c	T17	T21	T23	T92	T122	18Cr-2Mo	---	---	---	---	---
UNS Number	K41245	K12047	K31545	---	K92460	---	---	---	---	---	---	---
ASTM A 249/A 249M-98 - Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes												
Grade, Class, Type	TP201	TP202	TP305	TP309Cb	TP309HCb	TP310Cb	TP310H	TP310HCb	TP316N	TP348	TP348H	XM-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	S30815	S31725	S31726	S24565	S33228	S30415	S32654	---	---	---
ASTM A 688/A 688M-00 - 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-98 - 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	---	---	---	---	---
UNS Number	S44626	S44635	S44660	S44700	S44800	S44400	S44735	---	---	---	---	---
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 3467:1988 - Steel Tubes for Fired Heater												
Symbol of Class	SUS 309 TF	---	---	---	---	---	---	---	---	---	---	---
BSI BS 3059-2:1990 - Steel Boiler and Superheater Tubes - Part 2 - Specification for Carbon, Alloy and Austenitic Stainless Steel Tubes with Specified Elevated Temperature Properties												
Type No.	215S15	---	---	---	---	---	---	---	---	---	---	---
BSI BS 3606:1992 - Steel Tubes for Heat Exchangers												
Grade	261	---	---	---	---	---	---	---	---	---	---	---
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		X3CrNiNi18-10		X3CrNiMoN19-14		X8CrNi25-20		---		---	
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												
Designation	TS E 24 W 3	TS E 36 WB3	---	---	---	---	---	---	---	---	---	---
AFNOR NF A 49-247:1981 - Tubes Welded Longitudinally for Heat Exchangers - Austenitic Stainless Steels Dimensions - Technical Delivery Conditions												
Designation	TS Z 2 CND 19-15		---	---	---	---	---	---	---	---	---	---
ISO 2604-II:1975 - Steel Products for Pressure Purposes - Quality Requirements - Part 2 - Wrought Seamless Tubes												
Steel Type	TS 43	TS 45	TS 67	TS 69	---	---	---	---	---	---	---	---
ISO 2604-V:1975 - Steel Products for Pressure Purposes - Quality Requirements - Part 5: Longitudinally Welded Austenitic Stainless Steel Tubes												
Steel Type	TW 69	---	---	---	---	---	---	---	---	---	---	---

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	---
					35 < t ≤ 160	---	255	---	460-580	---	23	---
EN 10222-4:1999	P355QH	1.0571	---	QT	70 < t ≤ 100	---	315	---	470-630	---	21	63 J at 22°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	26	480-660	70-95	20	---
	1A	---	---	QT	≤ 75	≤ 3	250	26	480-660	70-95	20	---
ASTM A 105/A 105M-98	---	---	K03504	---	---	---	250	36	485	70	22	187 HB max
ASTM A 266/A 266M-99	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-00	70	---	K03502	---	---	---	250	36	485	70	18	---
ASTM A 350/A 350M-00	LF2, Cl 1	---	K03011	N, NT, or QT	---	---	250	36	485-655	70-95	22	20 J at -45.6°C
	LF2, Cl 2											0 J at -45.6°C
ASTM A 508/A 508M-95 (1999)	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	---
JIS G 3202:1988 (1991)	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	---
				QT	≤ 70	---	285	---	510-630	---	22	---
EN 10222-4:1999	P355NH	1.0565	---	N	≤ 16	---	355	---	490-630	---	23	55 J at 22°C 47 J at 0°C 40 J at -20°C 28 J at -40°C
					16 < t ≤ 35	---	355	---				
					35 < t ≤ 70	---	335	---				

NOTE: this section continues on the next page.

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 10222-4:1999	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 to 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 (1991)	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-00	60	---	K03502	0.35	1.10	0.10-0.35	0.05	0.05	---	---	---	---
ASTM A 266/A 266M-99	1	---	---	0.35	0.40-1.05	0.15-0.35	0.025	0.025	---	---	---	---
ASTM A 350/A 350M-00	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 0.03
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 10222-4:1999	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-98	---	---	K03504	0.35	0.60-1.05	0.15-0.35	0.040	0.050	0.30	0.40	0.12	Cu 0.40; V 0.03; Nb 0.02; Cu+Ni+Cr+Mo 1.00; Cr+Mo 0.32
ASTM A 266/A 266M-99	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-00	70	---	K03502	0.35	1.10	0.10-0.35	0.05	0.05	---	---	---	---
ASTM A 350/A 350M-00	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 0.03
ASTM A 508/A 508M-95 (1999)	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	0.25	0.25	0.40	0.10	V 0.05
JIS G 3202:1988 (1991)	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 10222-4:1999	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				

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.5A Chemical Composition of 2¼Cr-1Mo Alloy 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 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-00	F 22, Cl 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-99	F22, Cl 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-00	F 22, Cl 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-99	F22, Cl 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 508 M-95 (1999)	22, Cl 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, Cl 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	Cu 0.20; 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-99	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-00	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 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/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-00	F 22, Cl 1	---	K21590	A, NT	---	---	205	30	415	60	20.0	170 HB max
ASTM A 336/A 336M-99	F22, Cl 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-00	F 22, Cl 3			A, NT	---	---	310	45	515	75	20.0	156-207 HB
ASTM A 336/A 336M-99	F22, Cl 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	---	520-760	---	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	---	10	54 J at -18°C
ASTM A 508/A 508 M-95 (1999)	22, Cl 3	---	K21590	QT	---	---	380	55	585-760	85-110	18	---
ASTM A 541/A 541M-95 (1999)	22, Cl 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-99	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-00	F 22V	---	K31835	NT, QT	---	---	415	60	585-780	85-110	18.0	HB 174-237

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-00	F 304	---	S30400	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
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-00	F 304L	---	S30403	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.0-13.0	---	---
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	0.015	17.00-19.00	8.00-11.00	---	---
ASTM A 182/A 182M-00	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	8.00-11.00	---	---
ASTM A 182/A 182M-00	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-0	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
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-00	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	---	---

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/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
EN 10222-5:1999	X6CrNi18-10	1.4948	---	AT	≤ 250	---	195	---	490-690	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C
	X5CrNi18-10	1.4301	---	AT	≤ 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-00	F 304	---	S30400	ST+Q	---	---	205	30	515	75	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-00	F 304L	---	S30403	ST+Q	---	---	170	25	485	70	30	---
EN 10222-5:1999	X2CrNi18-9	1.4307	---	AT	≤ 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
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-00	F 304H	---	S30409	ST+Q	---	---	205	30	515	75	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

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

ASTM A 182/A 182M-98 - 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, Cl 1	F 12, Cl 1	F 3VCb	F 23	F 24	FR	---	---	---
UNS Number	K 90901	---	---	K11597	K11562	K31835	K41650	---	K22035	---	---	---
ASTM A 336/A 336M-99 - Alloy Steel Forgings for Pressure and High-Temperature Parts												
Grade, Class, Type	F11, Cl 1	F6	F91	F911	F3VCb	---	---	---	---	---	---	---
UNS Number	---	S41000	---	---	---	---	---	---	---	---	---	---
ASTM A 350/A 350M-00 - 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-95 (1999) - Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels												
Grade, Class, Type	4N, Cl 1	4N, Cl 2	5, Cl 1	5, Cl 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, Cl 4	22, Cl 4	22, Cl 5	4N, Cl 1	4N, Cl 2	5, Cl 1	5, Cl 2	3VCb	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
JIS G 3204:1988 - Quenched and Tempered Alloy Steel Forgings for Pressure Vessels												
Symbol of Grade	SFVQ 2A	SFVQ 2B	---	---	---	---	---	---	---	---	---	---
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	---	---	---	---	---	---	---	---	---	---	---

7.3 Cast Alloy Steels

7.3.2.A 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 10213-2:1996	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-99	WC1	---	J12524	0.25	0.50-0.80	0.60	0.04	0.045	---	0.45-0.65	---	---
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-99	WC6	---	J12072	0.05-0.20	0.50-0.80	0.60	0.04	0.045	1.00-1.50	---	0.45-0.65	---
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 10213-2:1996	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-93 (1998)	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 10213-2:1996	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-99	WC9	---	J21890	0.05-0.20	0.40-0.70	0.60	0.04	0.045	2.00-2.75	---	0.90-1.20	---
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/A487M-93 (1998)	8 Cl. ABC	---	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 10213-2:1996	G17CrMo9-10	1.7379	---	0.13-0.20	0.50-0.90	0.60	0.020	0.020	2.00-2.50	---	0.90-1.10	---
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-99	C5	---	J42045	0.20	0.40-0.70	0.75	0.04	0.045	4.00-6.50	---	0.45-0.65	---
EN 10213-2:1996	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	---
ASTM A 217/A 217M-99	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 10213-2:1996	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-99	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-99	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 10213-2:1996	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-93 (1998)	C24	---	J12092	NT	---	---	345	50	552	80	15.0	---
ISO 4991:1994	C35BH	---	---	N_{ac}T or QT	---	---	420	---	590-740	---	15	24 Jat RT
EN 10213-2:1996	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-99	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/A487M-93 (1998)	8 Cl A	---	J22091	NT	---	---	380	55	585-760	85-110	20	---
EN 10213-2:1996	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/A487M-93 (1998)	8 Cl C	---	J22091	QT	---	---	515	75	690	100	17	22 HRC max 235 HB max
ASTM A 487/A487M-93 (1998)	8 Cl B	---	J22091	QT	---	---	585	85	725	105	17	---

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

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 5121:1991	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-98	CF-20	---	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 10283:1999	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 5121:1991	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	---	---
BSI 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-98	CF-8	---	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 5121:1991	SCS 19	---	---	0.03	2.00	2.00	0.040	0.040	17.00-21.00	8.00-12.00	---	---
BSI 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 10283:1999	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 5121:1991	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-98	CF-3	---	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 10283:1999	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 5121:1991	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
BSI 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-98	CF-8C	---	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

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

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 5121:1991	SCS 12	---	---	S	---	---	205	---	480	---	28	183 HB max
ASTM A 743/A 743M-98	CF-20	---	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 10283:1999	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 5121:1991	SCS 13	---	---	S	---	---	185	---	440	---	30	183 HB max
	SCS 13A	---	---	S	---	---	205	---	480	---	33	183 HB max
BSI 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-98	CF-8	---	J92600	S	---	---	205	30	485	70	35	---
ASTM A 744/A 744M-00	CF8	---	J92600	S	---	---	205	30	485	70	35	---
JIS G 5121:1991	SCS 19	---	---	S	---	---	185	---	390	---	33	183 HB max
BSI BS 3100:1991 AMD.1:1992	304C12	---	---	ST	---	---	215	---	430	---	26	---
	304C12LT196	---	---	ST	---	---	215	---	430	---	26	41 J at -196°C
EN 10283:1999	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 5121:1991	SCS 19A	---	---	S	---	---	205	---	480	---	33	183 HB max
ASTM A 743/A 743M-98	CF-3	---	J92500	S	---	---	205	30	485	70	35	---
ASTM A 744/A 744M-00	CF3	---	J92500	S	---	---	205	30	485	70	35	---
EN 10283:1999	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 5121:1991	SCS 21	---	---	S	---	---	205	---	480	---	28	183 HB max
BSI BS 3100:1991 AMD.1:1992	347C17	---	---	ST	---	---	215	---	480	---	22	---
ASTM A 743/A 743M-98	CF-8C	---	J92710	S	---	---	205	30	485	70	30	---
ASTM A 744/A 744M-00	CF8C	---	J92710	S	---	---	205	30	485	70	30	---

7.6 Non-Comparable Steel Castings

ASTM A 148/A 148 M-93 (1998) - 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 217/A 217M-99 - 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 351/A 351M-94 (1999) - 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	---	---	---	---	---	---
ASTM A 352/A 352M-93 (1998) - 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 389/A 389M-93 (1998) - 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/A487M-93 (1998) - 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	---	---	---	---	---	---	---	---	---	---	---
ASTM A 743/A 743M-98 - 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-40	CA-40F	CF10SMnN	CG6MMN	CN-7MS
UNS Number	J93001	J92701	---	---	J93423	J91803	J92615	J91153	J91154	J92972	---	---
Grade, Class, Type	CA6N	CA-28MWV	CK-35MN	CB-6	---	---	---	---	---	---	---	
UNS Number	---	J91422	---	J91804	---	---	---	---	---	---	---	---
ASTM A 744/A 744M-98 - Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service												
Grade, Class, Type	CN7MS	---	---	---	---	---	---	---	---	---	---	---
UNS Number	J94650	---	---	---	---	---	---	---	---	---	---	---
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	---	---
UNS Number	J41501	J41501	J12582	J22092	J22092	J22092	J22092	J22092	J22092	J42220	---	---

7.6 Non-Comparable Steel Castings (Continued)

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	SCMnM3	---	---	---	---	---	---
JIS G 5121:1991 - Stainless Steel Castings												
Class	SCS 4	SCS 10	SCS 11	SCS 15	SCS 16	SCS 20	SCS 24	---	---	---	---	---
JIS G 5131:1991 - High Manganese Steel Castings												
Class	SCMnH 21	---	---	---	---	---	---	---	---	---	---	---
JIS G 5151:1991 - Steel Castings for High Temperature and High Pressure Service												
Class	SCPH 22	---	---	---	---	---	---	---	---	---	---	---
BSI BSI 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 N14-M	10 N19-M	20 NCD4-M	---	---	---	---	---
AFNOR NF A32-054:1994 - 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 10213-2:1996 - 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		---	---	---	---	---	---	---	---	---
EN 10213-4:1996 - Steel Castings for Pressure Purposes Part 4: Austenitic and Austenitic-Ferritic Steel Grades												
Steel Name	GX2CrNiMoN26-7-4		GX2CrNiMoN26 5 3		---	---	---	---	---	---	---	---
Steel Number	1.4469		1.4470		---	---	---	---	---	---	---	---
EN 10283:1999 - Corrosion Resistant Steel Castings												
Steel Name	GX4CrNiMo16-5-2		GX5CrNiCu16-4		GX2CrNiMo19-11-2		GX2NiCrMoCu25-20-5		GX2CrNiMoCuN29-25-5		GX6CrNiN26-7	
Steel Number	1.4411		1.4525		1.4409		1.4584		1.4587		1.4347	
EN 10283:1999 - Corrosion Resistant Steel Castings												
Steel Name	GX2CrNiMoN22-5-3		GX2CrNiMoN25-6-3		GX2CrNiMoCuN25-6-3-3		GX2CrNiMoN25-7-3		GX2CrNiMoN26-7-4		---	
Steel Number	1.4470		1.4468		1.4517		1.4417		1.4469		---	

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
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
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
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
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	---
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

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/mm^2 or MPa	ksi	N/mm^2 or MPa	ksi		
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	---				
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	---						
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	---/---/---
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	---						
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	---	---	---	---	---	---	---	---/---/---
ISO 4955:1994	X15CrN26	---	---	Pl, Sh, St/TA	---	---	280	---	500-700	---	see standard	212/---/---

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 666-00	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
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 666-00	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 666-00	202	---	S20200	0.15	7.5-10.0	0.75	0.060	0.030	17.0-19.0	4.0-6.0	---	N 0.25
EN 10088-2:1995	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 666-00	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	---	---
JIS G 4305:1999	SUS301	---	---	0.15	2.00	1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	---
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 666-00	301L	---	S30103	0.03	2.00	1.00	0.045	0.030	16.0-18.0	6.0-8.0	---	N 0.20
	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
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
	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	SUS301L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	N 0.20
	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	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 666-00	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	0.75	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 167-00	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	---	---
ASTM A 666-00	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 666-00	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	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

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 666-00	201, Class 1	---	S20100	Pl, Sh, St/A	---	---	260	38	655	95	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/---
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 666-00	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	
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	

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 666-00	202	---	S20200	Pl, Sh, St/A	---	---	260	38	620	90	40	241/---/---
				Pl, Sh, St/ CW, ¼ Hard	---	≤ 0.030	515	75	860	125	12	---/---/---
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	
ASTM A 666-00	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, ⅛ Hard	---	---	380	55	690	100	40	
				Pl, Sh, St/ CW, ¼ Hard	---	---	515	75	860	125	25	
				Pl, Sh, St/ CW, ½ Hard	---	< 0.015	760	110	1035	150	15	
					---	≥ 0.015					18	
				Pl, Sh, St/ CW, ¾ 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	
JIS G 4304:1999	SUS301	---	---	Pl, Sh, St/ HR, S	---	---	205	---	520	---	40	207/95/218
JIS G 4305:1999	SUS301	---	---	Pl, Sh, St/ CR, S	---	---	205	---	520	---	40	207/95/218
				Pl, Sh, St/ TRR, ¼ H	< 0.4	---	510	---	860	---	25	---/---/---
					0.4 ≤ t < 0.8	---					25	
					≥ 0.8	---					25	
				Pl, Sh, St/ TRR, ½ H	< 0.4	---	755	---	1030	---	9	---/---/---
					0.4 ≤ t < 0.8	---					10	
					≥ 0.8	---					10	
				Pl, Sh, St/ TRR, ¾ 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	
EN 10088-2:1995	X10CrNi18-8	1.4310	---	St/CR, AT	≤ 6	---	250	---	600-950	---	40	---/---/---

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 276-00	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 276-00	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 276-00	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-95	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-95	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 276-00	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 276-00	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 276-00	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 276-00	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	0.015	17.00-19.50	8.50-11.50	---	N 0.12-0.22
ASTM A 276-00	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

8.2.3B 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 276-00	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 276-00	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 276-00	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-95	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/---/---

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

ASTM A 167-99 - Stainless Chromium-Nickel Steel Plate, Sheet, and Strip												
Grade, Class, Type	308	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S30800	---	---	---	---	---	---	---	---	---	---	---
ASTM A 176-99 - Stainless Chromium Steel Plate, Sheet, and Strip												
Grade, Class, Type	422	431	442	---	---	---	---	---	---	---	---	---
UNS Number	S42200	S43100	S44200	---	---	---	---	---	---	---	---	---
ASTM A 666-00 - 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 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	SUS305	SUS315J1	SUS315J2	SUS316J1	SUS316J1L	SUS317	SUS317J1	SUS317J2
	SUS217J3L	SUSXM7	SUSXM15J1	SUS410L	SUS429	SUS430J1L	SUS436L	SUS436J1L	SUS445J1	SUS445J2	SUS447J1	SUSXM27
	SUS410	SUS429J1	SUS440A	---	---	---	---	---	---	---	---	---
JIS G 4305:1991 - Cold rolled stainless steel plates, sheets and strip												
Symbol of Grade	SUS304N2	SUS304J1	SUS304J2	SUS305	SUS315J1	SUS315J2	SUS316J1	SUS316J1L	SUS317	SUS317J1	SUS317J2	SUS317J3L
	SUSXM7	SUSXM15J1	SUS329J1	SUS329J4L	SUS410L	SUS429	SUS430J1L	SUS436L	SUS436J1L	SUS444	SUS445J1	SUS445J2
	SUS447J1	SUSXM27	SUS410	SUS410S	SUS420J1	SUS420J2	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	X2CrNi12	X2CrNiTi12	X2CrMoTi17-1	X6CrNi17-1	X2CrNbZr17	X2CrAlTi18-2	X2CrTiNb18	X2CrMoTi29-4	X12Cr13	X39Cr13	X46Cr13	X50CrMoV15
Steel Number	1.4003	1.4516	1.4513	1.4017	1.4590	1.4605	1.4509	1.4592	1.4006	1.4031	1.4034	1.4116
Steel Name	X39CrMo17-1	X3CrNiMo13-4	X2CrNiN23-4	X2CrNiMoCuN	X2CrNi19-11	X8CrNiS18-9	X4CrNi18-12	X1CrNi25-21	---	---	---	---
Steel Number	1.4122	1.4313	1.4362	1.4507	1.4306	1.4305	1.4303	1.4335	---	---	---	---
Steel Name	X1CrNiSi18-15-4		X1NiCrMoCu31-27-4		X1CrNiMoCuN25-25-5		X1CrNiMoNCu20-18-7		X4CrNiMo16-5-1		X8CrNoMoAl15-7-2	
Steel Number	1.4361		1.4563		1.4537		1.4529		1.4418		1.4532	
Steel Name	X2CrNiMoN17-13-5		1XCrNiMoN25-22-2		X6CrNiMoNb17-12-2		X2CrNiMoN25-7-4		X2CrNiMoCuWN25-7-4		X6CrMoNb17-1	
Steel Number	1.4439		1.4466		1.4580		1.4410		1.4501		1.4526	

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 4401:1983	SK 7	---	---	0.60-0.70	0.50	0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
EN 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 4401:1983	SK 6	---	---	0.70-0.80	0.50	0.35	0.030	0.030	0.030	0.25	---	Cu 0.25
EN 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 4401:1983	SK 5	---	---	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	---	---	---	---	---	---	---	---
EN 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 4401:1983	SK 4	---	---	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 4401:1983	SK 3	---	---	1.00-1.10	0.50	0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
EN 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 4401:1983	SK 2	---	---	1.10-1.30	0.50	0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
EN 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 4404:1983	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
EN ISO 4957:1999	105V	---	---	1.00-1.10	0.10-0.40	0.10-0.30	---	---	---	---	---	V 0.10-0.30
ASTM A 686-92 (1999)	W2-A-81/2	---		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 4404:1983	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

9.7 Non-Comparable Tool Steels

ASTM A 600-92 (1999) - Tool Steel High Speed												
Type	T6	T8	M1	M6	M10	M30	M33	M34	M41	M43	M44	M46
UNS Number	T12006	T12008	T11301	T11306	11310	T11330	T11333	T11334	T11341	T11343	T11344	T11346
Type	M47	M48	M62	M50	M52	---	---	---	---	---	---	---
UNS Number	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	---	---	---	---	---	---	---	---	---	---
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	M2	M3	M4	---	---	---	---	---	---	---
UNS Number	T12008	T11301	T11302	T11313	T11304	---	---	---	---	---	---	---
JIS G 4401:1983 - Carbon Tool Steels												
Grade	SK 1	---	---	---	---	---	---	---	---	---	---	---
JIS G 4404:1983 - Alloy Tool Steels												
Grade	SKS 2	SKS 21	SKS 5	SKS 7	SKS 8	SKS 4	SKS 41	SKS 3	SKS 31	SKS 93	SKS 94	SKS 95
Grade	SKD 4	SKT 3	---	---	---	---	---	---	---	---	---	---
EN ISO 4957:2000 - 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	HS6-5-2	HS6-5-3
Steel Name	HS6-5-3-8	---	---	---	---	---	---	---	---	---	---	---

Designation	Title
ASTM A 1-00	Standard Specification for Carbon Steel Tee Rails
ASTM A 2-90 (1997)	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-01	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 20/A 20M-01	Standard Specification for General Requirements for Steel Plates for Pressure Vessels
ASTM A 21-94 (1999)	Standard Specification for Carbon Steel Axles, Non-Heat-Treated and Heat-Treated, for Railway Use
ASTM A 27/A 27M-95 (2000)	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A 29/A 29M-99e1	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-96	Standard Practice for Sampling and Procurement Testing of Magnetic Materials
ASTM A 36/A 36M-00a	Standard Specification for Carbon Structural Steel
ASTM A 47/A 47M-99	Standard Specification for Ferritic Malleable Iron Castings
ASTM A 48-94ae1	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-01	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 74-98	Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A 82-97a	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A 90/A 90M-95a (1999)	Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM A 99-82 (2000)	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-00	Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A 106-99e1	Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 108-99	Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A 109/A 109M-00e1	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-00	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 125-96	Standard Specification for Steel Springs, Helical, Heat-Treated
ASTM A 126-95e1	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 128/A 128M-93 (1998)	Standard Specification for Steel Castings, Austenitic Manganese
ASTM A 131/A 131M-94	Standard Specification for Structural Steel for Ships
ASTM A 132-89 (2000)	Standard Specification for Ferromolybdenum
ASTM A 134-96	Standard Specification for Pipe, Steel, Electric-Fusion (Arc)-Welded (Sizes NPS 16 and Over)
ASTM A 135-97c	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 143-74 (1999)	Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A 144-73 (1990)e1	Specification for Ferrotungsten
ASTM A 146-64 (2000)	Standard Specification for Molybdenum Oxide Products
ASTM A 148/A 148M-01	Standard Specification for Steel Castings, High Strength, for Structural Purposes
ASTM A 153/A 153M-00	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 159-83 (1993)	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-95 (2000)	Standard Specification for Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes
ASTM A 179/A 179M-90a (1996)e1	Standard Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes
ASTM A 181/A 181M-00	Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
ASTM A 182/A 182M-00c	Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A 183-98	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

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	A 236 – Discontinued 1981; 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

Designation	Title
G 3101:1995	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 3106:1999	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 3114:1998	Hot-rolled atmospheric corrosion resisting steels for welded structure
G 3115:1990	Steel plates for pressure vessels for intermediate temperature service
G 3115-1:1995	Steel plates for pressure vessels for intermediate temperature service-Part 1: Thicker plates
G 3116:1990	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 3124:1987	High strength steel plates for pressure vessel for intermediate and moderate temperature service
G 3125:1987	Superior atmospheric corrosion resisting rolled steels
G 3126:1990	Carbon steel plates for pressure vessels for low temperature service
G 3127:1990	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 3133:1999	Decarburized steel sheets and strip for porcelain enameling
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 3191:1966	Shape, dimensions, weight and tolerance for hot rolled steel bar and bar-in-coil
G 3192:1994	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 3303:1987	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
G 3314:1995	Hot-dip aluminium-coated steel sheets and coils
G 3315:1987	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

Designation	Date Whitdrawn/Replaced by
JIS G 0301	Withdrawn in: 1954-12-18
JIS G 0302	Withdrawn in: 1966-11-01 Replaced by: G 1501;G 1511;G 1512;G1513
JIS G 0304	Withdrawn in: 1957-10-30
JIS G 0305	Withdrawn in: 1962-03-01
JIS G 0405	Withdrawn in: 1959-12-01 Replaced by: G4801
JIS G 0406	Withdrawn in: 1959-12-01 Replaced by: G4801
JIS G 0501	Withdrawn in: 1955-02-12 Replaced by: G3421;G3422;G3423
JIS G 0502	Withdrawn in: 1955-02-12 Replaced by: G3436;G3437;G3438
JIS G 0704	Withdrawn in: 1980-03-01
JIS G 1202:1975	Withdrawn in: 1995-07-01 Replaced by: G1253
JIS G 1203	Withdrawn in: 1986-06-01 Replaced by: Z2611
JIS G 1230	Withdrawn in: 1982-09-01 Replaced by: G1257
JIS G 1231	Withdrawn in: 1981-03-01 Replaced by: G1236;G1237
JIS G 1251:1976	---
JIS G 1252:1975	---
JIS G 1254	Withdrawn in: 1986-06-01 Replaced by: G1256
JIS G 1255	Withdrawn in: 1986-06-01 Replaced by: G1256
JIS G 1315	Withdrawn in: 1983-11-01
JIS G 1511	Withdrawn in: 1986-02-01 Replaced by: G1601
JIS G 1512	Withdrawn in: 1986-02-01 Replaced by: G1601
JIS G 1513	Withdrawn in: 1986-02-01 Replaced by: G1601
JIS G 1514	Withdrawn in: 1986-02-01 Replaced by: G1601
JIS G 1515	Withdrawn in: 1986-02-01 Replaced by: G1601
JIS G 1516:1976	Withdrawn in: 1986-02-01 Replaced by: G1601
JIS G 1517	Withdrawn in: 1985-03-01
JIS G 1518	Withdrawn in: 1986-02-01 Replaced by: G1602
JIS G 1519	Withdrawn in: 1986-02-01 Replaced by: G1602
JIS G 1520	Withdrawn in: 1986-02-01 Replaced by: G1602
JIS G 1521	Withdrawn in: 1986-02-01 Replaced by: G1602
JIS G 1522	Withdrawn in: 1986-02-01 Replaced by: G1603
JIS G 1523	Withdrawn in: 1986-02-01 Replaced by: G1603
JIS G 1524	Withdrawn in: 1986-02-01 Replaced by: G1603
JIS G 1525	Withdrawn in: 1986-02-01 Replaced by: G1603
JIS G 1526	Withdrawn in: 1986-02-01 Replaced by: G1603
JIS G 1527	Withdrawn in: 1986-02-01 Replaced by: G1601
JIS G 1528	Withdrawn in: 1986-02-01 Replaced by: G1604
JIS G 1529	Withdrawn in: 1985-03-01
JIS G 1530	Withdrawn in: 1986-02-01 Replaced by: G1603
JIS G 1531	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	Withdrawn in: 1953-11-07 Replaced by: G2201;G2202
JIS G 2204	Withdrawn in: 1953-11-07 Replaced by: G2201;G2202
JIS G 2205	Withdrawn in: 1953-11-07 Replaced by: G2201;G2202
JIS G 2305	Withdrawn in: 1978-12-01
JIS G 2317	Withdrawn in: 1978-12-01
JIS G 3102	Withdrawn in: 1965-07-01 Replaced by: G4051
JIS G 3107	Withdrawn in: 1956-04-18 Replaced by: G3111
JIS G 3110	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	Withdrawn in: 1955-02-12 Replaced by: G3123
JIS G 3122	Withdrawn in: 1955-02-12 Replaced by: G3123
JIS G 3211	Withdrawn in: 1982-07-01 Replaced by: G3202;G3203;G3204;G3205
JIS G 3212	Withdrawn in: 1982-07-01 Replaced by: G3202;G3203;G3204;G3205
JIS G 3213	Withdrawn in: 1982-07-01 Replaced by: G3202;G3203;G3204;G3205
JIS G 3301	Withdrawn in: 1967-07-01 Replaced by: G3131
JIS G 3304	Withdrawn in: 1956-07-17 Replaced by: G3301
JIS G 3305	Withdrawn in: 1956-07-17 Replaced by: G3310
JIS G 3306	Withdrawn in: 1956-07-17 Replaced by: G3310
JIS G 3307	Withdrawn in: 1967-07-01 Replaced by: G3131
JIS G 3307	Withdrawn in: 1967-07-01 Replaced by: G3101
JIS G 3308	Withdrawn in: 1969-08-06 Replaced by: G3141

Designation	Title
EN ISO 683-17:1999	Heat-Treated Steels, Alloy Steels and Free-Cutting Steels. Ball and Roller Bearing Steels
EN ISO 1127:1997	Stainless Steel Tubes. Dimensions, Tolerances and Conventional Masses per Unit Length
EN ISO 4066:2000	Construction Drawings. Bar Scheduling
EN ISO 4957:2000	Tool Steels
EN ISO 7153-1:2001	Surgical Instruments. Metallic Materials. Stainless Steel
EN ISO 11960:1998	Petroleum and Natural Gas Industries. Steel Pipes for Use as Casing or Tubing for Wells
EN 502:2000	Roofing Products from Metal Sheet. Specification for Fully Supported Products of Stainless Steel Sheet
EN 505:2000	Roofing Products from Metal Sheet. Specification for Fully Supported Roofing Products of Steel Sheet
EN 508-1:2000	Roofing Products from Metal Sheet. Specification for Self-Supporting Products of Steel, Aluminum or Stainless Steel Sheet. Steel
EN 523:1997	Steel Strip Sheaths for Prestressing Tendons. Terminology, Requirements, Quality Control
EN 524-1:1997	Steel Strip Sheaths for Prestressing Tendons. Test Methods. Determination of Shape and Dimensions
EN 524-2:1997	Steel Strip Sheaths for Prestressing Tendons. Test Methods. Determination of Flexural Behaviour
EN 524-3:1997	Steel Strip Sheaths for Prestressing Tendons. Test Methods. To-and-Fro Bending Test
EN 524-4:1997	Steel Strip Sheaths for Prestressing Tendons. Test Methods. Determination of Lateral Load Resistance
EN 524-5:1997	Steel Strip Sheaths for Prestressing Tendons. Test Methods. Determination of Tensile Load Resistance
EN 524-6:1997	Steel Strip Sheaths for Prestressing Tendons. Test Methods. 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. 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. Dimensions
EN 1124-1:1999	Pipes and Fittings of Longitudinally Welded Stainless Steel Pipes with Spigot and Socket for Waste Water Systems. 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. System S. Dimensions
EN 1124-3:1999	Pipes and Fittings of Longitudinally Welded Stainless Steel Pipes with Spigot and Socket for Waste Water Systems. System X; Dimensions
EN 1370:1997	Founding. Surface Roughness Inspection by Visual Tactile Comparators
EN 1503-1:2000	Valves. Materials for Bodies, Bonnets and Covers. Steels Specified In European Standards
EN 1503-2:2000	Valves. Materials for Bodies, Bonnets and Covers. Steels Other Than Those Specified In European Standards
EN 1559-2:2000	Founding. Technical Conditions of Delivery. Additional Requirements for Steel Castings
EN 1677-1:2000	Components for Slings. Safety. Forged Steel Components, Grade 8
EN 1677-2:2000	Components for Slings. Safety. Forged Steel Lifting Hooks with Latch, Grade 8
EN 10016-1:1995	Non-Alloy Steel Rods for Drawing and/or Cold Rolling. General Requirements
EN 10016-2:1995	Non-Alloy Steel Rods for Drawing and/or Cold Rolling. Specific Requirements for General Purpose Rod
EN 10016-3:1995	Non-Alloy Steel Rods for Drawing and/or Cold Rolling. Specific Requirements for Rimmed and Rimmed Substitute Low Carbon Steel Rod
EN 10016-4:1995	Non-Alloy Steel Rods for Drawing and/or Cold Rolling. Specific Requirements for Rod for Special Applications
EN 10024:1995	Hot Rolled Taper Flange I Sections. Tolerances On Shape and Dimensions
EN 10025:1993	Hot Rolled Products of Non-Alloy Structural Steels. Technical Delivery Conditions
EN 10028-1:2000	Specification for Flat Products Made of Steels for Pressure Purposes. General Requirements
EN 10028-2:1993	Specification for Flat Products Made of Steels for Pressure Purposes. Non-Alloy and Alloy Steels with Specified Elevated Temperature Properties
EN 10028-3:1993	Specification for Flat Products Made of Steels for Pressure Purposes. Weldable Fine Grain Steels, Normalized
EN 10028-4:1995	Specification for Flat Products Made of Steels for Pressure Purposes. Nickel Alloy Steels with Specified Low Temperature Properties
EN 10028-5:1997	Specification for Flat Products Made of Steels for Pressure Purposes. Weldable Fine Grain Steels, Thermomechanically Rolled
EN 10028-6:1997	Specification for Flat Products Made of Steels for Pressure Purposes. Weldable Fine Grain Steels, Quenched and Tempered
EN 10028-7:2000	Specification for Flat Products Made of Steels for Pressure Purposes. Stainless Steels
EN 10029:1991	Specification for Tolerances On Dimensions, Shape and Mass for Hot Rolled Steel Plates 3 Mm Thick or Above
EN 10034:1993	Structural Steel I and H Sections. Tolerances On Shape and Dimensions
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 10055:1996	Hot Rolled Steel Equal Flange Tees with Radiused Root and Toes. Dimensions and Tolerances On Shape and Dimensions
EN 10056-1:1999	Specification for Structural Steel Equal and Unequal Angles. Dimensions
EN 10056-2:1993	Specification for Structural Steel Equal and Unequal Angles. Tolerances On Shape and Dimensions
EN 10067:1997	Hot Rolled Bulb Flats. Dimensions and Tolerances On Shape, Dimensions and Mass
EN 10079:1993	Definition of Steel Products

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 Technical Delivery Conditions for Special Steels EN 10083–2:1991+A1:1996 Quenched and Tempered Steels Technical Delivery Conditions for Unalloyed Quality Steels	Supersedes: BSI BS 970-Part 1:1983 Specification for 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 10084:1998 Case Hardening Steels. Technical Delivery Conditions	Supersedes: BSI BS 970-Part 1:1996 Specification for 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 10016-Part 1:1995 Non-Alloy Steel Rod for Drawing or Cold Rolling; General Requirements EN 10016-Part 2:1995 Non-Alloy Steel Rod for Drawing or Cold Rolling; Specific Requirements for General Purpose Rod	Supersedes: DIN 17140-Part 1:1983 Wire Rod for Cold Drawing; Technical Delivery Conditions for Basic Steel and Unalloyed Quality Steels
EN 10016-Part 2:1995 Non-Alloy Steel Rod for Drawing and/or Cold Rolling 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-Part 1:1997 Quenched And Tempered Steels Technical Delivery Conditions For Specials Steels.	Supersedes: AFNOR NF EN 10083-Part 1:1991 Aciers pour Trempe et Revenu – Partie 1: Conditions Techniques de Livraison des Aciers Spéciaux
EN 10083-Part 2:1997 Quenched And Tempered Steels Technical Delivery Conditions For Unalloyed Quality Steels.	Supersedes: AFNOR NF EN 10083-Part 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 2: Carbon and Alloy Steels for General Use	
Former National Standards Superseded by EN Standards	**Current Standards**
BSI BS 970-Part 1:1983 Specification for Wrought Steels for Mechanical and Allied Engineering Purposes. 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 Technical Delivery Conditions for Special Steels EN 10083–2:1991+A1:1996 Quenched and Tempered Steels Technical Delivery Conditions for Unalloyed Quality Steels
BSI BS 970-Part 1:1991 Specification for Wrought Steels for Mechanical and Allied Engineering Purposes. General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels	Superseded by: BS 970-Part 1:1996 Specification for 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-Part 3:1996 Quenched and Tempered Steels. Technical Delivery Conditions for Boron Steels EN 10088:1995 Stainless Steels EN 10088-Part 1:1995 List of Stainless Steels EN 10088-Part 3:1995 Technical Delivery Conditions for Semi-Finished Products, Bars, Rods and Sections for General Purposes
BSI BS 970-Part 1:1996 Specification for Wrought Steels for Mechanical and Allied Engineering Purposes. 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-Part 4:2000 Open Die Steel Forgings for General Stainless Steels Engineering Purposes
DIN 17140-Part 1 :1983 Wire Rod for Cold Drawing; Technical Delivery Conditions for Basic Steel and Unalloyed Quality Steels	Superseded by: EN 10016-Part 1:1995 Non-Alloy Steel Rod for Drawing or Cold Rolling; General Requirements EN 10016-Part 2:1995 Non-Alloy Steel Rod for Drawing or Cold Rolling; Specific Requirements for General Purpose Rod
AFNOR NF A35-051:1982 Fil Machine en Acier Non Allié Destiné au Tréfilage et au Laminage à Froid-Nuances	Superseded by: EN 10016-Part 2:1995 Non-Alloy Steel Rod for Drawing and/or Cold Rolling Specific Requirements for General Purposes Rod.
AFNOR NF EN 10083-Part 1:1991 (A35-552-Part 1) Aciers Pour Trempe et Revenu–Partie 1:Conditions Techniques de Livraison des Aciers Spéciaux	Superseded by: EN 10083-Part 1:1997 Quenched and Tempered Steels Technical Delivery Conditions for Specials Steels.
AFNOR NF EN 10083-Part 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-Part 2:1997 Quenched and Tempered Steels Technical Delivery Conditions for Unalloyed Quality Steels.
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

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 9444:1990	Hot-rolled stainless steel wide strip and sheet -- Tolerances on dimensions and form
ISO 9445:1990	Cold-rolled stainless steel wide strip and sheet -- Tolerances on dimensions and form
ISO 9446:1990	Hot-rolled stainless steel narrow strip -- Tolerances on dimensions and form
ISO 9447:1990	Cold-rolled stainless steel narrow strip -- Tolerances on dimensions and form
ISO/TR 11637:1997	Boron treated engineering steels for quenching and tempering
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ISO 6935-3:1992	Steel for the reinforcement of concrete -- Part 3: Welded fabric
ISO 10065:1990	Steel bars for reinforcement of concrete -- Bend and rebend tests
ISO 10144:1991	Certification scheme for steel bars and wires for the reinforcement of concrete structures
ISO 10287:1992	Steel for the reinforcement of concrete -- Determination of strength of joints in welded fabric
ISO 10544:1992	Cold-reduced steel wire for the reinforcement of concrete and the manufacture of welded fabric
ISO 10606:1995	Steel for the reinforcement of concrete -- Determination of percentage total elongation at maximum force
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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
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ISO 7153-1:1991	Surgical instruments -- Metallic materials -- Part 1: Stainless steel Amd 1:1999
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ISO 9444:1990	Hot-rolled stainless steel wide strip and sheet -- Tolerances on dimensions and form
ISO 9445:1990	Cold-rolled stainless steel wide strip and sheet -- Tolerances on dimensions and form

Designation: A 941 – 00

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 A-1 is responsible, it is included herein only when judged, after review by Subcommittee A 01.92, to be a generally usable term.

1.3 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; 0.06 for columbium (niobium); 0.40 for copper; 0.40 for lead; 1.65 for manganese; 0.08 for molybdenum; 0.30 for nickel; 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, columbium (niobium), molybdenum, nickel, 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.

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.

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.

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.

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[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.

Designation: E 527 – 83 (Reapproved 1997)ε1

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.

ε[1] NOTE—Keywords were added editorially in October 1997.

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 A-1 on Steel, Stainless Steel, and Related Alloys and is the direct responsibility of Subcommittee A01.91 on Editorial.

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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	$N \cdot m$	joule	J
specific	J/kg		
entropy			
heat capacity	J/K		
specific	J/(kg·K)		
flow, mass	kg/s		
flow, volume	m^3/s		
force	$kg \cdot m/s^2$	newton	N
frequency			
periodic	1/s	hertz	Hz
rotating	rev/s		
inductance	Wb/A	henry	H
magnetic flux	$V \cdot s$	weber	Wb
mass flow	kg/s		
moment of a force	$N \cdot m$		
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	$W/(m \cdot K)$		
velocity			
angular	rad/s		
linear	m/s		
viscosity			
dynamic (absolute)(μ)	$Pa \cdot s$		
kinematic (ν)	m^2/s		
volume	m^3		
volume, specific	m^3/kg		

*For complete information see *IEEE/ASTM SI-10.*

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